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NORFOLK Bird & Mammal Report 1975

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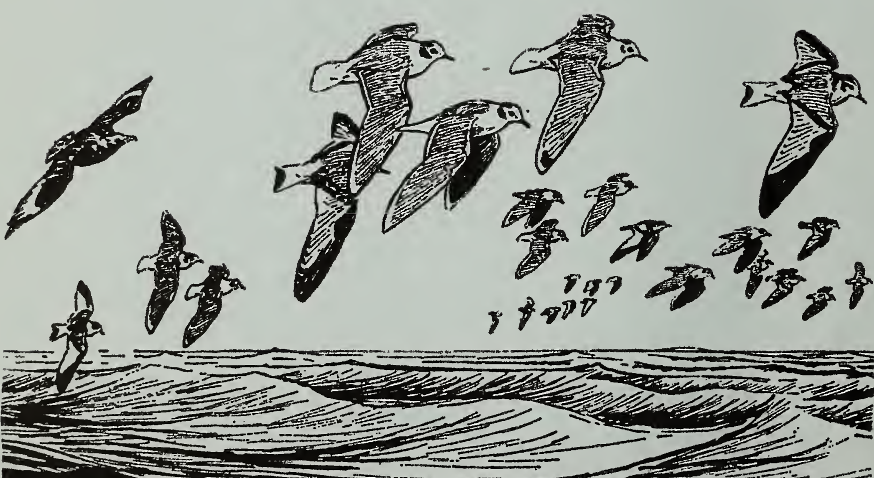

Norfolk Bird Report - 1975

Editor: Michael J. Seago
County Recorder: D. A. Dorling
Editorial Assistants: P. R. Allard, A. D. Boote, J. F. W. Bruhn, G. E. Dunmore and Dr. M. P. Taylor

Norfolk Mammal Report - 1975

Editor: Rex Hancey

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NORFOLK BIRD REPORT 1975

Editorial

The Council of the Norfolk Naturalists Trust, in co-operation with the Norfolk and Norwich Naturalists' Society, is pleased to present the annual report on the birds of Norfolk. It is also the Trust's Jubilee edition.

Weather . . . Review of the Year . . . Road Casualties . . . B.T.O. Rookery Survey Acknowledgments . . . Recording

The Weather: 1975 will long be remembered for the mild winter. Spring, in contrast, was cold and wet, but these conditions ended abruptly in early June to give the warmest and driest summer for many years. Jan. was the mildest for 14 years, but unsettled weather for the second half brought precipitation on every day after the 16th. Feb. was much drier and sunnier than normal; March was the wettest and cloudiest for 11 years and ground frost of —8.6C. on the last day of the month was the lowest of the winter.

April was wetter than normal and the dullest for 9 years. May was the coldest for 20 years and sunshine was below normal. June was much sunnier than normal and July the warmest since 1969.

Aug. was the warmest since records began at Sprowston in 1925, equalling the mean temperature of Aug. 1942. It was also the sunniest and driest since 1947. The month was influenced mainly by anti-cyclonic conditions. Sept. was wetter than normal and Oct. the driest since 1969, again with anti-cyclonic conditions; fogs and mists were frequent. Nov. was largely unsettled, but high pressure influenced the weather for much of Dec. (*Eastern Daily Press*).

Review of the Year: 1975 will long be remembered for the unprecedented number of rare birds which appeared in Norfolk, including five additions to the County list. Normally few unusual birds appear in the early months of the year and hence the appearance of a wanderer from more northerly latitudes at Sandringham in February, a Two-barred Crossbill, was surprising especially in view of the mild weather.

Whilst a few summer visitors arrived in the first half of March, adverse weather conditions delayed the main arrival of many migrants until well into the following month. On April 19th an abrupt change to warmer southerly winds resulted in a spectacular fall of migrants on the north coast with Chiffchaffs, Willow Warblers and Wheatears in abundance.

During the spring many observers look forward to anticyclonic weather conditions associated with warm south-easterly winds in the hope that a sprinkling of Mediterranean species will occur having "overshot" their normal breeding range. These ideal conditions did not generally occur in 1975 although a Black-eared Wheatear appeared at Cley on May 13th together with a second bird (presumably lost)! for 20 days at Holme in June. Other notable records during this period included two Purple Herons, Golden Oriole and unprecedented numbers of Rough-legged Buzzards on their return journey to Scandinavia and North Russia.

A variety of unusual waders also occurred. Two Dotterel were seen by many observers near Salthouse Heath for two days in late May. A Terek Sandpiper appeared at Breydon on June 1st, followed by the arrival of a Wilson's Phalarope (a vagrant from America) at Wisbech S.F. six days later. Somewhat amazingly a second Terek Sandpiper was seen at Cley for three days in early July, and one can only speculate, in view of the date, whether it was on its journey to, or from, its breeding ground in Finland or further east.

Normally July produces few Scandinavian passerine migrants so the records of an immature Arctic Warbler at Holme on 5th and a Barred Warbler at Sheringham on 29th are both surprising. A Rose-coloured Starling (an erratic wanderer from Asia) was seen at Winterton on the last day of the month. In contrast Pectoral Sandpipers were detected at Wisbech S.F. in July and at Cley in August.

Several small "falls" of passerine migrants were recorded on the coast between August 10th and September 14th. Such falls are normally associated with winds between north and east, with overcast conditions; on August 30th, however, a significant arrival of birds occurred on the north coast, especially at Blakeney Point, with a west-north-west wind (the winds being easterly further north over the North Sea) and it was interesting that there was a virtual lack of migrants on the north-east and east coasts. These arrivals included on various dates such species as Wryneck, Bluethroat, Icterine and Barred Warbler, Red-breasted Flycatcher and Ortolan, but rather surprisingly no large numbers of the more common migrants such as Pied Flycatchers were recorded.

Rare birds in the early autumn included a Scarlet Rosefinch at Holkham August 29th and an Aquatic Warbler on Blakeney Point September 5/6th. This latter bird was virtually the only migrant on the Point and it can only be assumed that it had arrived but remained "hidden" since the previous weekend. Pride of place must go to the Greater Yellowlegs which attracted and delighted so many observers from September 8th to 13th. A Buff-breasted Sandpiper also appeared at Cley during the month. Sea watchers were not disappointed; large movements of seabirds were noted close inshore along the north coast on August 31st during a strong northerly wind and on September 14th in a north-easterly gale.

South-westerly winds prevailed from mid-September to early October resulting in a noticeable lack of visual migration.

A Blue-winged Teal, however, was unfortunately shot at Hickling during this period.

On 9th October the wind veered north-easterly as an anticyclone established itself over the Baltic. This weather system remained for most of the month and the associated easterly airstream across the whole of central Europe resulted in the arrival of an incredible number of Asiatic vagrants. This period will be long remembered in the annals of Norfolk ornithology!

Goldcrests appeared in large numbers on 10th October on the north and east coasts. Yarmouth produced single Yellow-browed Warblers and Red-breasted Flycatchers with two of the latter at Wells, where an Olive-backed Pipit was found.

The next day a Pallas's Warbler was discovered in silver birches at the western end of Holkham pines. On 12th there was a total of at least 15 Yellow-browed Warblers at Wells/Holkham, together with a pale shrike, one of the eastern Asiatic races of the Red-backed Shrike. A Dusky Warbler was discovered close to Wells boating lake on 14th and the next day two Pallas's Warblers were seen together at Holkham.

On 17th further Pallas's Warblers were recorded at Scolt Head and Happisburgh and a Radde's Warbler at Brancaster. A second Radde's Warbler was seen at Holkham the next day, together with another Dusky Warbler on Blakeney Point (the only warbler present!). A group of observers walking out along the Point to see this bird also found a Rustic Bunting; another of this species was subsequently at Cley on 22nd. A Far Eastern vagrant, a Yellow-browed Bunting, at Wells on 19th will be the first British record if accepted by the B.O.U. Records Committee. A Black-throated Thrush enthralled visitors to Holkham from 22nd to 25th and on the latter date the third Radde's Warbler of the autumn was found at the same locality. On 25th an adult Lesser Grey Shrike was at Holme, which was very surprising in view of its more southerly range compared with the majority of species which occurred at the time. The next day a distinctive eastern race of the Redstart was identified at Heacham and on 27th another rarity was discovered at Holme—a Short-toed Lark.

During the period considerable numbers of winter visitors were arriving, including thrushes, finches and sea ducks together with abnormal numbers of Long-eared Owls. Migration continued well into November, including several small flocks of Little Auks.

Road Casualties: Along a five-mile stretch of the A47 between Yarmouth and "Stracey Arms" totalled 117 birds as follows: 40 Moorhens, 36 Black-headed Gulls, 7 Barn Owls, 24 House Sparrows, 2 Blackbirds, 3 Lapwing, 2 Redwing and single Mallard, Rook and Mute Swan (RHH).

B.T.O. Rookery Survey: During 1975 coverage of the county as a whole was patchy with 80% of west Norfolk completed, but, with rather more disappointments JGG reports that he had much more work to complete, rounding up uncovered squares than were left over in west Norfolk.

Of the 30 squares in west Norfolk, 1 was 'lost' to Suffolk and 4 were not covered, but these were completed by late April 1976 so that the total number of Rooks in the West can be assessed. In the west all recorders report a decline and this was borne out by the fact that, at the time of the B.T.O. Atlas project, every 10km. square had Rooks breeding in them, whereas at the present time, 5 widely scattered squares are apparently Rookless. In the Fens, a former large rookery near Outwell was reduced to three birds attending a single nest.

The largest number of nests in a 10km. square was just over 700 in both halves of the county (in the Dickleburgh and Leziate squares). In the west, the adjacent Downham Market square had 638 nests and the adjacent Narborough and Beechamwell squares had 220 and 274 respectively. Further east, Cranworth square had 522, Dereham 389 and Ryburgh 440. Of the remaining 22 squares, only 4 topped the hundred mark.

The following points emerge: Rooks are scarcer in areas where there are large estates. Thus the five squares which each cover the Royal estate in part have only 301 nests between them. TF82 had 9 rookeries all of them small and all adjacent to the western boundary of the square the remainder of which covers 3 large estates in part.

Rooks are scarce in the coastal fringe, in the Fens they have greatly declined and in the deep Brecks, where there have never been many, there are now two adjacent squares with none: Thetford and East Harling. The Lexiate square held 710 nests in

33 rookeries (an average of 21.5 nests per rookery) including a large one of 175 nests. The Beechamwell square with only 5 rookeries contained 274 nests (revealing the high average of 55 nests per rookery).

A few years ago, I counted the rookeries within a mile radius of Letton Hall (TF90) reaching a total of 10 rookeries with 530 nests. Now the number has dwindled to 6 rookeries with scarcely 300 nests, the largest being 105 instead of 209.

The grand total for West Norfolk amounted to 4507 nests in 194 rookeries (an average of 23.2 nests per rookery). (ALB).

Acknowledgements: Thanks are due to G.M.S. Easy for the Marsh Harrier cover drawing and for text illustrations; also to P. R. Clarke, J. H. Marchant, R. Powley and Dr. R. Vaughan for photographs and vignettes; to Holme Bird Observatory/N.O.A. for access to their records; to the Norfolk Naturalists Trust Wardens; to the National Trust (Blakeney Point); to the Nature Conservancy (Scolt Head, Holkham, Bure Marshes (Woodbastwick) and Hoveton Great Broad); to the Cambridge Bird Club; to the Gt. Yarmouth Naturalists Society; to D. A. Dorling and P. R. Allard for compiling the annual record cards; to Mrs. M. Dorling, J. T. Fenton, P. D. Kirby, Mrs. P. A. Rix, Mrs. S. F. Seago and Miss I. Wymer for valuable assistance and to all other contributors.

Recording: Records for the 1976 Report should be sent *by the end of January* to Michael J. Seago, 33 Acacia Road, Thorpe St. Andrew, Norwich NR7 0PP. Contributors are requested to submit notes in the order followed in B.T.O. Guide 13 (*A species List of British and Irish Birds*). In order to minimise the work involved, records will not normally be acknowledged. The names of all contributors will be included in the Report. Following boundary adjustments in April 1974, this Report includes records from localities formerly appearing in the *Suffolk Bird Report.*

In order to obtain a uniformity of approach in common with the majority of county Bird Reports, it has been decided that no records of species on the list considered by the British Birds Rarities Committee will be included unless accepted by that committee. At the time this Report has gone to press several such records are being considered by the above Committee and are accordingly excluded. It is anticipated that the majority of these records will be accepted and they will be included in the 1976 Report. In order to avoid such situations arising in the future all observers are requested to submit such records to the Editor as soon as possible after the actual observation(s) and in any event before the end of the year of sighting.

In addition a County Records Committee has been established (P. R. Allard, G. E. Dunmore, D. Holman, S. C. Joyner and Dr. M. P. Taylor) to adjudicate on submitted records of semi-rarities and any records of more common species out of normal season or range. Accordingly for records for 1976 and subsequent years all observers are asked to submit written descriptions for records of the following species *unless* the bird or birds were seen by three or more observers as a general rule (in which case names of other observers where known should be noted):

Black-throated and Great Northern Divers; Red-necked, Slavonian and Black-necked Grebes; Great and Sooty Shearwaters; Storm and Leach's Petrels, Red-crested Pochard, Ferruginous Duck; Buzzard and Rough-legged Buzzard, Goshawk, Red Kite, Honey Buzzard, Montagu's Harrier, Hobby, Peregrine, Spotted Crake, Corncrake, Kentish Plover, Dotterel, Temminck's Stint, Pectoral Sandpiper, Grey and Red-necked Phalaropes, Pomarine Skua; Iceland, Mediterranean and Sabine's Gulls, Roseate Tern, Little Auk, Black Guillemot, Hoopoe, Golden Oriole, Raven, Bluethroat, Icterine, Barred and Yellow-browed Warblers, Red-breasted Flycatcher and Ortolan Bunting.

Classified notes

These notes are based on *Birds of Norfolk* (1967) where fuller details regarding status, distribution, migration and ringing recoveries may be found. Important records for Wisbech Sewage Farm (part of which is on the Lincolnshire side of the county boundary) have been selected from the files of Cambridge Bird Club. Fuller details of Fens records may be found in the *Cambridge Bird Club Report* for 1975,

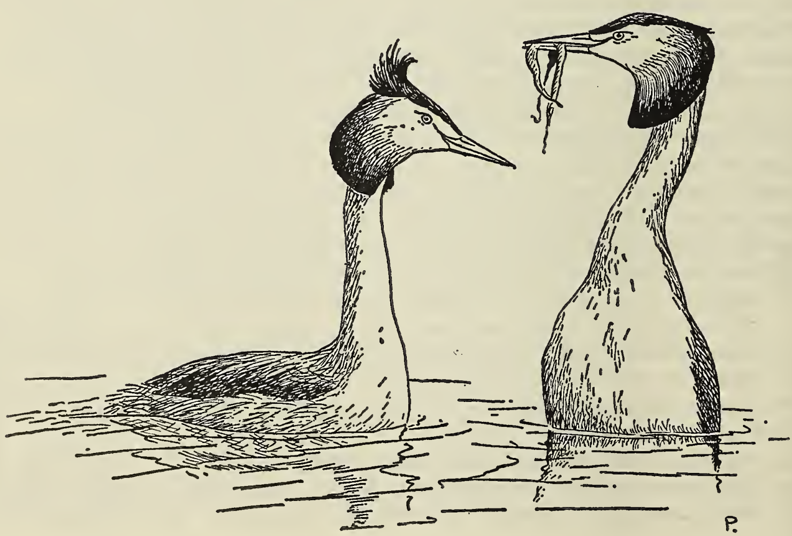
The order used is that of the B.T.O. guide *A Species List of British and Irish Birds* (1971) and English names follow current practice. Observations refer to 1975, unless otherwise stated. To save space, all but the most essential initials have been omitted. Records are of *single* birds unless otherwise stated.

Great Northern Diver: North/Wash: up to 4 till March 24th and from Sept. 14th. Titchwell June 4th. East: Breydon Dec. 28th.

Red Throated Diver: East: 20 at Horsey Gap Jan. 1 is unusual. (GED).

Great Crested Grebe: A B.T.O. survey revealed a county total of 559 adults, as follows:

Broads: Rollesby 13 adults, Filby 4, Ormesby 18, Lady 2, Hickling 6, Heigham Sounds 10, Horsey Mere 6, Rockland 8, Surlingham 4, Strumpshaw 2, Mautby Decoy 2, Martham 6, Barton 33, South Walsham 6, Salhouse 3, Hoveton Great 39, Black Horse 21, Wroxham 19, Hardley Flood 6, Hardley Dyke 2, Burnt Fen 4, Ranworth Inner 11, Upton 2, Woodbastwick Decoy 6, Woodbastwick Old Hall 2, Malthouse 6, Sutton 4, Lound 6, Fritton 4, Cromes 2 (total of 257 adults). Negative returns from several broads holding adults in 1973 including Belaugh and Alderfen. River Yare: between Thorpe Reach and Berney Arms (total of 71 adults). Thorpe



Reach—Coldham Hall 22; Coldham Hall—Buckenham Ferry 12; Buckenham Ferry—Reedham 23; Reedham — Breydon Water (Berney End)—14.
River Chet: 2 adults.
River Bure: between Yarmouth and Coltishall (total of 25 adults). Yarmouth—Acle Bridge 0; Acle Bridge—Thurne Mouth 0; Thurne Mouth—Ranworth Dyke 6; Ranworth Dyke—Salhouse Broad 10; Salhouse Broad—Wroxham Broad 3; Wroxham Broad—Wroxham Bridge 2; Wroxham Bridge—Coltishall 4.
River Ant: Ant Mouth—Irstead—Stalham Dyke 5 adults.
River Waveney: St. Olaves 2 adults.
Lakes and Gravel Pits: Sparham Pool 4, Lenwade G.P. 9, Fusty Weed G.P. 6, Lyng G.P. 4, Lyng Easthaugh G.P. 4, Shropham G.P. 4, Swanton Morley G.P. 8, Seamere 8, Snetterton G.P. 6, Taverham Mill 2, Costessey G.P. 6, Haveringland Lake 4, Blickling 9, Cawston Lakes 2, Gunton 2, Holkham 4, Earsham G.P. 2, Gunthorpe Lake 2, Melton Constable Lake 4, Pentney G.P. 4, East Winch/Foster's End/Blackborough End/Middleton G.P. 2, Bawburgh/Colney G.P. 4, Worthing G.P. 2, Broome Heath G.P. 2, Barningham Lake 1, Pentney Abbey G.P. 4, Quidenham 2, All other returns negative. Total of 111 adults.
Brecks: Stradsett Park 1, Narborough G.P. 5, Narford Lake 3, Thompson Water 1, Shadwell Park 1, Sahan Toney Mere 2, Scoulton Mere 2, Hill Mere 1, Rush Mere 2, Wretham West Mere 2. All other returns negative. Total of 20 adults.
Fens: total of 66 adults.
R. Great Ouse Denver—Brandon Ship 16; Relief Channel Denver—Lynn 12; R. Wissey (Wissey Pits)—2; Old/New Bedford Levels & Delph 10; Cut-Off Channell—Denver—Hilgay 2; Writton 2, Stoke Ferry 5, Black Dyke 3, Hockwold 4; River Little Ouse 6; Wissington Pits 2; King's Lynn Pits 2.

In addition, 10 on the Wash at Ouse Mouth/Bulldog's Sands Area, June 11th. (*this figure excluded from county total*).

Very early breeding at Narborough G.P., with a bird sitting March 11th and 3 young riding on parents' backs April 8th. (Summary by AMH).

Red Necked Grebe: North: Hunstanton Dec. 7th; Sheringham Aug. 31st; Blakeney Harbour Aug. 30th in breeding plumage; Overy Staithe Dec. 29th; Salthouse Nov. 7th; Cley Aug. 31st, Sept. 2nd, 11th, 12th, Oct. 11th and 19th and Nov. 13th. East: Yarmouth Nov. 8th/18th.

Slavonian Grebe: North: Hunstanton 4 Nov. 17th, 2 Dec. 6th and singles on 23rd and 29th. Holme Oct. 12th. Scolt Head Oct. 14th. Brancaster 2 Nov. 24th. East-: Breydon Nov. 8th. Fens: Downham Market flood relief channel Jan. 1st - 5th.

Black Necked Grebe: North: Brancaster for most of Jan. Titchwell Dec. 24th. Sheringham Oct. 9th. Weybourne Nov. 1st. Hunstanton 3 Oct. 11th. Broads: Barton Nov. 16th.

Little Grebe: Wash: maximum of 64 at Snettisham G.P. in Nov. Broads: Hickling 32 Oct. 20th. Breydon: estimate of 15 breeding pairs in adjacent dykes including one which bred successfully in partially polluted area next to refuse tip.

Fulmar: North: total of 48 young counted on cliff ledges between Weybourne and Cromer as follows (JCM): Weybourne—Sheringham 24; Sheringham—West Runton 7; West Runton—East Runton 4; East Runton—Cromer 13.

Total of 60 adults during breeding season on Cromer West Cliff and 44 between Sheringham and West Runton. 6 returned Nov. 8th. 2,200 off Sheringham in northerly gale Sept. 14th, when thousands off Cley/Salthouse. Dying blue phase bird washed ashore at Sheringham May 24th.

Wash: Hunstanton 100 Feb. 20th and 14 young in June. First birds returned Nov. 29th. East: Winterton/Horsey 2 - 3 over sandhills May/June. Gorleston Cliffs 1 - 3 between May and August.

Manx Shearwater: North: Cley/Salthouse 2 April 20th, 15 May 3rd, July 9th and 2 on 15th, 30 - 40 Aug. 31st, Sept. 1st, 6th, 13th, 49 on 14th during northerly gales, 26th, 27th and 28th. Blakeney 26 Aug. 31st and Sept. 15th. Weybourne Sept. 14th and 3 of the Balearic race the same day. Sheringham 9 May 7th, 3 on 30th, 14 June 3rd, 19 Aug. 31st, 30 Sept. 14th and 1 on 21st, 2 Nov. 7th. Titchwell May 11th, Hunstanton April 3rd. Holme 10 May 7th, 3 Aug. 30th and 11 of the Balearic race on 31st, 3 Sept. 15th. East: Winterton 2 Sept. 15th.

Sooty Shearwater: North: Cley/Salthouse Aug. 30th, 7 on 31st and 12 Sept. 14th, Blakeney 2 Aug. 31st. Weybourne/Sheringham 7 Aug. 31st, 12 Sept. 14th and 1 Nov. 18th. Hunstanton Sept. 14th. Holme 2 Sept. 15th. East: Winterton Sept. 15th.

Storm Petrel: North: Holme Nov. 17th. Sheringham Sept. 14th and Nov. 8th.

Leach's Petrel: North: Cley/Salthouse at least 11 Sept. 14th with 3 on 15th. Cley one over Eye field Nov. 16th and one offshore on 17th. Blakeney Sept. 15th. East: Winterton Sept. 15th.

Gannet: North: impressive totals off Sheringham Aug. 31st when 420 east and again on Sept. 14th when 800 east. Blakeney Point 200 east in two hours on Aug. 31st.

Cormorant: East: maximum of 101 at Breydon March 23rd and 126 departing from Ranworth roost towards Breydon soon after sunrise Dec. 14th. Broads: Filby 96 Dec. 14th, *in addition to Breydon birds* and 115 on 26th. Wash: Ouse, maximum of 44 entering river Jan. 20th. Fens: Welney 12 Jan. 5th.

Shag: Coastal records between Hunstanton and Gorleston with maximum of 8 at Hunstanton March 7th. Broads: Barton 7 Feb. 3rd. Inland: 6 on Yare between Buckenham Ferry and Hardley Cross in early April. Colney G.P. 4 Jan. 26th.

Grey Heron: The following heronries were counted: Borders of Wash: Snettisham 18 nests; Fens: Hilgay 34, Islington 42, Denver Sluice 4. Brecks: Didlington 10, Shadwell 8, Narford 0 (all birds shot). Mid-Norfolk: Colney Hall 2 - 4. Broads: Strumpshaw 1, Barton 10, Heckingham 1, Heigham Sounds 7, Herringfleet 5, Thurlton 1, Belaugh 8, Upton 7. South: Earsham (America Wood and Holy Grove) 12.

Purple Heron: Broads: Hickling immature April 26th (PH & RL). Rockland June 20th (RMcI). Halvergate Aug. 17th - 30th (DT).

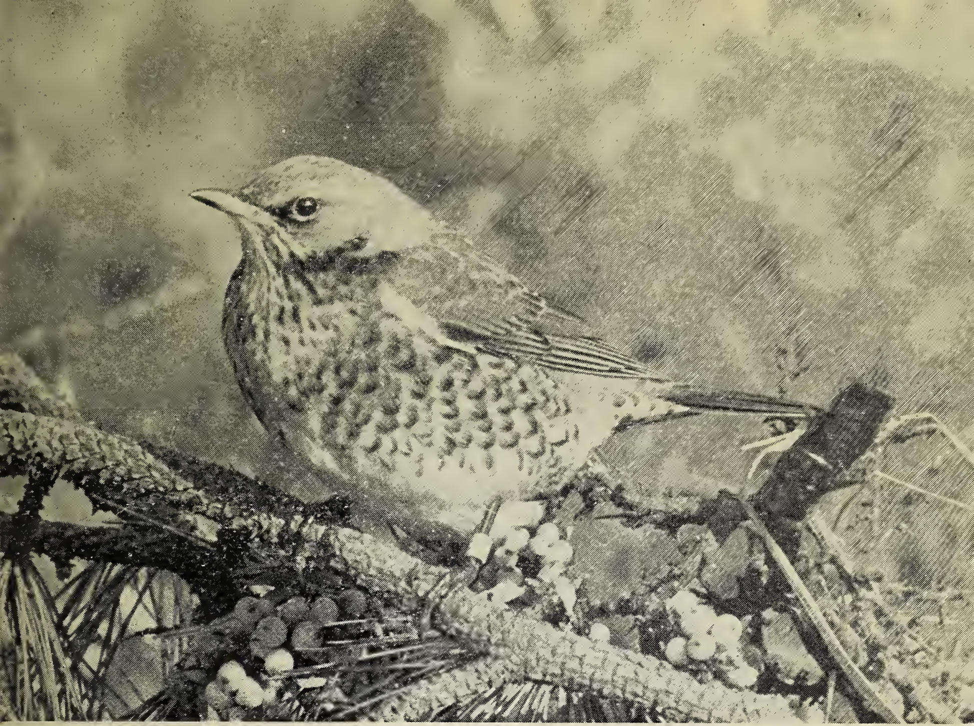
Cattle Egret: Broads: Hickling April 22nd - 26th and for several days previous (PRA GED, *et al*).

Bittern: Broads: Barton 3 breeding pairs. Horsey 4 breeding pairs. Stokesby Ferry pair bred. Martham single young in Starch Grass. Strumpshaw one booming. Upton Mill one booming.

Spoonbill: North/East Coasts Broads: ones, twos and threes at Cley, Holme, Salthouse, Breydon, Winterton, Barton, Hickling and Horsey between April 29th and Sept. 21st.

Teal: Fens: Welney, record peak of 3,300 Jan. - Feb.

Garganey: Spring arrival from April 6th at Cley and subsequently at Hickling, Holme, Breydon, Postwick, Wisbech S.F. and Winterton. Only breeding record from Cley where brood of 7 noted Aug. 7th.



Sea-buckthorn berries provide ample food supplies for autumn Fieldfares arriving on the coast at Holme Photo by P. R. Clarke

This Black Guillemot remained in Wells Harbour for several weeks at the beginning of the year. Others were identified off Sheringham and Cley. Photo by J. H. Marchant

Curlew Sandpipers were a feature of the first half of September; 24 appeared at Wisbech sewage farm and 15 on Rush Hills, Hickling. On the coast as many as 64 were at Breydon, 71 at Cley and 80 at Holme. Photo by Dr. R. Vaughan

Blue Winged Teal: Broads: Hickling, duck shot Sept. 27th and set-up by a local taxidermist (per MJS). Record being considered by British Birds Rarity Committee.

Gadwall: Brecks: largest counts Stanford 60 June 12th, Didlington 50 Dec. 5th, Shadwell 54 Nov. 16th and Micklemere 36 Nov. 9th. East: 11 Haddiscoe Dec. 6th. Fens (Welney): 50 young in July.

Wigeon: North: Cley 1,500 - 2,000 Jan. 7th. East: Buckenham 1,500 Feb. 2nd. Horsey 1,000 end of Jan. Fens: Welney 20,000 in Jan. - Feb. and 15,000 in late Dec.

Pintail: Fens: Welney 2,000 end of Jan. Brecks: 1 - 5 at Stanford and Mickle Mere. Wash: maximum of 47 at Snettisham in Jan. East: Breydon peaks of 286 on Jan. 12th and 277 Feb. 18th, with 83 on Dec. 28th. Pair present June 14th and 3 on 21st considered 'birds of the year'. North: Cley 120 Jan. 23rd and 60 Dec. 25th. Central: Colney G.P. 3 Jan. 12th.

Shoveler: Brecks: counts include 36 at Micklemere Dec. 14th. Fens: Welney 80 June 1st, with a record count of 1,500 in late Jan. Tottenhill G.P. 33 Sept. 7th. Broads: Filby 88 Dec. 18th.

Scaup: East: Breydon maximum of 14 Nov. 16th, with late drake May 8th. Wash: Snettisham maximum of 13 in Jan.

Tufted Duck: Breeding records: 27 pairs bred in Brecks at 10 sites; elsewhere a minimum of 22 pairs at 10 sites. In addition 100 young in Fens at Welney.

Pochard: Breeding records: 8 pairs bred in Brecks at 5 sites; elsewhere 17 pairs bred at 9 sites. In addition nested for first time at Welney but young lost.

Goldeneye: North-Brancaster maximum of 58 in Nov. Wash: late birds at Wissington (May 19th) and Kings Lynn—Saddlebow, where singles May 31st and July 16th.

Long Tailed Duck: Wash: Hunstanton monthly maxima as follows: Jan. 20, Feb. 10, March 25, April 9, Oct. 3, Nov. 14 and Dec. 11. North: Occasional records of up to 12 until April 22nd and from Oct. 9th. East: Breydon Dec. 7th.

Velvet Scoter: Wash/North coasts: Recorded in Feb. Sept. Nov. and Dec. No party exceeded 20 apart from 63 off Sheringham Nov. 9th. East: Yarmouth 4, Nov. 8th and one Dec. 7th. Gorleston, 2 Nov. 9th.

Common Scoter: Wash: Hunstanton maxima 1,000+ in Jan. and 700 in Feb. with 500 in Dec. North: Maximum recorded off Sheringham 750 Nov. 9th.

Eider: Coastal records most months and the largest flocks for main localities are given below. East: Gorleston, 50 Nov. North: Sheringham 24 Nov. Wash: Hunstanton 24, Jan.

Red-breasted Merganser: No numbers reported apart from 51 at Hunstanton in March, 29 at Snettisham and 35 at Sheringham, both in Nov. East: Breydon 10 Nov. 9th.

Goosander: Winter observations from 12 localities including 11 at Gunton Park, 7 at Narborough Lake, 6 at Stanford Water and 8 off Cley.

Smew: Winter singles at Brancaster, Barton Broad, Bawburgh G.P. and Snettisham.

Shelduck: Wash: Snettisham maxima 806 in Feb. Total of 159 young, Vinegar Middle, July 26th, with 182 on Aug. 11th and 140 young off Ongar Hill July 12th. East: Breydon, record winter peak of 953 Jan. 26th with 833 on Nov. 16th. Cantley, exceptional total of 200 young June 30th.

Egyptian Goose: Reported at Stradsett, Lyng, Lenwade, Narford, Bawdeswell, Fustyweed, Docking, Cley, Hempstead Mill, Sparham, Bayfield, Blickling, Barton, Breydon, How Hill and Winterton.

White-fronted Goose: East: None reported in Breydon Area. Elsewhere in Yare Valley, single from Jan. 21st to Feb. 2nd with 3 Dec. 14th. Horsey, 6 Feb. 9th and 5 on 16th. West Caister, 6 on Feb. 9th. North: Cley, 14 in Feb. and early March. Holkham, 34 on Jan. 12th, increasing to 50 by Feb. 18th and 80 by late Dec. Brancaster, 46 Feb. 12th. Blakeney, 10 Feb. 8th.

Bean Goose: East: Up to 102 in usual area till Feb. 16th; 9 returned Nov. 8th, with 65 from 22nd and 79 at end of year. North: Holme, 9 Nov. 6th and 5 mid Dec. Fens: Welney, 7 Jan. 1st until early March.

Pink-footed Goose: East: Tunstall Marshes, 20, Dec. 20th. Wash: Snettisham area, peak of 2,731 (a new record) in Nov. and over 2,000 in Jan. feeding on sugar-beet tops. North: Titchwell, 350 Feb. 12th. Hunstanton, 100 south-west Nov. 29th.

Brent Goose: Maximum numbers at regular localities: Breydon 120, Wells 500, Brancaster 1,500, Blakeney 1,500, Salthouse 250, Hunstanton - Holme 600 and Snettisham 516. Yarmouth, exceptional numbers offshore Nov. 8th when 554 in 5 hours, and again Nov. 9th when 441 in 3 hours during gales.

Barnacle Goose: East: West Caister 25, Feb. 5th to 9th, with 2 on Feb. 11th. Horsey, 4 on Feb. 9th with 10 on 16th. Breydon, single Feb. 7th. North: Cley, 49 Feb. 13th to 17th with 2 March 17th and single April 1st. Holkham, 1 with Canada Geese Feb. 20th. Wash: Snettisham area, one with Pink-Feet, Dec. 17th.

Whooper Swan: Recorded up to April 1st and from Oct. 15th at 8 localities with largest herds at Welney, where 42 in Jan. and 48 by end of year.

Bewick's Swan: Recorded up to March 29th and from Sept. 20th. Largest concentration at Welney Washes where 900 by end of Jan. and 1,200 present at end of year. Elsewhere most impressive assemblies at Runham/Mautby (100 Dec. 20th), Muck Fleet/Fleggburgh/Lower Bure (96 Dec. 26th), Halvergate (68 in Feb.) and Clippesby (51 Dec. 27th). In Brecks, maximum of 8 at Stanford Dec. 14th.

Buzzard: North: Holme March 31st, April 13th and 18th. Titchwell April 13th. Wells/Holkham area, 2 April 18th to 28th, and one at Holkham April 6th. Salthouse Heath April 22nd, Cley April 10th and one in from sea Oct. 19th. East: Buckenham Jan. 26th, Winterton April 13th.

Rough-legged Buzzard: An exceptional spring movement following large Autumn arrival in 1974 with unprecedented numbers in April/May. Recorded in every month except July. Surprisingly few autumn arrivals. The records are given in detail:

East: Winterton/Horsey Gap, singles in Jan. and Feb. apart from 4 Jan. 30th., 2 in March and first half of April increasing to 5, April 13th. On April 19th, 10 in air together at times drifting at a height away to N.E., but always returning; 9 present next day. Further counts here: 7, April 22nd, 8 on 26th and 5 on 27th. Twelve in area May 1st, including a pair displaying and calling low over observers' heads and repeated again on 4th when additional aerial displays over woods. This pair remained till May 15th when most unfortunately a mechanical bird-scarer arrived. Other May counts include 7 on 4th. One remained in the area most of June and was last seen at Martham Holmes on 22nd. Another, or same bird, August 3rd. Exceptional numbers of rabbits were the great attraction.

Hickling Oct. 29th, Breydon March 8th, Martham Broad Jan. 1st, Ingham-Happisburgh April 1st, Wheatacre Fen Nov. 8th. North: Holme, 1 - 3 on six dates Feb. 21st - April 21st with 6 March 4th. Total of 15 April 28th arrived from N.E. in space of 15 minutes and soared away to S.W.; another May 4th, Wells-Holkham, singles on four dates Jan. 6th to Feb. 16th, 5 - 6 April 21st, and another Dec. 5th. Cley on eight dates Jan. 1st to May 14th with 2 April 29th. Arrival here Oct. 19th and Nov. 9th. Titchwell 3, Feb. 19th and 9 singles between Feb. 21st and April 29th. Wiveton April 4th, Blakeney Feb. 15th, Salthouse Heath unusual date of Aug. 8th, Brancaster 2, April 21st and singles on 29th and Sept. 11th, Scolt Head 2, March 31st, Letheringsett May 2nd, Stiffkey Dec. 18th. Wash: Wolferton Feb. 21st, 5 March 6th, April 21st. Breck: Weeting Heath March 20th. Elsewhere: Castleacre March 3rd (dead). Docking Dec. 25th where 2 for some time, Massingham Heath 2, Jan./Feb. and one March 15th. Banningham Sept. 21st, Narford Feb. 10th and 3 between Sedgeford and Ringstead Jan. 6th.

Sparrow Hawk: Recorded from 40 localities. No known breeding recorded in the county. Migrants at Winterton March 16th to May 8th with 6 in the air together April 19th and 4 next day.

Goshawk: North: Aylmerton Sept. 11th. East: Winterton April 19th. Brecks: Pair summered at one site, the female carried a falconer's bell.

Red Kite: Wash: Wolferton July 22nd and 23rd (GBB). East: Herringfleet Nov. 3rd and presumably same bird at Thurlton/Reedham marshes Nov. 19th (DK).

Honey Buzzard: North: Pair present at one site from May 11th until at least July 30th, but no evidence of breeding. Third bird present June 1st. Wells/Holkham Sept. 15th (HE).

Marsh Harrier: Broads: (Hickling - Horsey - Martham area) a pair bred successfully rearing 4 young. Also a minimum of 3 additional birds for most of summer. Halvergate/Lower Bure levels—2 for several weeks during summer. Ranworth, pair summered. Strumpshaw, female June - August. Cantley Reservoir March 1st - 2nd and July 13th. Hardley Flood May 23rd. Rockland Broad April 20th and Breydon April 7th, May 23rd and June 1st. East: Winterton/Horsey Gap wintering male till May 25th. 2 - 4 regularly May 15th - June 15th (when one departed out to sea) and 1 - 2 irregularly to Oct. 6th. Caister, 3 south April 29th. North: Cley, singles on seven dates April 19th - June 5th, also August 11th to 14th. Titchwell, 1 - 2 on eight dates in spring and on five days in autumn. Wash: Snettisham April 29th :- Sept. 21st with peak of 5 roosting here Sept. 10th. Ongar Hill, Sept. 21st.

Hen Harrier: Recorded up to May 4th (Winterton) and 21st (Holme) and from Sept. 17th (Cley). Apparently increasing as a winter visitor in coastal localities, with 4 at Winterton April 19th and similar number at Roydon Common and Castle Acre. More adult males than usual.

Montagu's Harrier: North: Female at 1972 nesting site from April 29th (same date as 1974) till July 17th. No male appeared. Additional passage birds (4) in mid-May. North: Holme, July 26th to August 1st and East Ruston Common May 18th. East: Winterton June 1st. Broads: Horsey, Sept. 5th, Strumpshaw, June 4th, Hickling Aug. 23rd. Wash: Snettisham, six occasions in July.

Osprey: Recorded between April 1st and August 12th at Hickling, Breydon, Buckenham/Hassingham/Strumpshaw, Barton, How Hill, Cley, Wells, Felbrigg, Brancaster, Holme and Old Hunstanton.

Hobby: North: Recorded on eleven dates between April 26th and June 16th at Cley, Salthouse Heath, Blakeney Point, Wells, Gunton, Sheringham and Felbrigg. East: Winterton May 18th, Breydon Sept. 10th, Sea Palling July 19th. Wash: Sandringham June 23rd.

Peregrine: North: Cley, recorded on six dates. Blakeney Point Oct. 14th. East: Winterton, Nov. 12th and Yarmouth (with falconers' jesses) Feb. 2nd.

Merlin: Singles at Cley, Stiffkey, Brancaster, Wells, Winterton, Yarmouth, Hickling, Roydon Common, Snettisham, King's Lynn and Wolferton up to April 18th and from Oct. 18th.

Quail: Heard calling during summer at Holme, Warham, between Brancaster and Burnham Market (2) and Babingley. Interesting record of 5 near Bawsey July 31st.

Golden Pheasant: Recorded from Wolferton, Santon Downham, Sandringham, Dersingham, Swaffham Heath and St. Helen's Well.

Lady Amherst's Pheasant: Central, Elsing, Oct. 21st (GJG).

Spotted Crake: North: Cley, Aug. 27th and 2 next day till Sept. 4th, one remaining till 9th.

Coot: Broads, Interesting count of 246 Filby Broad, Dec. 15th.

Oystercatcher: Breeding records of pairs include: East: Breydon area 7 and Stokesby 1. Broads: Horsey 3. North: Blakeney Point 180, Stiffkey Binks 22. Wells 15, Scolt Head 160 - 170 and Brancaster Golf Course 5. Fens: Wisbech SF 1. Maximum count of 12,300 at Snettisham in Dec.

Ringed Plover: Breeding records of pairs include: East: Caister 1, Winterton—Horsey Gap 8. North: Blakeney Point 122, Wells 14 and Scolt Head 120-130 (400 chicks fledged). Wash: Snettisham 17. Breck: Gooderstone 2, Bodney 2 and Foulden 1. Fens: Kings Lynn B.F. 5-6, Wissington 1 and Welney 1. West: Total of 9 pairs at 4 gravel pit sites; 3 sites shared with Little Ringed Plovers.

Little Ringed Plover: Breeding : Total of at least 26 pairs at 15 sites; minimum of 51 young reared. First seen in Spring at Titchwell April 2nd and at Colney on 6th. In West, 3 gravel pit sites shared successfully with Ringed Plover. Away from breeding localities, passage birds recorded at Wisbech SF (8), Hickling, Cley, Holme and Breydon. Latest record at Stoke Ferry BF Oct. 5th.

Kentish Plover: North: Cley/Salthouse, a male and female on numerous dates April 19th - June 6th and again June 21st; in Autumn Sept. 3rd and 10th. Blakeney Harbour Aug. 31st with female and immature, Sept. 7th - 8th. Titchwell male May 19th. East: Breydon male June 1st - 4th (in song display on 2nd). Broads: Hickling May 16th.

Grey Plover: Wash: maximum count of 450 at Snettisham in Sept. East: Breydon 73 Oct. 23rd.

Golden Plover: largest concentration reported was 2,000 at Horsey, Jan. 8th.

Dotterel. During spring one at Blakeney Point ternery May 10th and two on field adjoining Salthouse Heath May 25th/26th. In Autumn one over Wells Aug. 12th and two at Winterton on 29th which were joined by a third bird Sept. 3rd - 12th; one subsequently found dead on 13th.

Jack Snipe: Latest spring record Wissington BF April 20th. First recorded in autumn at Hickling Sept. 11th.

Curlew: Recorded at six localities in Brecks in breeding season with three pairs at Roydon Common. Maximum count of 2,300 at Snettisham in Sept.

Whimbrel: 3 at Wells on the early date of April 4th. Spring passage appeared to be in below-average numbers and few records received. Early commencement to autumn passage at Breydon from June 21st with 9 by June 30th. Late birds Nov. 2nd at both Thornham/Holme and Hickling.

Black-tailed Godwit: In Fens at Welney peak number of 97 April 10th; at least 7 pairs reared young. (55 pairs along total length of Ouse Washes). Elsewhere passage birds March 1st - Oct. 18th with maximum of 28 at Snettisham July 13th. One winter record Salthouse Dec. 30th.

Bar-tailed Godwit: East: Breydon spring peak 101 April 27th; autumn maximum 63 Sept. 23rd. Wash: Snettisham maximum 1840 in Sept. Inland: Sparham Pools 4 April 17th; Wisbech SF 2 April 25th and 1 July 8th.

Green Sandpiper: Maximum numbers: 10 Wissington BF and 12 Hickling end July, and 15 Cley early Aug.

Wood Sandpiper: Passage birds May 6th—June 3rd and again July 9th - Sept. 15th with maximum of 6 at Cley June 1st and Aug. 10th.

Common Sandpiper: Winter records at Yarmouth Jan. 29th and Caistor St. Edmunds Dec. 16th. Largest numbers on passage seen at Wisbech SF where 33 Aug. 2nd, and Holme where 24 Aug. 9th.

Redshank: East: Breydon noticeable increase both in winter and on passage; peaks of 1000 Feb. 18th and March 31st with 547 Aug. 9th.

Spotted Redshank: Passage birds March 31st - Nov. 9th with maximum of 20 at Cley May 5th, 17 Wisbech SF June 21st, 12 Breydon July 26th, 19 Snettisham Sept. 1st and 9 Hickling April 26th. One winter record Cley Dec. 25th - 30th. Inland: Cantley BF Sept. 6th.

Greater Yellowlegs: East Breydon Sept. 8th - 13th (PRA *et al*). First county record.

Greenshank: Largest numbers seen on autumn passage with peaks of 17 Breydon Aug. 13th, 30 Holme Aug. 29th, 14 Cley Aug. 30th, 26 Snettisham Oct. 2nd and 22 Brancaster Oct. 7th.

Terek Sandpiper: Singles at Breydon June 1st (PRA *et al*) and Cley July 2nd - 4th (WFB, EMcE, PJM *et al*) First county records.

Knot: maximum count of 27,000 at Snettisham in Jan.

Purple Sandpiper: Regularly recorded in winter months at Sheringham (up to 3), Hunstanton (up to 4) and Heacham (up to 4). Elsewhere recorded as follows: Gorleston Jan. 25th, Yarmouth Jan. 1st and 11th, Scroby Sands on the unusual dates of July 11th/12th, Caister-on-Sea 2 Oct. 10th, Winterton 3 Oct. 9th, Bacton 3 in Jan. and Aug. 30th, Salthouse Nov. 16th, Cley 4 Aug. 30th and singles several dates Sept. - Nov., Scolt Nov. 20th and Titchwell Aug. 26th and Sept. 14th.

Little Stint: Spring passage noted at Wisbech SF, where one April 16th and up to 3 May 18th - June 11th, and Cley, where up to 7 June 7th - 14th with one June 22nd and 2 July 2nd/3rd. At Stoke Ferry BF 2 also June 22nd. More widespread in autumn with records July 26th - Nov. 6th with maxima of 16 Holme Aug. 31st, Hickling Aug. 31st and Sept. 6th, 18 Wisbech SF Sept. 5th and 25 Cley Sept. 10th.

Temminck's Stint: North: Cley 1/2 numerous dates April 29th - May 29th, 2 July 19th/20th, July 26th, Aug. 12th and Sept. 3rd - 11th, Holme July 27th. Broads: Hickling June 2nd, Aug. 11th and 2 Sept. 6th. Fens: Welney 2 May 20th; Wisbech SF July 15th - 19th and Sept. 5th - 8th and Tottenhill G.P. May 31st. Inland: Sparham G.P. May 18th.

Pectoral Sandpiper: North: Cley Aug. 8th - 12th. Fens: Wisbech SF July 15th - 21st.

Dunlin: Maximum numbers for specific localities as follows: Breydon 4,500 Nov. 5th, Snettisham 11,000 in Jan. and Wisbech SF 500 Mar. 25th.

Curlew Sandpiper: Spring records only from Cley, where singles May 8th and 13th and June 14th with 2 May 26th, and Wisbech SF June 7th. Widespread autumn passage July 21st - Oct. 9th with maxima of 71 Cley Sept. 3rd, 15 Hickling on 5th, 80 Holme on 8th, 64 Breydon on 13th and 24 Wisbech SF. on 16th.

Sanderling: Wash: Snettisham, largest numbers seen in Aug. when up to 600 present. Fens: Wisbech SF 2 April 30th and also May 23rd.

Buff-breasted Sandpiper: North: Cley Sept. 15th - 20th (WFB FC *et al*).

Ruff: Breeding: Welney 2 pairs successfully reared young. Winter records from Cley, Hickling and Wisbech SF. Maximum numbers recorded at Wisbech SF where up to 100 in July, 60 in Aug., 10 in Sept. and 6 in Oct.

Avocet: East: Breydon Jan. 18th, 11 March 23rd, 2 March 24th, April 6th, April 11th/12th, April 19th, 2 June 2nd, June 19th and 2 Aug. 27th; Winterton April 6th. Broads: Hickling July 6th. North: Cley March 6th, 2 April 10th - 16th, 5 June 7th - 11th, 4 July 9th and July 13th; Holme May 11th, June 10th and July 26th. Wash: Snettisham 2 May 10th and 1/2 early Sept. Fens: Welney May 20th; Wisbech SF May 21st - 24th.

Grey Phalarope: North: Cley May 7th - 10th (still in winter plumage) and Oct. 19th, Blakeney Point Sept. 14th. Broads: Hickling female (summer plumage) May 29th. East: Yarmouth Nov. 18th in harbour entrance.

Red-necked Phalarope: North: Cley May 31st and June 1st. Inland: Freethorpe Sept. 4th on village pond.

Wilson's Phalarope: Fens: Wisbech SF male June 7th - 11th (HM-G, JAWM, BW *et al*).

Stone Curlew: Status details will appear in the next report.

Great Skua: East: Yarmouth Sept. 29th. North coast: Noted between Aug. 31st and Nov. 20th with the majority of records on Aug. 31st when 51 east at Sheringham and Sept. 14th when at least 56 east at Cley and 149 east at Sheringham during on-shore gales. Wash: Hunstanton/Snettisham 7 south Sept. 14th.

Pomarine Skua: East: Winterton Nov. 7th. North: Sheringham 17 east Aug. 31st, 4 Sept. 13th, 3 Sept. 14th, Sept. 21st, 2 Oct. 7th and 10 Nov. 18th; Weybourne 7 east Nov. 16th; Salthouse Sept. 15th and 2 Oct. 10th; Cley Aug. 23rd, Sept. 13th and 20th, 2 Sept. 27th and Nov. 16th; Blakeney Point 4 Aug. 31st; Holkham Nov. 1st. Wash: Snettisham an exhausted immature on beach Nov. 21st - 23rd.

Arctic Skua: East: Winterton 6 south Aug. 24th and 16 south Aug. 31st; Bacton maximum 4 daily Aug. 30th - Sept. 1st. North: Recorded July 8th - Nov. 7th with largest gale movements on Aug. 31st, when 125 east at Sheringham and 74 east at Cley and Sept. 14th when 168 at Sheringham with 77 east at Salthouse. Broads: Hickling Aug. 2nd. Fens: an injured bird near Stoke Ferry Sept. 29th.

Long-tailed Skua: North: an immature east at Cley Aug. 31st (JBK) and an adult east at Sheringham Sept. 14th (FF, JCM, DHS, MPT).

Great Black-backed Gull: An interesting gathering of 286 in Yare Valley Dec. 14th.

Herring Gull: North: Blakeney Point a pair successfully reared one young. Yellow-legged birds at Hickling Aug. 23rd and Yarmouth Dec. 21st.

Common Gull: North: Blakeney Point a pair successfully reared two young.

Glaucous Gull: North: records of 1 - 2 birds up to May 12th and from Aug. 6th. Elsewhere one inland at Rockland Broad April 20th and one at Ouse Mouth and two at Gorleston, both records Nov. 17th.

Iceland Gull: North: A first-year bird west at Cley March 15th (PJO).

Mediterranean Gull: A second year bird at Breydon July 10th (PRA) and adults at Cley Sept. 13th (DBS, RTS), and Nov. 22nd (DJB, GC), Salthouse Oct. 26th (JMB, CMJ) and Gorleston/Yarmouth Nov. 17th/18th (PRA, JCE).

Little Gull: Numerous observations received but as in 1974 not recorded in Feb., March or Dec. Two immatures summered at Wisbech SF (June - July). Largest numbers: 12 frequented a ploughed field at Holme Oct. 17th following NW gales and during a NE gale Nov. 7th at least 15 east at Salthouse, 16 south at Winterton and 10 headed out from Ouse Mouth.

Black-headed Gull: East: Unsuccessful breeding at Cantley BF due to predation by foxes which destroyed all nests. Few other nesting localities reported.

Sabine's Gull: North: an immature east Blakeney Point Sept. 7th (MHR); during northerly gale Sept. 14th two adults off Cley (SCJ) and Salthouse (BWJ) and an adult west Weybourne (PJO); an adult west Sheringham Oct. 10th (JCM).

Kittiwake: Wash: Ouse Mouth 6,000 Nov. 17th many going inland. East: Scroby Sands, over 1,000 July 12th.

Black Tern: Only recorded in small numbers, with maximum of 7, April 29th - Sept. 12th with several records of singles throughout June. Late birds at Cley Oct. 5th and Hickling on 15th. Breeding: a pair reared one young in Fens at Welney, the first time since 1969.

White-winged Black Tern: East: Winterton Aug. 10th (RL, RMcI).

Common Tern: Pairs at breeding sites (number of fledged young where known in brackets) include: Wash: Snettisham 52 (79). North: Titchwell 11, Brancaster 5, Scolt Head 420 (110 - high predation by Kestrel and Short-eared Owl). Wells 12, Stiffkey Binks 130, and Blakeney Point 1500 – (300 nests lost by high tides, also high predation by owls.) East: Scroby Sands 50+. Broads: Ranworth 27 (47), Ormsby 4, How Hill 1, Hardley Flood 10 (16), Martham 1 (3), Barton 3 (2), Hickling 6 and Hoveton Great Broad 5. Inland: noted in breeding season at Costessey, Taverham Mill, Sparham, Lyng, Fustyweed GP, Swanton Morley, Worthing and Lenwade.

Arctic Tern: North: Breeding pairs Scolt 1 and Blakeney Point 2. Elsewhere up to 2 at Cley July 20th - Sept. 28th with a late bird Oct. 19th.

Roseate Tern: North: Up to 3 at Scolt Head during breeding season. At Cley 3 May 9th and singles on four dates June 6th :- July 20th. Holme one May 11th. East: Happisburgh 4 north-west May 5th.

Little Tern: Breeding records of pairs (number of fledged young in brackets where known) include: North: Thornham 20, Titchwell 27 (12), Brancaster 18 (2/3), Scolt Head 70 (11 - predation by Oystercatchers and Kestrels), Overy Staithe 5/6, Wells 11, Stiffkey Binks 30 - 40 and Blakeney Point 208. East: Winterton/Horsey 66 (122) and Caister-on-Sea one unsuccessful (first attempt since 1962). Broads: Hickling 2 Fens: Unusual inland record of 18 at Wisbech SF July 19th. Latest 2 Cley Oct. 5th.

Sandwich Tern: Breeding: North: Scolt Head 3,200 pairs with a minimum estimate of 2,800 flying young. Stiffkey Binks and Blakeney Point none nested. East: Scroby Sands minimum of 60 pairs. Extreme dates Cley Mar. 27th and Nov. 2nd.

Razorbill: North: Sheringham, maximum counts of 153 Nov. 8th, and exceptional total of 567 on 30th.

Little Auk: North: Cley, Nov. 2nd, 10 west on 7th and one on 8th. One also on Nov. 19th and one dead Feb. 2nd. Sheringham, Nov. 7th, 8th, 19th and 20th. Hunstanton, Feb. 21st, and Hunstanton/Holme Nov. 8th. Holkham dead March 14th and Brancaster one flew into netting and died Nov. 29th. East: Winterton, 18 north Nov. 7th. Yarmouth, 2 north and 2 inland with starlings on same date, 14 north on 8th and one on 9th.

Black Guillemot: North: Sheringham Oct. 11th, Cley Aug. 10th, Sept. 13th, Wells Harbour Jan. 3rd to Feb. 22nd and again April 5th.

Puffin: North: Sheringham Aug. 31st, Nov. 7th - 22nd with 9 on 9th and 5 Dec. 13th, Blakeney Point 3, Aug. 31st and one Sept. 15th, Cley 5 Sept. 28th and Nov. 9th, Titchwell Sept. 22nd.

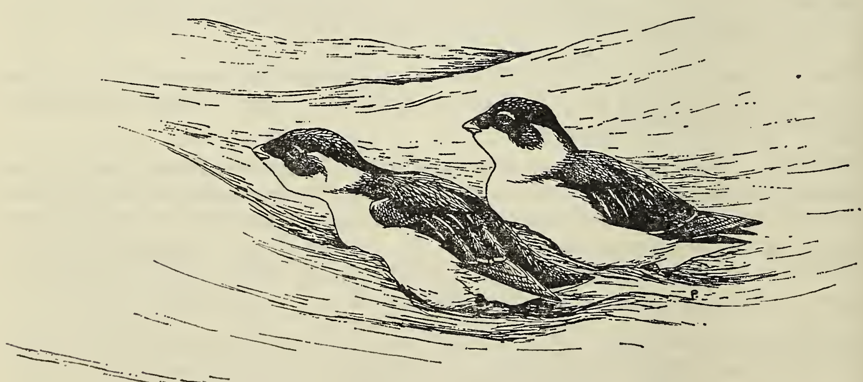
Turtle Dove: Late bird at Banningham Oct. 22nd. Notable passage records include Winterton 569 north in three hours (0600 - 0900) June 1st and again on 15th when 58 north. Holme, up to 100 per hour passing west till 1100 hrs. May 12th. Colney/ Bawburgh G.P. 90, May 26th.

Collared Dove: Inland, large gathering of 250 at Downham Market May 31st.

Barn Owl: Noted at 108 localities. North: Cley, one of the dark-breasted form Feb. 14th (RAR).

Little Owl: Recorded at 28 localities.

Long-eared Owl: Bred successfully at East Wretham and near Brandon. Breeding season records from Strumpshaw, Wells, Sheringham, Holkham and Brancaster Staithe. Very unusual numbers (approx. 60 birds) arrived on the coast following easterly winds in October and northerly winds in early November.
North: Blakeney Point, Oct. 11th, 19th (2) and 21st. Blakeney Oct. 11th and 19th. Cley/Salthouse Oct. 11th, 12th (in from sea and settled on East Bank), 19th, 21st, at least 4 Nov. 8th, and one dead Nov. 22nd. Salthouse Heath Feb. 22nd, Sheringham April 21st, May 15th - 27th, Sept. 28th, Oct. 20th and Nov. 9th (2 in from sea), Brancaster Staithe approx. 10 in autumn and winter, Brancaster Common Jan. 6th-12th (2) and April 25th, May 1st - 7th. Hunstanton Oct. 13th, Wells March 3rd, May 20th, Oct. 20th (2), Holme singles on four dates Oct. 5th - 19th.



East: Yarmouth Nov. 8th, Caister Nov. 8th, Winterton April 20th and Oct. 19th (2), Stokesby Dec. 13th, Waxham April 20th, Happisburgh Oct. 19th and one caught on 24th carried a Dutch ring, Oct. 25th and 27th with 2 on 26th.

Elsewhere: Display flight at South Runcton April 4th and another Dec. 27th. Docking (dead) April 3rd, East Wretham Jan. 26th, Ringstead Common (2) Jan. 26th, minimum roost of 4 Massingham Heath in Dec., Strumpshaw dead Oct. 14th and on 22nd. Snettisham Oct. 11th.
Interesting offshore observations include singles at Inner Dowsing Lighthouse Nov. 8th, 10th and 13th, and 4 "owls" (2 certainly of this species) on gas production platforms 40 miles N.E. of Yarmouth in late Oct. Additional 1973 nesting record at Bradeston (in crow's nest).

Short-eared Owl: Breeding season records from Horsey (June 10th) and Syderstone (June 11th carrying food). Also juveniles at Warham saltmarsh Aug. 17th. Small immigration in October.
East: Breydon/Halvergate/Wickhampton, 10 Jan. 1st and migrants in spring to May 16th, 6 Dec. 26th. Haddiscoe area 7, Dec. 6th. Winterton singles up to May 15th. Happisburgh, 1 in from sea Oct. 20th. Bacton Oct. 16th, Paston Oct. 19th.
North: Cley maximum 7 Feb. 6th, and 3 April 21st. Singles in from sea Oct. 11th and Nov. 10th with 2 Oct. 19th. Cromer in from sea Oct. 19th.
Wash: Ongar Hill 9 Feb. 2nd.
West: Roydon Common, pair March 7th - April 19th performing display flights at dusk.

Kingfisher: Bred at Bawburgh Mill, Colney, Cranworth, Crostwight, Downham Market (3 pairs), Easton, How Hill, Keswick Mill, Lakenham, Snettisham, Sparham G.P. (3 pairs) & Strumpshaw. At Crostwight the nest was built between the exposed roots of a fallen tree in the middle of a small wood.

Hoopoe: In Spring reported from Eaton G.C., March 14th, Caister April 4th - 11th, Cley 19th - 22nd, Winterton on 24th, and Holme and Hunstanton May 20th. In Autumn at Herringfleet Marshes and Ashby Oct. 12th, Thornham on 13th, Edingthorpe on 23rd and Holkham Nov. 23rd.

Wryneck: Four spring records: Cley April 19th/20th, Winterton May 1st and 4th, Hunstanton G.C. between 8th - 10th and Fleggburgh Common on 13th. Far fewer in autumn than in recent years: Cley/Blakeney Point 1 - 2 on seven dates Aug. 13th-Sept. 14th and 1 on Oct. 21st; Holme 1 - 2 Aug. 28th - Sept. 16th; Sheringham Sept. 14th & 28th (2); Snettisham Sept. 20th; Waxham Sept. 5th and Winterton Sept. 3rd/4th.

Short-Toed Lark: North: Holme one present Oct. 27th - Nov. 16th (DJB, PRC, GW *et al*). The third county record.

Woodlark: In Brecks 9 Breeding pairs were located. Elsewhere recorded at Holme Jan. 13th and Oct. 28th - Nov. 1st (2); Felthorpe March 14th and Hickling Oct. 24th.

Shorelark: North: Cley/Salthouse present up to April 19th and from Oct. 21st, with a maximum of 30 on Jan. 6th. Weybourne 1 April 12th; Scolt Head 1 Oct. 21st, Titchwell 1 - 2 in autumn, Holme singles Jan. 1st, Oct. 11th and 30th, with 6 on 18th.

Swallow: One at Twyford Oct. 4th was pale cream in colour apart from a black cap. Late migrants included singles at Horstead Nov. 5th, Wells on 25th/26th and Thornham Dec. 24th.

House Martin: Early birds at California on March 10th and at Swanton Morley on 23rd. November birds at Hunstanton and Holkham (6) on 1st, Sheringham on 5th and Brancaster (2) on 6th. Again a large breeding colony along Relief Channel near King's Lynn with 141 nests on Saddlebow Bridge.

Sand Martin: Late migrants at Crostwight (3) and Sea Palling on Oct. 26th.

Golden Oriole: East: Winterton male in song June 1st (PRA). No evidence of nesting in the county.

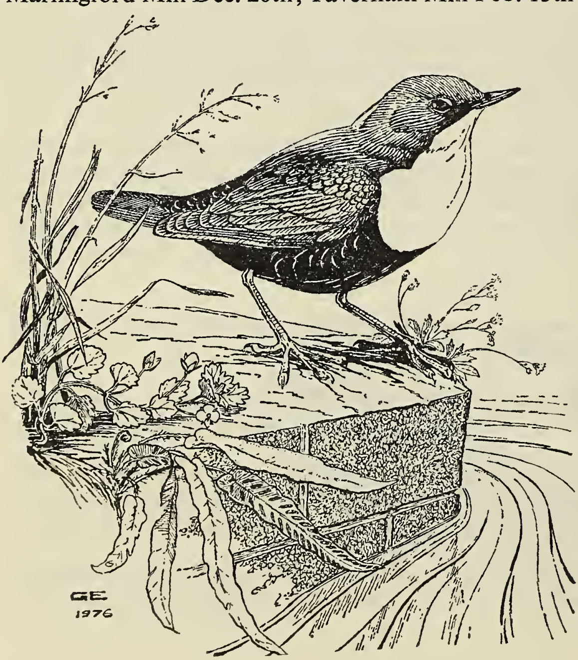
Carrion Crow: West: Roydon Common, the winter roost contained up to 200 birds in January and 300 in December.

Hooded Crow: West: highest count 35 at Snettisham Oct. 26th and Sandringham Common Dec. 23rd. North: Holkham 21 on Nov. 1st. East: Breydon 10 Jan. 18th; Winterton 27 Feb. 16th and 45 Oct. 26th. East Ruston 30 during Nov. West: Roydon Common up to 20 in March, April and Oct. Singles summered at Sheringham and Winterton.

Jay: The following Oct. records could well refer to birds of the Continental race, *glandarius:* North: Sheringham 3 flying south-east on 4th; Titchwell 14 on 11th. East: Winterton 4 apparently in off the sea on 12th. Wash: Snettisham 2 on 21st.

Long Tailed Tit: East: Winterton 3 white-headed birds April 20th were considered to be of the Northern race, *caudatus*. Happisburgh, noticeable passage of small flocks in October and total of 77 ringed. Trimingham, 6 ringed on Oct. 11th were controlled at Sheringham the following day.

Black-Bellied Dipper: As in 1974/75 winter reported from several localities: Banningham Nov. 8th - 12th; Briggate Mill Feb. 18th; Hempstead Mill Dec. 2nd - 31st; Honingham Feb. 1st - April 11th & Dec. 1st - 14th; Hunworth March 26th; Marlingford Mill Dec. 20th; Taverham Mill Feb. 13th & Dec. 16th - 31st; Thetford



Black-Bellied Dippers appeared at eight localities

Mill Dec. 11th. Two were caught and colour-ringed in the winter of 1975/76 and may well return to the same areas in subsequent winters.

Bearded Tit: Broads: Bred at Barton, Hickling, Whiteslea, Heigham Sounds, Martham, Horsey and How Hill. North: Bred at Titchwell, Cley and Salthouse. East- Bred at Cantley BF. A count in mid-Dec. (Titchwell to Salthouse) produced a total of 120 birds.

Mistle Thrush: East Tuddenham a cream-coloured bird on Sept. 6th.

Fieldfare: Late spring bird at Holkham May 18th, with 2 at Kelling June 1st. A pair summered in East Norfolk, but no evidence of nesting. First autumn bird Corpusty Aug. 10th. One at Lower East Carlton Jan. 27th was albino apart from a black tail bar.

Redwing: Extreme dates Winterton May 18th and Felmingham Aug. 23rd.

Black-Throated Thrush: North: Holkham immature Oct. 21st - 24th (WVF, DGW *et al*). The first county record of this vagrant from Asia.

Ring Ouzel: Spring: recorded April 12th - May 15th from the majority of the coastal parishes between Hunstanton and Sheringham in the North; from Waxham, Horsey, Winterton and Breydon in the East and inland at Cantley and Hickling. Maximum Hunstanton G.C. (9) April 21st and Holme (8) April 26th. Autumn: 1 - 3 recorded Sept. 30th - Nov. 5th. In North at Holme and Holkham; in East at Hickling, Winterton, Scratby and Yarmouth.

Wheatear: Late autumn date: Cley Oct. 31st. Marked passage on April 19th when 70 between Salthouse and Weybourne. An unusual record was of one in the centre of Norwich Oct. 14th - 17th.

Black-Eared Wheatear: North: Cley May 13th (PT). Holme June 2nd - 21st (PRC, DJH, MR *et al*). The second and third county records.

Stonechat: Breeding pairs noted at Weybourne (1), Winterton/Horsey (10) and Breydon (1). During the winter recorded at many coastal and sixteen inland localities, the majority of the latter in East. Maxima at Holme (6) Feb. 22nd and at Caister (5) Oct. 26th.

Whinchat: Extreme dates Brandon April 2nd and very late bird at Holme Nov. 24th. During breeding season noted only at Sturston Warren, where 2 immatures July 12th. A sandy-coloured bird at Hickling Aug. 31st.

Redstart: Extreme dates April 29th (Yarmouth) and Oct. 27th (Hellesdon). Breeding season records from Santon Downham (male singing), Castle Rising (2 males singing), Tottington (pair with young) and Sheringham (pair with young). Wash: Heacham, adult male Oct. 26th showed the characteristics of the white-winged Eastern subspecies, known as Ehrenberg's Redstart, in summer plumage.

Black Redstart: Breeding: Yarmouth 8 singing males, with breeding proved at 2 sites and an exceptionally early singing male Feb. 1st. Gorleston 1 pair. Norwich 3 males singing, but no proof of breeding. Migrants: Many coastal records in spring and autumn, with inland reports from King's Lynn, North Walsham, Reepham and Sparham. Winter: Noted in mid-winter at Norwich (Jan. 29th) Sheringham (all Jan.) and Heacham (Jan. to March).

Nightingale: Passage birds at Holme May 1st/2nd and Winterton Aug. 27th. A full breeding summary will be published in the 1976 Report.

Bluethroat: Spring: Sheringham May 7th - 9th, Blakeney Point and Titchwell on 26th. Autumn: Blakeney Point Sept. 14th - 17th (2). For the second consecutive year more records in spring than autumn.

Cetti's Warbler: Broads: Yare valley, a total of 12 singing males at four localities, and two nests found. A further male in song at another Broadland site. Song heard from Feb. 1st.

Aquatic Warbler: North: Blakeney Point Sept. 5th/6th (DJH) *et al.*

Icterine Warbler: North: Wells 1 in song May 18th, the first spring record for eleven years (JHM). Blakeney Point Aug. 10th (2). Holme Aug. 12th, 13th, 30th, 31st, Sept. 3rd and 5th. East: Eccles Aug. 16th. Winterton Sept. 4th.

Blackcap: Winter records: North Pickenham Jan. 8th (pair); Castle Rising Feb. 6th; Cley Feb. 22nd; Brancaster Staithe Feb. 22nd (remaining until mid-April); Gaywood Dec. 8th; Sheringham Dec. 10th and 16th; Thorpe St. Andrew Dec. 28th.

Barred Warbler: North: Sheringham July 29th (the earliest date for the county), Aug. 30th - Sept. 5th (ringed and retrapped), Sept. 6th (on G.C., probably same bird); Blakeney Point Aug. 12th, Sept. 1st, 7th, 14th/15th (2), 16th; Holme Aug. 30th, Sept. 2nd, 4th (2), 7th (2) 16th; East: Winterton Sept. 21st.

Garden Warbler: Extreme dates April 20th (Winterton) and Oct. 24th (Holkham).

Chiffchaff: Spring arrival from March 9th (Chedgrave). A bird showing the characteristics of the Northern race, *tristis*, at Yarmouth Nov. 10th, while one at East Ruston Common Nov. 22nd was probably one of the Northern race. Winter records from Stoke Ferry Jan. 18th (singing) and Gorleston Dec. 23rd.

Wood Warbler: Kelling 2 pairs throughout breeding season. Noted in May at East Wretham Heath, Mundford, Santon Downham and Wells, while one was at Sheringham July 8th.

Arctic Warbler: North: Titchwell immature trapped July 5th (JR). A highly unusual date.

Yellow-Browed Warbler: North: Wells/Holkham Oct. 10th - 23rd, present almost daily, with a peak of 15 on 12th, although only 4 on 11th and 13th. East: Waxham Oct. 12th. Yarmouth Oct. 10th/11th and 19th.

Pallas's Warbler: North: Holkham Oct. 11th - 15th, with 2 on the latter date (FKC, JCE, SCJ); Scolt Head Oct. 17th (JB). East: Happisburgh trapped Oct. 17th (BMEU).

Dusky Warbler: North: Wells Oct. 14th - 16th (GBB, SCJ, NW *et al*); Blakeney Point Oct. 18th (GED *et al*). The fourth and fifth county records.

Radde's Warbler: North: Brancaster GC, by clubhouse, Oct. 17th (FKC). Holkham Oct. 18th - 20th (DMN & RBHS) and a different bird on 25th/26th (PD, GJJ & ETW). The third fourth and fifth county records.

Goldcrest: Unprecedented numbers occurred along the coast in mid-Oct., following north-easterly gales including: North: Holme, 200 on Oct. 10th and 250 on 12th; Holkham 200 on Oct. 12th. East: Happisburgh, at least 1000 passed through area Oct. 9th - 15th, with 500 on 10th; Yarmouth, 200 on Oct. 11th, 1000+ on 13th and 100 on 23rd.

Firecrest: Spring: Total of 25 at Blakeney Point, Brancaster, Caister, Cley, Crostwight, Dersingham, Fowl Mere, Holme, Kelling Heath, North Walsham, Sheringham, Stiffkey, Titchwell, Waxham, Wells/Holkham, Winterton and Witton Wood between

Four Pallas's Warblers (upper) and over 18 Yellow-Browed Warblers (lower) were identified in October.

March 29th and May 30th. At five of the localities two birds were present together and several males were heard in song. Autumn: Total of at least 8 at Holme, Salthouse Heath, Trimingham, Wells/Holkham and Yarmouth between Oct. 11th and Nov. 15th.

Pied Flycatcher: Total of 10 in May, the majority on coast but 1 at Wroxham May 12th, and more surprising male in song Cranworth May 22nd - June 5th. Another at Hickling June 14th. Late autumn birds at Yarmouth Oct. 10th and 14th (2) and at Holme on 12th.

Red-Breasted Flycatcher: North: Blakeney Point Aug. 29th, 30th and Sept. 14th (3); Wells/Holkham Sept. 29th, Oct. 10th/11th and 12th (2); Hunstanton Aug. 30th; Kelling Heath Sept. 18th. East: Yarmouth Oct. 10th; Trimingham Oct. 12th.

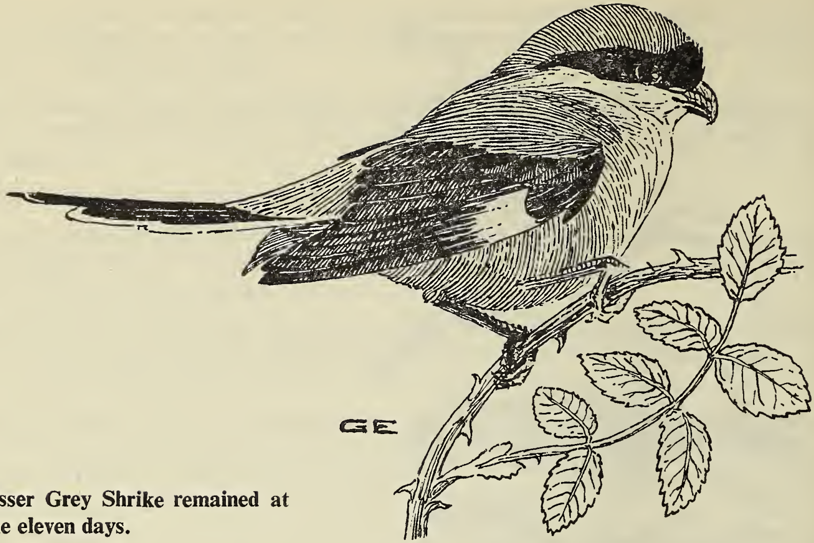
Olive-backed Pipit: North: Wells Oct. 10th (SCJ & NW). The first county record of this vagrant from Asia.

Pied Wagtail: A roost on East Ruston Common contained 80 birds in Nov.

White Wagtail: More reports in spring than usual with 12 at Snettisham April 19th and 15 at Cley on 21st. At Great Moulton a male White Wagtail bred with a female pied rearing three young in an open-fronted nestbox.

Grey Wagtail: Bred at a record total of 19 localities. The increase, at least in part, due to better coverage. Details as follows:

North: R. Glaven—Bayfield Hall. Central: R. Yare—Barnham Broom, Cringleford, Earlham, Keswick, Lakenham and Marlingford. R. Bure—Horstead. R. Tudd—Easton and Honingham. R. Wensum—Lenwade, Lyng, Norwich (2 sites) and Taverham. South: R. Waveney—Ellingham, Mendham and Needham. Brecks: R. Thet—Brettenham Bridge.



A Lesser Grey Shrike remained at Holme eleven days.

Yellow Wagtail: Extreme dates April 1st (Cley) and Oct. 24th (Holkham). Marked spring passage noted at Snettisham April 19th (70) and Cley April 20th (150).

Blue-Headed Wagtail: Breydon April 19th; Snettisham April 22nd; Cley 1 - 4 April 19th - May 5th; East Ruston Common May 31st; Downham Market male summered but no evidence of breeding.

Grey-Headed Wagtail: Hickling May 16th; Cley May 21st - June 1st; Kelling May 25th.

Waxwing: Recorded up to April 20th (Norwich) and from Oct. 19th (Wells). Monthly totals: January 21 (maximum 13 in Norwich); February 10 (maximum 6 in Norwich); March 6; April 5; October 25 (maximum 12 at Hunstanton); November 52 (maximum 16 at Brancaster); December 12 (maximum 6 at Downham Market). The majority were recorded on the coast and in and around Norwich.

Great Grey Shrike: Recorded up to April 19th (Beeston Common and Holkham) and from Oct. 1st (Holkham), whilst one with an injured wing was present at Cranworth May 1st and 22nd. During the winter months single birds were recorded from 20 coastal and 25 inland localities, with 2 on Salthouse Heath.

Lesser Grey Shrike: North: Holme/Thornham Oct. 25th - Nov. 4th (PRC, *et al*). The first autumn record for the county for over fifty years.

Red-Backed Shrike: Breeding season: A total of 13 breeding pairs in the county compared with a revised total of 14 pairs in 1974. Spring migrant at Holkham May 20th. Autumn migrants noted at Blakeney Point, Hickling, Holkham and Winterton between July 24th and Oct. 20th. One showing the characteristics of one of the eastern races of Red-tailed shrike at Holkham Oct. 12th/13th (GBB, SCJ & RPM).

Rose-Coloured Starling: East: Winterton July 31st (ADB).

Hawfinch: Recorded in breeding season at Weeting (2), Felthorpe (4 - 5) and Santon Downham. At East Wretham in late Jan and in early Feb. unprecedented total of up to 183 roosting in hornbeams and silver birches, the number falling to 25 by the end of March. The remaining records concern 2 at Attlebridge April 2nd and Sheringham July 31st, singles at Shadwell Nov. 16th and Salthouse Heath on 22nd, and 7 at Cranwich Nov. 16th.

Greenfinch: East: Winterton a flock of 2000 feeding in fields Feb. 23rd, with 1500 still present March 9th.

Siskin: Brecks: Grimes Graves, a pair present throughout May. Santon Downham, a pair June 19th and female July 5th (singing frequently heard in this area April to June 1974). Largest winter flocks Holkham Oct. 24th (20), Chedgrave Common Nov. and Dec. (40) and East Wretham Dec. 26th (50). 46 feeding on nuts and seeds at Banningham Oct. 22nd is exceptional for the county.

Twite: Recorded up to April 22nd (Winterton) and from Sept. 4th (Blakeney). North: counts include 4 - 500 at Wells (on late date of April 21st), 400 at Titchwell, and 200 at Blakeney Point and at Holme. East: maximum of 120 at Breydon Jan. 1st. Broads: 35 at Hickling Oct. 3rd. West: inland at Roydon Common Jan. 2nd (few) and 6th. Central: Keswick Mill a male with redpolls and goldfinches on the extraordinary date of June 17th/18th.

Scarlet Rosefinch: North: Holkham female Aug. 29th (DMW). The fourth county record, and the third consecutive year that one has appeared in Norfolk, the only previous one being in 1892.

Crossbill: No definite breeding records, but widely distributed in Brecks and in West. Numbers, however, small with maxima of only 7 at Sandringham (July) and 9 at Wells (Oct.).

Two-Barred Crossbill: West: Sandringham Feb. 16th (JC & GP). The third county record.

Brambling: Late birds at Winterton May 4th and at Cantley between 18th and 26th. Concentration of 1500 in Fens at Wissington B.F. end Dec.

The following summary by GED relates to the Norwich area.

During the first days of 1975, considerable numbers of finches were reported feeding in the beech woods in the grounds of County Hall. On 5th January, despite and almost continuous movement of birds in to and out of the woods, it was estimated that at least 1,250 Bramblings were present, with somewhat surprisingly only 50 - 75 chaffinches. Bramblings continued to feed in this area throughout Jan. and Feb. including up to 600 at the nearby Colman works, where 100 were ringed. Elsewhere during the period, records were received of up to 300 at Colney and Arminghall and up to 400 at Twenty Acre Wood at North Earlham.

In the middle of January a regular north/south movement of finches was noted over Thorpe Road throughout the day. By following their flight path with the aid of an Ordnance Survey map, at least 500 Bramblings were found feeding in beeches at Mousehold Heath to the north on the 19th. These birds were undoubtedly flying southwards to the County Hall area. Later in the month many hundreds were also seen flying north over Christchurch Road early each morning, presumably feeding to the north of the city.

Again with the use of an O.S. map and by observing the direction of departure of birds leaving County Hall in late afternoon, RFJ ascertained that they were roosting at Brooke Wood, 6 miles to the south-south-east. On the afternoon of 26th Jan. GED obtained a reasonably accurate count of the finches by standing adjacent to the road to the north of the wood, especially as the birds were arriving in two well-defined corridors from the north and flying low because of the wind. Birds started arriving at 3.30 p.m. and continued until 4.40 p.m. with the largest numbers about 4.00 p.m. As many arrived singly or in small flocks, with a larger party of 200 to 300 birds only every few minutes, it was possible to identify most birds as well as count them. Whilst small numbers of Yellow-hammers, Linnets and Tree Sparrows were arriving, with larger numbers of Chaffinches, out of a total of 7,600 birds the majority were Bramblings i.e. a total of 6,500 - 7,000. It would appear that such numbers are unprecendented in the Norwich area but unfortunately one can only speculate how many birds were also arriving at Brooke Wood from the east, south and west!

During February the flocks of Bramblings tended to become smaller and the birds more widespread. Small numbers were seen in many parts of Norwich including birds feeding in and on the ground below isolated beech trees well within the city centre. In March birds were still present in many areas of beech especially in gardens but the largest numbers tended to disperse away from the city with records of 700 feeding on stubble near Bramerton on 2nd and 400 near Horstead on 24th. (GED).

Yellow-Browed Bunting: North: Wells Oct. 19th (DJH, JBK & MP). This record has been accepted by British Birds Rarities Committee and is under consideration by the B.O.U. Records Committee. If accepted it will be the first British record of this Asian vagrant.

Ortolan: North: Blakeney Point Aug. 30th (GBB, SCJ *et al*).

Rustic Bunting: North: Blakeney Point Oct. 18th (AJLS) and Cley Oct. 19th (FKC) with another at Cley on 22nd (RJ & DIMW).

Reed Bunting: North: Blakeney Point 2 - 300 feeding in small flocks on top of the shingle on Oct. 18th is unusual.

Lapland Bunting: North: in autumn recorded from Aug. 30th (5 at Blakeney Point). Maximum counts 15 at Cley in Oct., 10 west at Holkham Nov. 5th and 12 at Overy Staithe Dec. 29th. Otherwise 1 - 2 noted at Holme, Sheringham, Snettisham and Titchwell. East: singles at Breydon Sept. 6th and Dec. 28th.

Snow Bunting: North: May reports from Cley (19th) and Cromer (male in summer plumage 29th/30th). In autumn recorded from Sept. 7th (Holme). Up to 200 present at Holme and Salthouse in Dec., 100 at Brancaster in Nov. and 80 at Titchwell in Oct. East: maxima at Yarmouth of 40 Jan. 1st and 27 Dec. 6th. Only inland record at Ten Mile Bank Nov. 26th - Dec. 3rd.

Ring-Necked Parakeet: North: Sheringham Sept. 30th. East: Waxham April 13th; Yarmouth April 21st (2) and Dec. 29th; Caister April 14th; Gorleston July 27th; Winterton Aug. 28th. Broads: Surlingham May 24th.

Observers are requested to submit all records of this species.

The following, not mentioned in the Classified Notes, were also recorded in 1975 (*breeding species in italics*): Black-throated Diver, *Mallard*, *Canada Goose*, *Kestrel*, *Red-legged Partridge*, *Partridge*, *Pheasant*, *Water Rail*, *Moorhen*, *Lapwing*, Turnstone, *Snipe*, *Woodcock*, Lesser Black-backed Gull, Guillemot, *Stock Dove*, *Woodpigeon*, *Cuckoo*, *Tawny Owl*, *Nightjar*, *Swift*, *Green Woodpecker*, *Great Spotted Woodpecker*, *Lesser Spotted Woodpecker*, *Skylark*, *Rook*, *Jackdaw*, *Magpie*, *Great Tit*, *Blue Tit*, *Coal Tit*, *Marsh Tit*, *Willow Tit*, *Nuthatch*, *Treecreeper*, *Wren*, *Song Thrush*, *Blackbird*, *Robin*, *Grasshopper Warbler*, *Reed Warbler*, *Sedge Warbler*, *Whitethroat*, *Lesser Whitethroat*, *Willow Warbler*, *Spotted Flycatcher*, *Dunnock*, *Meadow Pipit*, *Tree Pipit*, Rock/Water Pipit, *Starling*, *Goldfinch*, *Linnet*, *Redpoll*, *Bullfinch*, *Chaffinch*, *Corn Bunting*, *Yellowhammer*, *House Sparrow* and *Tree Sparrow*.

Bird Ringing Report

IN THIS year's report, the list of recoveries has been shortened, although the amount of material available is ever on the increase. Some species have been omitted altogether, including the Bearded Tit and most of the waders, and these will be dealt with at greater length in a future report. The extra space made available this way has been devoted to a short article on the movements of Black-headed Gulls.

Some species rarely appear in these lists; this year both the Long-eared and Short-eared Owls have their turn, and there are some interesting series of recoveries for other species, with some for 1976 brought forward where appropriate.

While checking through the material sent in by ringers we were most impressed by the number of ringed birds that were controlled, or in other words, caught and released with their ring still on. The three Goldcrest movements came to light this way as did also the warblers and most of the finches.

Shag

Farne Is., Northumberland (pullus) 2.8.74	Titchwell (dead) 11.11.74

Heron

Nestlings ringed at Broadland colonies were recovered from various parts of eastern England. The following are all from at least 250km distant, and are among the most northerly for the species from this area.

Wickhampton 30.5.74	Harrogate, Yorks. (dead) 8.4.75
Wickhampton 30.5.74	Wooler, Northumberland (dead) 11.5.76
Belaugh 10.5.75	Levens Park, Kendal, Westmorland (shot) 14.3.76

Wigeon

Nine ringed at Snettisham between 1970 and 1975 were reported shot in U.S.S.R. between May and early October, the latest of these being on 2nd October on the River Volga, 300 miles east of Moscow. Two others were in Denmark in September and October.

Shelduck

Cantley (pullus) 16.7.72	Grays, Essex (shot) 23.10.75

Kestrel

Snettisham (pullus) 10.6.71	Gressenhall, Dereham (dead) 10.2.75

Coot

Deeping St. James, Lincs. (juv.) 31.10.73	Elmham (caught by dog) 27.4.75

Little Ringed Plover

Little is yet known of the movements of this summer visitor, but no doubt the following are typical.

Gt Witchingham (Ad.) 24.6.71	R. Somme, N. France (killed) 24.3.72
Near King's Lynn (pullus) 12.6.75	Majorca, Balearic Is. (control) 26.8.75

Snipe

Salthouse 19.8.72	Vichuga, Ivanov, U.S.S.R. (shot) 30.8.74

Black-headed Gull—see separate report (page 28).

Long-eared Owl

One of the many found in eastern England in late 1975 carried a German ring

Wittmund, Niedersachsen, Germany (pullus) 16.6.74	Happisburgh (control) 24.10.75

Short-eared Owl

A bird reared in Yorkshire and apparently wintering on the Wash.

Goole, Yorks (pullus) 11.6.75	Terrington (shot) 19.10.75

Swallow

Bedworth, Warwicks (roosting) 15.9.74	Shotesham (control) 18.5.75

House Martin

The bird from Lancashire had presumably passed through north Norfolk on passage.

Happisburgh 18.5.75	Ince Blundell, Lancs. (control) 31.5.75
Downham Market 5.9.74	Zarauz, Spain 29.10.74

Song Thrush

Shotesham (pullus) 26.5.69	Guines, Calais, France (killed) 20.12.75
Holme 17.9.73	Tortesa, Tarragona, Spain 26.1.75
Titchwell 11.5.73	Mimizan, France 30.3.75

Redwing

The following two recoveries may usefully be compared with those in the 1972 and 1973 Norfolk B.R's, where recovery localities are further south than ringing localities.

Mintlyn, King's Lynn 30.3.73	Aviz, Alentejo, Portugal (killed) 2.1.75
Mintlyn 8.3.75	Windesheim, Overijssel, Netherlands (dead) September 1975

Blackbird

The first bird, an adult male on ringing, had possibly changed breeding areas by 1974, unless this is an instance of very late return migration.

Eckero, Aland, Finland 21.4.70	East Ruston (control) 25.5.74
Fair Isle, Shetland 27.11.74	Holme (control) 9.11.75

Redstart

Titchwell 16.9.74	Bremerhaven, Germany (cat) 5.5.75

Robin

Holme 24.4.73	Algamitas, Sevilla, Spain (trapped) 4.2.75
Titchwell 21.10.74	St. Nicolaas, Netherlands (control) 10.10.75

Reed Warbler

Two autumn movements to Sussex, the birds no doubt travelling together, a habit already seen in other small passerines such as Bearded Tit and Long-tailed Tit.

Titchwell 29.7.75	Bexhill, Sussex (control) 30.8.75
Titchwell 29.7.75	Bexhill (control) 1.9.75

Garden Warbler

A reverse movement in autumn.

Berg, Limburg, Belgium 2.8.75	Holme (control) 6.9.75

Goldcrest

The first two examples below provide useful information on the timing and direction of the autumn movement.

Falsterbo, Sweden 8.10.75	Titchwell (control) 11.10.75
Schiermonnikoog, Netherlands 11.10.75	Gt. Yarmouth (caught and released) 18.10.75
Titchwell 16.10.74	Friesian Is., Netherlands (control) 23.4.75

Starling

Movement was traced by ringing between Norfolk and Belgium, Netherlands, Denmark (4), East Germany, Baltic States (5), U.S.S.R. (2) and Finland (2). This number includes some recently reported from previous years.

Greenfinch

Doncaster, Yorks. 17.8.74	Downham Market (control) 28.12.74
Friesian Is., Netherlands 12.7.74	Walcot (dead) 17.4.75

Redpoll

Considerably more recoveries and controls were reported in 1975 than in any single year previously. The majority concern birds caught between August and October in the west of the county and recovered in Belgium in

October or November, or in various parts of East Anglia during subsequent breeding seasons. Three others are given in full.

Salthouse 8.5.72	Peterborough (control) 24.6.75
Leziate, King's Lynn 11.9.75	Dungeness, Kent (control) 19.10.75
La Londe, Seine M'me, France 20.4.74	Sheringham (control) 22.4.75

Brambling

Arstad, Rogaland, Norway 19.10.70	Mintlyn, King's Lynn (control) 8.3.75
Stola, Rogaland, Norway 7.10.73	Norwich (dead) 22.3.75
Mintlyn 27.12.73	Lebbeke, W. Flanders, Belgium (control) 9.11.75

Reed Bunting

A well travelled bird! But it would be interesting to know of its movements between Nov. 1973 and Jan. 1976. See Norfolk B.R. for 1974 page 201.

Winterton (adult) 9.9.73	a. Budleigh Salterton, Devon 17.11.73 b. Lisburn, Co. Antrim, N. Ireland (control) 5.1.76

Tree Sparrow

Movements over a few miles are unusual, although the species has been shown by ringing to cross the southern North Sea.

Ongar, Essex 5.8.75	Gt. Yarmouth (dead on beach) 15.5.75

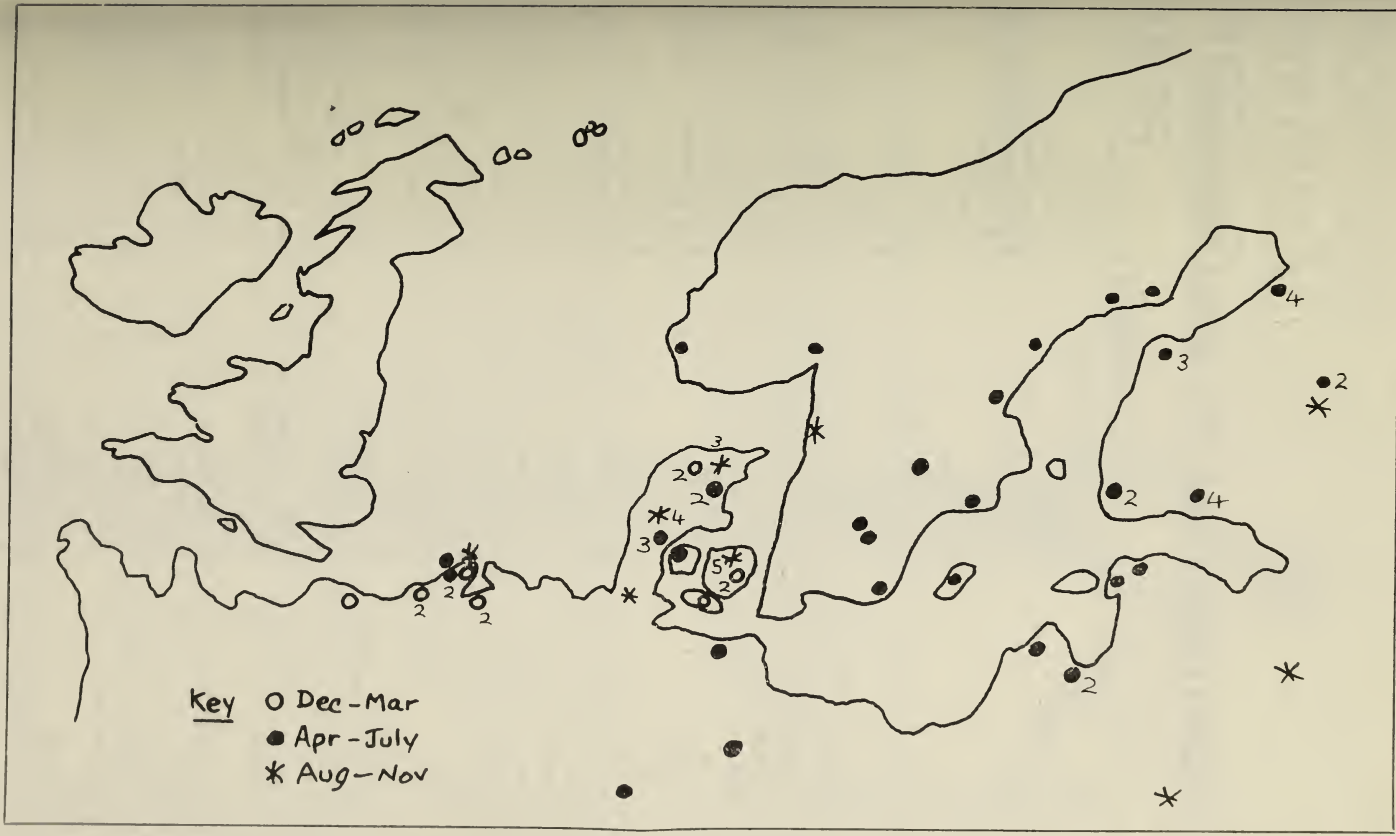
BLACK HEADED GULL RECOVERIES

Wintering gulls have been trapped and ringed in this and other countries for many years—they are comparatively easy to catch in gardens or on rubbish tips as they come down for food. Many thousands of others are ringed annually as nestlings, and as these birds are found again and reported back to us, a picture of their movements can be built up.

Many are shot, particularly in Denmark in autumn while they are on their way southwest for the winter. Others have been found injured or poisoned or caught in traps or machinery.

The map makes no distinction between "winter-ringed in Britain" and "summer-ringed abroad", but it shows firstly where our gulls spend the summer months—chiefly in Sweden, Finland and the Baltic area generally. Secondly, eastern England is only part of a much wider wintering area, that extends eastwards to include Denmark. A third point that is not seen from the map, but is nevertheless very important, is that there is little, if any, evidence to suggest that our wintering gulls are home-bred. Young gulls from Norfolk colonies appear to move westwards into the Midlands and beyond after fledgling.

It has been established by ringing that the starlings that come so greedily for winter scraps are a mixture of residents and visitors. It is fairly clear that the gulls that accompany them, and compete with them for the food supply, are mostly if not all winter visitors from the lakes and islands of the Baltic and other eastern parts.



Map showing recovery or ringing localities of Black-headed Gulls present in Norfolk during the winter months

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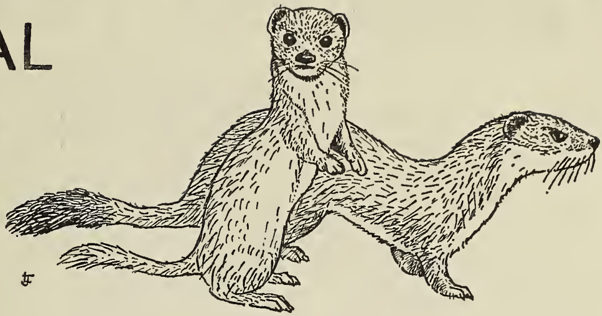
NORFOLK MAMMAL REPORT 1975



Editorial

The Editor is pleased to present the 20th Norfolk Mammal Report.

This bleak version of our customary gracious opening exemplifies the severe pruning necessary to present the essence of three years observations within the page limitations imposed by financial stringency. The continuance of the policy of including informative articles on topics of current importance demanded space be given to a specialist contributor. We are grateful to Morris Gosling for his account of the research behind recently improved coypu control and the narrowly averted crisis situation with this introduction.

Our gratitude must be expressed to the contributors who have faithfully sent in records in spite of the gap in publication. The Editor begs indulgence for errors or omissions in the appended list. All notes submitted are filed and add to our knowledge of Norfolk mammals. The classified notes show that many species, including some of the most widespread, need much more routine observation to help build up accurate records. Mammals are certainly more difficult to see than birds, but there are far fewer species to identify! Lack of space forbids a bibliography, but the Editor will be pleased to send a list of helpful literature on finding and identifying mammals or, just as useful, their signs. (s.a.e. please).

The report published on the Otter survey conducted by S. MacDonald and C. F. Mason administered a jolt and must surely make us face up to the desperate situation of this rapidly disappearing carnivore. Intensive research goes on with other species. Red Squirrel carcasses are still required and members finding a dead Badger are requested to cover it and 'phone as below. Collection will be arranged.

Special thanks go to Bill Vaughan, Rex Whitta and Arthur Woodhams for their help in gathering material and to John Goldsmith for acting as scientific right hand. John has kindly agreed to continue as consultant and will deal with queries addressed to him c/o The Castle Museum, Norwich, NR1 3JU. Tel.: Norwich 22233 ext. 649.

Contributions for the 1976 report should be sent to R. C. Hancy, 124 Fakenham Road, Taverham, Norwich, NR8 6QH, by the end of January, 1977.

Classified notes

INSECTIVORA

The thriving **Hedgehog** (*Erinaceus europaeus*) has reached near garden-pet status in some town-fringe areas. Activity has been reported all through the mild winters with road casualties to the end of December. Three observers witnessed the peculiar circling display, one on 8 occasions in the same garden between May and August. The massive totals of **Moles** (*Talpa europaea*) on gibbets previously recorded have not been noted but numbers seem high. On Holme reserve they have worked the mobile dunes and even the upper beach. The few records submitted of **Common Shrew** (*Sorex araneus*) and **Pigmy Shrew** (*Sorex minutus*) cannot give a real indication of status. Two observers feel there have been local decreases. **Water Shrew** (*Neomys fodiens*) have been found dead by the Cromer Lighthouse Station and observed at Cley and Ringland where 5 were seen together in April 1974.

CHIROPTERA

"Maternity colonies" of **Pipistrelle** (*Pipistrellus pipistrellus*) caused their usual flutters but it is pleasing to record more people taking a positive conservation attitude. Mild winter days have seen flights as late as Dec. 23rd (1974) and as early as Jan. 30th (1975). Three bats joined the list of road casualties. A **Long-eared bat** (*Plectolus auritus*) was found at Upper Kelling, a **Natterer's** (*Myotis nattereri*) at Taverham and a **Noctule** (*Nyctalus noctula*) at Morley St. Botolph.

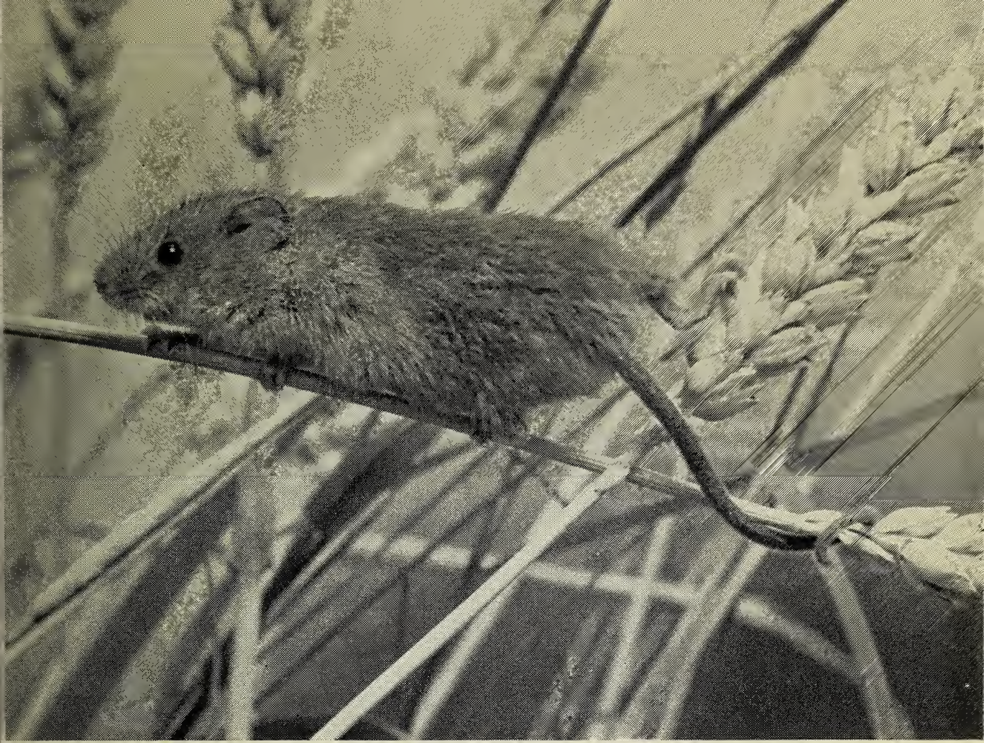
Since our last report, bats have received more favourable publicity and interest has centred on the provision of boxes for summer roosting. The "British First" from Ludham must give heart to those of us who have been unsuccessful. When an ash fell early in 1973, Noctules lost their summer roost. A box was fixed at an equivalent height and after Starlings had raised a brood, Noctules took up residence during July. Numbers reached a peak of 48 on Sept. 3rd. Peaks of 41 were reached in late August in both 1974 and 1975. The large scale experiment being conducted in Thetford Forest has not been running long enough to produce very definite results but signs are cautiously encouraging.

LAGOMORPHA

The continuing series of mild winters and locally increasing resistance to myxomatosis have brought about marked, and in some places serious, increases in **Rabbit** (*Oryctologus cuniculus*) numbers. Myxomatosis has reduced the peaks in many areas but vigorous control has been necessary in many others. There is a problem of balance at Holme—how many should be left to check the Sea Buckthorn, a problem itself? Black, melanistic, rabbits were sighted at Surlingham in June 1973, East Dereham during 1974 and at Shouldham in 1975. The **Brown Hare** (*Lepus europaeus*) still appears to be declining on the central farmlands but holding its own elsewhere. A "notable increase" is reported from the Breydon marshes.

RODENTIA

Bank Vole (*Clethrionomys glareolus*) reports have been few and scattered and prove little beyond the wisdom of checking the cat's catch. Owl pellet analysis can be a useful guide to relative numbers and a series from a Barn Owl roost at Broom contained 10.6% Bank Voles. A further indicator is mentioned in the report from Breydon marshes where the number of Short-eared Owls during 1974 suggested a plentiful supply of **Short-tailed Field Voles** (*Microtis agrestis*). 1974 was a "high"



The partly prehensile tail of the Harvest Mouse, subject of a national survey, is shown to advantage in this photograph by D. Avon and T. Tilford

The sensitive snout, rather than the tiny eyes, of the Common Shrew aid this voracious insectivore in its search for food. D. Avon and T. Tilford

This representative of the elusive Chinese Water Deer came out of its Broadland cover to present this alert pose to D. Woolner

Common Seals were often in the news, with numerous pups beached away from their colonies, like this one at Snettisham. Eastern Daily Press

and the term "plague proportions" was associated with the East Tudenham and Honingham area. In contrast, both Voles were down at Holkham in 1975, the long, dry summer being queried as a possibly explanation.

The return of the **Water Vole** (*Arviola amphibius*) to Breydon after the sixties crash was increasingly noticeable. They are reported rare at Martham, but in 1974 an adult was seen carrying a series of young across the broad close by fishermen's feet. While a 1973 survey tells of only 3 out of 65 field ponds in the Morley St. Botolph area producing positive evidence, the Bure is said to hold good numbers. 12 other sites were reported.

The **Wood Mouse** (*Apodemus sylvaticus*), another important prey species, is generally present and locally abundant. Recent work on the burrowing systems of Woodmice in woodland carried out in this county revealed apparent co-operation in building a multi-exit ring-road system from which a single tunnel led to the nest proper. In this investigation each complex was found under the root system of a hazel tree. Temporarily unused exits were blocked with litter and stones. An associated food store was found with each nest. Hopefully, the enthusiasm engendered by the national search for the **Harvest Mouse** (*Micromys minutus*) will bring in more reports of this tiny, engaging animal. They were consistently present at Horsey on the rougher, uncultivated ground and bred at Holme for the first recorded time. One observer raised an interesting point when he noticed that the Harvest Mice living in a meal shed seemed unaffected by the bait put out to control the over-abundant **House Mouse.** It may be that control of this latter (*Mus musculus*) has been generally effective, or has there been a natural decline? Is this one of the species considered unworthy of mention in notes? We did hear of the 7-metre climb by an individual to the eaves of a red-brick house in Wells.

The **Brown Rat** (*Rattus norvegicus*) is another rodent that can reach spectacular heights, numerically. Local infestations demanding control do not give a balanced view and we need more routine observation. The sets of county-wide road casualty figures from one contributor remind us of the value of these observations and of the survival capability of this animal in all types of habitat, multiplying explosively when conditions are favourable.

The **Coypu** (*Myocastor coypus*) is discussed in our major article.

While the **Red Squirrel** (*Sciurus vulgaris*) delights in many old haunts the "inevitable spread in this county" of the **Grey Squirrel** (*Sciurus carolinensis*), to quote the previous report, proceeds steadily. With so many hands turned against it, the spread may have been less dramatic than expected, but its double breeding season and willingness to traverse stretches of open ground with little cover make containment difficult. In the Stanford Training Area 94 Grey Squirrels were killed during the season ending February 1975 against 31 during the previous comparable season. 5 years before that none had been seen. The establishment of Greys in the area coincided with the outbreak of "Red Squirrel Disease" and the 1969/1970 peak was followed by a massive slump in Red Squirrel numbers. Reports from elsewhere are very mixed. Thursford Woods had a decreasing population of Red Squirrels during 1975 when only a Grey was seen in the old haunts of Reds at Cranworth. On the other hand, in parallel with the increase in Greys, there was a definite upturn in Red Squirrel numbers in Thetford Forest. Reds were more often seen at East Wretham during 1975 after their almost complete absence during 1974, and the Norwich fringe still holds small pockets. The Norfolk Young Naturalists' survey, mainly during 1974, found a red/grey proportion of about 4/1. An unusually dark red squirrel was reported from Aldeby in Sept. and a hardy red forager was about with the temperature at freezing point at Cockley Cley on 14th Dec., 1975.

CARNIVORA

The gradual rise in the **Fox** (*Vulpes vulpes*) population continued. In 1973 a "marked" increase was mentioned from North Norfolk while in the central area the term used was "slight". Another, later report from mid-county spoke of a "floating population, seldom left in peace for long". Records have been county-wide, many in daylight, especially from marshlands. Further records of the pure white individual seen in North Walsham in Oct. 1975 would be welcomed.

The **Badger** (*Meles meles*) has shrunk further into its enclaves, the term strongholds being entirely out of place. Snares and road vehicles contributed to the further decline of this pressured species. A sett reported in Ranworth turned out to be large rabbit burrows, one of which had been used by a fox. More positive encouragement must be given if the Badger is to remain on our list.

The number of **Mink** (*Mustela vison*) caught in coypu traps or sighted are too few for a serious build-up to be indicated and sightings of **Ferret** (*Putorius furio*) suggest a handful of escapees.

The insubstantial body of evidence submitted on the **Otter** (*Lutra lutra*) included, at worst, the adult road victim at Earlham in 1973 and, at best, the cubs seen on the middle Wensum. The impression is that the Otter has declined to a critical level and this was stated strongly and clearly in the paper on the survey mentioned in the editorial. This survey was conducted between Dec. 1974 and July 1975 and found signs of otters at only 32 of the 233 sites visited. These sites were chosen as the most likely places to find spraints, footprints and food remains. Where spraints were found, the quantity, which is cited as being in proportion to the density of population, was found to be low. The total evidence suggested that the county holds an estimated 17 pairs, well below carrying capacity and raises the question of minimum viable population. No single cause of this collapse could be given, but increased disturbance from many sources linked with the extensive removal of river and bank vegetation could be the key.

The immediate help that appears essential could be given by granting complete protection, by sympathetic river management in areas where wood and fen abutt the river to reduce disturbance in lying-up and breeding sites and by providing maximum security refuges at intervals along the rivers.

Stoat (*Mustela erminea*) and **Weasel** (*Mustela nivalis*) appear relatively common in most areas and provide the majority of strange tales, due no doubt to their single-minded ferocity and the hypnotic quality of their movements. A Stoat in full ermine was seen at Saxthorpe and part-ermine at other sites. Two reports speak of stoats running into buildings and one describes an unusual nest in a roof. The first recorded Weasel on Blakeney ternery was seen in 1975.

Seals were again seen along the Yare, most notably the two **Common Seal** (*Phoca vitulina*) at Reedham in November 1974. The small herd at Blakeney is most often reported and reached a high count of 124 on September 19th, 1975. Total numbers are very difficult to estimate and we are again indebted to the Seals Research Division, until recently based at Lowestoft, for their help. Their methods are outlined in the Mammal Report for 1970. The major herd of Common Seal is centred in The Wash and appears to be holding at about 5,000, the no-cull situation of the last two years leading to no apparent dramatic increase. Much more research will be done before the real controlling factors are thoroughly understood. Individuals from this group are almost certainly among those sighted along our north coast and contribute towards the peaks at Blakeney. The two smaller colonies, at Blakeney and on the shifting sands of Scroby, produce a small number of pups each year while total numbers remain constant. **Grey Seal** (*Halichoerus grypus*) continue to breed on Scroby and now produce about 25 pups annually. The only other group is found on the Dogshead Sand in The Wash but is non-breeding. The rapid and wide-ranging movement of the Grey Seal is illustrated by the individual tagged on Scroby early in January which turned up at Egersund, South Norway, just three weeks later.

ARTIODACTYLA

Our herds of **Red Deer** (*Cervus elephas*) have maintained numbers in their breeding areas and wandering parties have been headlined from many parts of the county. Their elusiveness makes it difficult to plot routes or estimate distances covered. The small group which caused over-excitement in Thorpe, Norwich, in November 1975, were believed to be connected with those reported from Stoke Holy Cross periodically. Cranworth, formerly considered out of their usual range, now appears to hold residents. **Fallow Deer** (*Dama dama*) are still in residence round Horsford but more reports flow from the King's Lynn forests where great colour variations are noted. Regular observers of **Roe Deer** (*Capreolus capreolus*) speak of increasing numbers in Breckland and sightings have been made over a wider area. One wandered into commercial premises in Swaffham in May, 1974, and one was shot in Taverham during December 1975. **Muntjac** (*Munticus reevesi*) have been seen more frequently in Thetford Forest and are reported present at Hillington and Hockham Fen.

After the 1973 press appeal had brought in more information, the elusive **Chinese Water Deer** (*Hydropotes inermis*) faded into the background of its Hoveton, Stalham, Ludham centre. Ludham produces the most consistent records of tracks and sightings. One, on several occasions, and later, two, were observed in a field at Catfield during the spring of 1974 feeding on inter-crop weeds. Two adult casualties were found, one a road victim dumped in the hedge on the South Walsham road, the other drowned in a Ludham ditch, where a very young one was found dead on the marsh.

CETACEA

Our few reports of live cetacea were of **Common Porpoise** (*Phocaena phocaena*) and included the sad tale of a young porpoise destroyed on West Runton beach. Dead specimens on the shore were, excepting one south of Waxham, found between Cley and Snettisham. Our only other cetacean report was of the intriguing skeleton of an adult male **White-beaked Dolphin** (*Lagenorhynchus albirostris*) dug from the beach between Holme and South Hunstanton. Detailed examination revealed abnormalities of the spinal column probably caused by an injury or mishap when the animal was much younger. No definite conclusions could be reached, but it seemed reasonable to suppose that the somewhat shortened body of this specimen and its spinal deformities were causally related.

Research on the Control of Coypus — 1973 to 1976

L. M. GOSLING,
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At the time of writing an earlier report in mid-1973 (Gosling, 1974), the East Anglian Coypu population was at the end of a period of rapid increase. The 1,000-2,000 animals that survived the 1969/70 winter had increased to about 10,000 by late 1972. The reasons were complex, but most important was that the springs, summers and autumns of 1971 and 1972 were extremely favourable: coypus were fatter and reproduced more successfully than in any year that we have since recorded. This circumstance conspired with 2 winters that were slightly milder than average to allow a phase of population growth that outstripped the efforts of 6 trappers to contain it. With the benefit of hindsight we now know that a force of this size could only control a population of 2,000-5,000 coypus when assisted by winters of moderate severity.

In response to the increased population, the number of trappers was increased to 15 by the autumn of 1973. Because of financial constraints this number was rather less than we had calculated would be necessary to substantially reduce the population, but we hoped that it would stop the increase which threatened to return to the very large numbers of the late 1950's. This expectation was realised and the population has been contained at about the 10,000 level. In reality this apparent stability conceals a highly dynamic situation: an average of 11% of the adult females litter each month and about 9% of the total are killed each month. These data give an idea of the rapid turn-over within the population so that it is rather surprising that stability, rather than an increase or decline, was achieved. In fact the stability is only relative and each year there are considerable seasonal fluctuations from a minimum in the spring to a maximum in the winter. The later winter reduction is due to effective trapping in the winter when the die-off of fen vegetation reveals runs and other evidence of coypu presence, and when littering and juvenile survival are at minimum values. The gradual climb during the summer is a result of more successful breeding and slightly less effective trapping.

Apart from some early use of snares and gin traps, all coypu control has been by cage trapping. Animals are live trapped and shot when the traps are inspected on the following morning. This method has the advantages of being humane and of avoiding any chance of harming non-target species such as otters. It is also an effective control method as shown by the decline of coypus from 1965 to 1970. It failed to control coypus in 1971 and 1972 only because we did not know what intensity of control to apply under these conditions. Accordingly the research effort at the Coypu Research Laboratory has been directed towards achieving a better understanding of coypu population dynamics and the ability to predict change in numbers and the impact of different trapping intensities. At the same time we have started a programme of operational research aimed at a detailed understanding of the effect of trapping in a 28 km^2 area of coypu habitat.

Our approach to predicting numbers has been through the construction of a computerized simulation of the coypu population. Simulations are a variety of population model that attempt to incorporate as much detail as possible about the dynamics of the population and which function in a similar way to a living population; that is, with continual births and deaths that vary in quantity with season and other environmental changes. The data that we need for the model are obtained from detailed dissections of about 90 adult coypus each month. From these we obtain estimates of such variables as the proportion of adult females that litter each month and the mean litter size at birth.

These results frequently conform to the average picture that we have measured over the past 6 years, but sometimes unprecedented events occur. An example was the major spring breeding peak that occurred in 1974 and 1975. A few births nor-normally occur at such times, but few females, except the minority that are over 18 months old, manage to maintain their preganancies after winter conceptions that follow the usual late autumn birth peak. However, the extra-ordinarily mild winters of 1973/74 and 1974/75 allowed many females to do this and large numbers of young were born in the following springs. Fortunately for the control operation, the remaining summer months provided less optimum breeding conditions than the classic summers of 1971 and 1972, so that in the end there was only average production of young. The cold spells in the winter of 1975/76 resulted in the abortion of most pregnancies and as a consequence we do not expect large numbers of young to be born until June and July.

Measured data, such as those described on breeding and the numbers killed each month are entered into the simulation and the output of the model, the monthly change in the size of the live population, is checked against a period of known popuation changes. We can then enter average, maximum and minimum values and use the model predictively to see what the result of current trends would be and also examine the effect of increasing or decreasing future mortality rates through change in the size of the trapper force.

The simulation is still being modified as we appreciate the need to incorporate additional factors. At present the main problem is to estimate the number of non-trapping deaths; natural predation undoubtedly accounts for a number of young and we now know that the dogs owned by reed cutters kill significant numbers. However interim corrections for these deaths have allowed us to use the simulation for recommendations about future control intensity. If the present trapping force is maintained it seems likely that coypus will be reduced to about 3,000 animals by the spring of 1977.

In conjunction with these efforts to determine the future trapping intensity, there has been an attempt to deploy the trapping force in a fashion that furthers the primary aim of reducing the total population size, rather than attempting to clear small sites of minor infestations. These two objectives are of course related, but an overall strategy should attempt to reduce the occurrence of minor outbreaks through a total reduction rather than through the opposite course of action. In terms of coypu population dynamics the objective thus becomes to kill the maximum number of animals in the shortest time possible. To achieve this aim we use 10km Ordnance Survey grid squares and for each, calculate an infestation index from the relationship between the number of coypus killed and man-weeks worked over the preceding year. The magnitude of the index is then used to simply calculate the amount of effort that should be applied in each square over the coming next three months. This procedure forms the basis of the broad strategy although it's requirements are intended to be modified by common sense field evidence. This approach has been in operation since late 1975 and there are clear indications that it has resulted in a higher kill per unit effort than in the past.

Parallel with these developments, the Coypu Laboratory has assumed control of the River Yare from Norwich to Reedham since June 1975. At the time of writing in May 1976, the 3 trappers working from the Laboratory have completed two rounds of the area and have accounted for about 1,600 coypus. This kill rate reflects a higher trapping intensity than was possible in the past and our results suggest that a significant reduction in numbers has been achieved. The aim of this work is to monitor in detail the effect of high intensity control and to examine the effect of treatments at known intervals. A large proportion of the animals killed is brought to the Laboratory for dissection and the results obtained are used to assess the progress of the work. Records of the habitat in which each animal is caught also allows us to measure the impact of control in relation to the strikingly different habitats in which coypus live: to date these results confirm the general impression that coypus are more easily kept at low levels on grazing marsh than in areas of fen and reed swamp; more detailed analyses are in progress.

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Norfolk Naturalists' Trust Properties

Date Acquired		Acreage		Status*
	On the Coast			
1926	Cley Marshes	435	Gift	S.S.S.I.†
1937	Duchess's Pightle, Burnham Overy ..	1	Gift	——
1937	Great and Little Eye, Salthouse ..	10	Purchased	S.S.S.I.
1945	East End of Scolt Island	76	Purchased	N.N.R.
1955	The Eye, Salthouse	21	Purchased	S.S.S.I.
1965	Holme Dunes	400	Purchased, Gift & Agreement	S.S.S.I.
1971	Salthouse Marshes	200	Agreement	S.S.S.I.
	Broadland			
1928 and 1974	Starch Grass (Martham)	43½	Purchased & Gift	S.S.S.I.
1930	Alderfen Broad	72	Purchased	S.S.S.I.
1945 and 1969	Hickling Broad	861	Purchased	N.N.R.
1945	,, ,, ...	500	Leased	N.N.R.
1945	Barton Broad	355	Half Gift &	S.S.S.I.
1952	,, ,, ...		Half Purchased	S.S.S.I.
1948	Surlingham Broad	253	Purchased	S.S.S.I.
1949	Ranworth Broad	124	Gift	N.N.R.
1949	Cockshoot Broad	12	Gift	N.N.R.
1964	Firs Marsh, Burgh St. Peter	2½	Leased	——
1971	Martham Broad	103	Leased	S.S.S.I.
1972	Hardley Flood	90	Leased	——
1972	Chedgrave Common	10	Leased	——
1974	Barton Marshes..	10¼	Gift	——
	Breckland			
1938	East Wretham Heath	362	Purchased & Gift	S.S.S.I.
1942	Weeting Heath	343	Gift	N.N.R.
1949	Thetford Heath	250	Gift	N.N.R.
	Other Areas			
1957	Thursford Woods	25	Gift	——
1960	Hethel Old Thorn	⅛	Gift	——
1961	Scarning Fen	10½	Gift	S.S.S.I.
1962	Hockham Fen (Cranberry Rough) ..	20	Purchased	S.S.S.I.
1963	Roydon Common	140	Purchased	S.S.S.I.
1966	Stoke Ferry Fen	25	Agreement	S.S.S.I.
1968	Lenwade Water	37	Agreement	——
1968	Dickleburgh Pightle	1	Agreement	——
1972	Smallburgh Fen..	19	Leased	S.S.S.I.
1972	Ringstead Downs	26	Agreement	S.S.S.I.

1973	East Winch Common	80	Gift	S.S.S.I.
1974	Sparham Pools	30	Agreement	——
1974	Buxton Heath	159	Agreement	S.S.S.I.
1975	Pope's Drift	8	Agreement	——
1975	Wayland Wood	80	Purchase	S.S.S.I.

In addition, the Trust shares with the National Trust in the management of the coastal reserve at Blakeney Point (1,335 acres), and it manages Arnold's Marsh, Cley (29 acres) on behalf of the National Trust.

By arrangement with the Nature Conservancy Council, Scolt Head Island, Ranworth Broad, Hickling Broad and the Breckland Heaths now form part of the National Nature Reserves.

*Status: N.N.R. denotes National Nature Reserve
S.S.S.I. „ Site of Special Scientific Interest

†In 1966 Cley Reserve was established as a Bird Sanctuary under the Protection of Birds Act, 1954.

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TRANSACTIONS
OF
THE NORFOLK & NORWICH NATURALISTS' SOCIETY

Vol. 24 PART 2

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TRANSACTIONS OF THE NORFOLK & NORWICH NATURALISTS' SOCIETY

Volume 24, Part 2 (April 1977)

Editor: Dr. E. A. Ellis

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THE DECLINE IN BROADLAND'S AQUATIC FAUNA AND FLORA: A REVIEW OF THE PRESENT POSITION

Read by the President, Dr. M. George to the members of the Norfolk and Norwich Naturalists' Society at a meeting held in the Central Library Lecture Theatre, Norwich, 3 December 1976

Introduction

During the past few years naturalists and lovers of Broadland have been dismayed by the widespread losses of aquatic plant and animal life, the outbreaks of avian botulism, the periodic fish kills and other signs that all is not well in the region. Some of these ecological changes have already been described, for example by Morgan (1972) and by Mason and Bryant (1965), but their interrelationships both with one another, and with contemporaneous changes in Broadland's physical environment are only now beginning to emerge. Figure 1 represents an attempt to portray diagrammatically some of the complicated "cause and effect" inter-reactions which are believed to be occurring.

Although we are not yet in a position to produce a comprehensive synoptic account of the way in which the ecology of the region is being affected by natural processes, by the increasing recreational pressure on the waterways, and other alterations in the pattern of land use, I thought it might be useful if I gave an interim review of the scope, probable causes and effects on wildlife of the principal changes taking place. I also propose to refer to some of the research which is being carried out to improve our understanding, both of the processes concerned, and the ways in which matters could be put right.

Ecological Monitoring

Attempts to assess and monitor the ecological changes taking place in an area are all too often frustrated by the absence of reliable information about what it was like in the past. In general, Broadland is well documented and Dr. Ann O'Riordan, who examined the literature about the region for the Nature Conservancy Council (NCC) in 1975/76 has produced over 500 abstracts. These are proving of great value to those working on the ecology and geography of the region. Nevertheless, there is a dearth of quantitative as distinct from qualitative date about the fauna and flora of the region.

Very little is known, for example, about the relative abundance of the different macrophytes which grew in the various broads, although the species present were often carefully recorded by earlier workers.

Despite the paucity of detailed ecological information it is known that many of the changes which have taken place have not done so uniformly. Aerial photographs show, for example, that Cockshoot Broad lost almost all its marginal reedswamp between 1956 and 1962 (see plates 1 and 2), whilst that in the Ormesby, Rollesby, Filby group of broads does not appear to have regressed at all during the past twenty-five years (Clarke in litt). Similarly, both Morgan (1972) and Mason & Bryant (1975) have pointed out that macrophytes ceased to grow in some broads much earlier than in others.

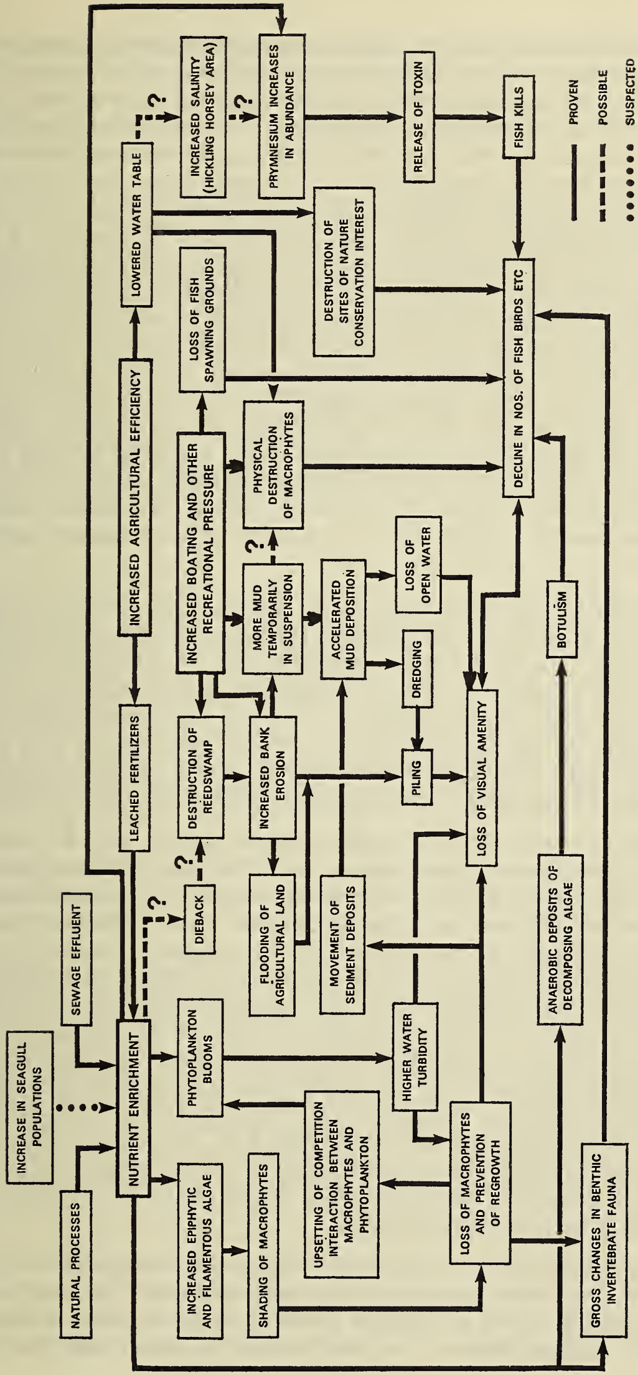
In order to find out more about the rate at which such changes have been taking place, and if possible relate this information to physical factors such as the increasing number of boats in use on the waterways, bank erosion, dredging and piling, the NCC has recently awarded a short term contract to Michael Jackson, a graduate from the University of East Anglia. He is studying not only the literature, but unpublished information contained in, for example, the diaries kept by the late Robert Gurney between 1921 and 1929, and the records kept by the NCC, the Anglian Water Authority (and its predecessor the East Suffolk and Norfolk River Authority) and the River Commissioners.

Another short term contract has recently been awarded by the NCC to Robert Driscoll to investigate, *inter alia*, the status of the brackish water fauna of the lower reaches of the Broadland rivers; this was described by Robert Gurney in a series of papers published in the Transactions between 1900 and 1930, but has not been studied in any detail since then. The information collected by Driscoll will confirm whether this fauna has, as we suspect, been adversely affected by eutrophication, intensive recreational use and other factors; it will also be of value in connection with the Yare Basin Flood Control Study now being carried out by Consultants for the Anglian Water Authority's Norfolk and Suffolk Land Drainage Committee.

Open Water Habitats in Broadland

Numerous writers, for example, Jennings and Lambert (1949) and Ellis (1965) have referred to the reduction in the amount of open water which has occurred in the region as a result of the overgrowth of the broads by marginal reedswamp. The rate at which this has occurred has varied from site to site. For example, according to figures given in the Report on Broadland (1965) Ranworth Broad shrank in size from 57 ha. in 1840 to 20 ha. in 1946, a 65% reduction, whilst during the same period, Barton Broad decreased in size from 115 ha. to 66 ha.

Although the total amount of water in Broadland declined from 1,200 ha. in the 1880's to 700 ha. in the 1940's, the amount increased somewhat during the 1950's as a result of the grazing pressure exerted on marginal reedswamp vegetation by numerous coypus (Ellis 1965). Ranworth Broad, for example, increased in size by about 4 ha. between 1946 and 1962. With the substantial reduction in the numbers of coypus during the hard winter of 1962/63, and the subsequent control exercised on the population by trapping, these animals are probably not sufficiently numerous significantly to affect the total amount of open water in Broadland. Nevertheless some indication of the biotic effect of these animals can be gauged from the fact that the annual production of the reedswamp at Alderfen Broad was reduced as a result of coypu grazing from 12.3 tonnes dry weight in 1972 to 6.3 tonnes dry weight in 1973 (Mason 1976).



NATURAL PROCESSES
INCREASE IN SEAGULL POPULATIONS
SEWAGE EFFLUENT
NUTRIENT ENRICHMENT
LEACHED FERTILIZERS
INCREASED AGRICULTURAL EFFICIENCY
LOWERED WATER TABLE
INCREASED EPIPHYTIC AND FILAMENTOUS ALGAE
PHYTOPLANKTON BLOOMS
DIEBACK
?
DESTRUCTION OF REEDSWAMP
?
INCREASED BOATING AND OTHER RECREATIONAL PRESSURE
LOSS OF FISH SPAWNING GROUNDS
?
INCREASED SALINITY (HICKLING HORSEY AREA)
SHADING OF MACROPHYTES
FLOODING OF AGRICULTURAL LAND
INCREASED BANK EROSION
MORE MUD TEMPORARILY IN SUSPENSION
?
PHYSICAL DESTRUCTION OF MACROPHYTES
?
PRYMNESIUM INCREASES IN ABUNDANCE
UPSETTING OF COMPETITION INTERACTION BETWEEN MACROPHYTES AND PHYTOPLANKTON
MOVEMENT OF SEDIMENT DEPOSITS
ACCELERATED MUD DEPOSITION
DESTRUCTION OF SITES OF NATURE CONSERVATION INTEREST
HIGHER WATER TURBIDITY
PILING
DREDGING
LOSS OF OPEN WATER
RELEASE OF TOXIN
LOSS OF MACROPHYTES AND PREVENTION OF REGROWTH
LOSS OF VISUAL AMENITY
DECLINE IN NOS. OF FISH BIRDS ETC
FISH KILLS
ANAEROBIC DEPOSITS OF DECOMPOSING ALGAE
BOTULISM
GROSS CHANGES IN BENTHIC INVERTEBRATE FAUNA
PROVEN
POSSIBLE
SUSPECTED

FIG. 1

Many of the broads are now much shallower than they used to be. This is inevitable given their artificial origin and that fact that they lie in close proximity to rivers carrying heavy sediment loads. Nevertheless, there is some evidence that the rate of mud deposition is accelerating. At Barton Broad, Osborne and Moss (1977) have shown that this varied from 1.2mm to 3.1mm a year between 1720 and 1950, but that thereafter the rate of deposition rose to about 5mm. a year during the 1950's, c.10mm during the 1960's and c.12mm a year during the 1970's. Osborne and Moss point out that the rate of deposition is now so large that it cannot be ascribed to the increased rate of phytoplankton production in the Broad. Furthermore although phosphate-rich sediments discharged from sewage treatment works into the river Ant upstream of the Broad are probably being deposited in the latter, these too can only be providing a relatively small contribution. In the circumstances, Osborne and Moss believe that much of the sediment is derived, firstly from the breakdown of the reedswamp around the Broad, and secondly from material eroded from the banks of the river Ant upstream of the Broad; this is caused by the wash produced by large numbers of motorcraft, and by vessels moored alongside the banks. Whatever the sources of the sediment, Oxborne and Moss' results suggest that Barton Broad will by 2025 have ceased to exist as we know it today unless remedial measures are put in hand.

To a limited extent such measures are already being taken by the Rivers Yare, Bure and Waveney Commissioners. The navigable channels across Barton Broad are currently being dredged by this Authority, whilst several other broads open to public navigation have been dredged in the past. According to figures kindly made available to me by Mr. C. Groves, the Commissioners' Rivers Manager, these include Malthouse Broad, where 118,220 tons were removed between 1961 and 1967, South Walsham Broad and Fleet Dyke (172,820 tons between 1960 and 1965) and Horsey Mere (123,800 tons between 1966 and 1970).

The environmental effects of mechanical dredging are not well understood, but research carried out in Lake Herman, South Dakota, USA, suggests that the rate of nutrient release increases, at least temporarily, as a result of the disturbance caused and the exposure of deposits below the mud surface Dunst et al (1974). Where it is necessary to minimize nutrient release, for example, in broads of particular ecological importance, it will almost certainly be desirable to use suction dredgers. Such machines have been extensively employed in Sweden and elsewhere but have not been widely used in Broadland mainly because they are slightly more expensive to use than mechanical dredgers (Groves pers.comm). One was used experimentally by the East Suffolk and Norfolk River Board at Rockland Broad between September 1959 and April 1960, but did not give satisfactory results. However in 1975 a "Mud Cat" was successfully employed by Mr. Colin Chapman to renovate a small broad and other water bodies at Brundall. The site is now being monitored as part of the NCC's commissioned research programme on eutrophication.

Conscious of the need to safeguard as much open water habitat as possible the NCC has given much attention to the maintenance of the dyke system in the Woodbastwick section of the Bure Marshes National Nature Reserve. As a result of past neglect this was in a near derelict condition when this site was established as a reserve in 1958 and very little aquatic plant and animal life remained. During the past seven years a substantial number of dykes have been restored by means of a Sykes 5in. Univac pump mounted on a pontoon and many of the cleaned out dykes have developed a luxuriant stand of macrophytes together with a good benthic invertebrate fauna.

Peat was still being dug from shallow (c.1¼m. deep) excavations in the fens until the end of the 19th century, and the flooded workings, known as turf ponds, were colonised by macrophytes before being occluded by reedswamp peat (Lambert and Jennings 1951). Being of substantial size (for example 27% of the area known as Woodbastwick Fen consisted of open water in 1845 (George 1976a)) these turf ponds would undoubtedly have supported a wealth of aquatic plant and animal life. Apart from examples at Ranworth Flood, Reedham Marsh (opposite How Hill) and near Catfield Hall, very few of these water bodies now survive in Broadland and those that do have largely lost their macrophytes and benthic invertebrates. In an attempt to provide conditions suitable for the re-establishment of this flora and fauna a small relict turf pond on the Bure Marshes National Nature Reserve has recently been mud pumped.

There is no doubt that the shallowing of the broads, the near derelict condition of the majority of the dykes cut in the adjoining fens, and the occlusion by peat of all but a few relict turf ponds, has been accompanied by a substantial impoverishment of Broadland's aquatic plant and animal life. However it is often difficult to decide whether the decline in the status of a species can be attributed to the natural processes associated with the senescence of the broads and man made waterways, or whether other factors, such as lack of management or eutrophication, are at least partly responsible. In many cases losses can be attributed to a combination of circumstances. The endemic damselfly—*Coenagrion armatum* for example, which used to occur near Sutton Broad, and at one or two other sites, and which was looked for in vain by a team of entomologists in 1974 and 1975, is believed to have become extinct, because the relict turf ponds and dykes once frequented by its nymphs, have, as a result of natural processes and lack of management, become infilled by peat and mud respectively; they have also probably been adversely affected by eutrophication.

Outbreaks of avian botulism have been recorded from many parts of the world and are characteristically associated with prolonged spells of warm sunny weather, and the presence of extensive areas of shallow, stagnant water in which oxygen levels have been depleted by accumulations of rotting vegetation or other organic material (Smith 1976). During the past ten to fifteen years habitat conditions in Broadland have become increasingly well suited to the causative bacterium (*Clostridium botulinum*) and it comes as no surprise that the organism has now been recorded from a large number of different sites in Broadland (Borland et al 1977). Conditions suitable for the multiplication of the bacterium, and the subsequent release of its toxin, have occurred every year since 1969, with the exception of 1972, and were responsible for the deaths of over a thousand waterfowl in both 1975 and 1976 (Lloyds et al 1976). Unfortunately, the only known methods of controlling further outbreaks of avian botulism, namely the removal of mud from all the infected broads, and the raising of water levels would respectively be prohibitively expensive or impracticable. However research being carried out by Dr. G. R. Smith of the Nuffield Institute may lead to the development of more practicable methods of control. In the meantime steps have been taken to set up a number of centres where birds affected by the disease can be rehabilitated (NCC 1976).

As a result of the investigations carried out for the NCC between 1972 and 1976 by Robert Driscoll, we now know that the most important remaining refuge for aquatic plants and invertebrates left in Broadland is the extensive system of dykes associated with the 20,250 ha. of reclaimed marshland. Parts of this system have been adversely affected by eutrophication, by saline water infiltration and by unsympathetic forms of management, but other areas still possess a remarkably rich diversity of aquatic species including national rarities such as Sharp-leaved Pondweed (*Potamogeton acutifolius*) and the dragonfly *Aeshna isocoles*. The survival of this fauna and flora can be attributed firstly to the fact that unlike the fenland waterways, aquatic herbicides have not displaced mechanical methods of dyke management, and secondly, that since most of the marshes are still used for pasturage, the majority of the dykes are kept fairly full of water in order to prevent cattle straying from one place to another.

Agricultural improvement, involving the conversion of the marshland to arable, and the subsequent cropping of the land for cereals, root crops or grass for sileage, usually involves the lowering of the water levels in the dykes. Driscoll (1977) has shown that this is soon followed by the impoverishment of their aquatic fauna and flora; this is caused partly by the more frequent cleaning out of the dykes, and partly by the fact that the remaining water in the latter receives relatively larger quantities of fertilizers and/or herbicides leached from the adjoining land. Salinities in some dykes also tend to rise as a result of the leakage of brackish water through the flood banks of the rivers.

Studies carried out by Rendel, Palmer and Tritton (1977) in connection with the Yare Basin Flood Control Study show that of the c.16,000 ha. of marshland which have potential for agricultural improvement, about 3,500 ha. have already been reclaimed, and that a further c.1,200 ha. are in the process of being improved. Of the c.11,300 ha. of unimproved grassland which remains, a further 1,200 ha. are likely to be improved; however the management of the remainder will probably remain unchanged unless measures are taken to remove, or at least limit, the risk of flooding, particularly by saline water.

The Loss of Marginal Reedswamp

Marginal reedswamp was formerly of widespread occurrence in Broadland, but since the Second World War it has largely disappeared from the broads associated with the rivers Bure and Ant. This is of considerable ecological significance as the invasion of open water firstly by Lesser Reed Mace (*Typha angustifolia*) and Bulrush (*Schoenoplectus lacustris*), and later by Reed (*Phragmites australis*) in the manner described by Lambert and Jennings (1951) no longer occurs. As a result the open water of these broads is now characteristically bordered by tussock fen communities rather than by *Phragmites*—dominated reedswamp. Although marginal reedswamp has not regressed to the same extent in the river Thurne broads as in those associated with the rivers Ant and Bure, many of the

Plate 1. Cockshoot Broad — (Bure Marshes NNR) — Oblique air photograph taken in May 1956. Note good development of marginal reedswamp, particularly on north western (unshaded) side of broad.

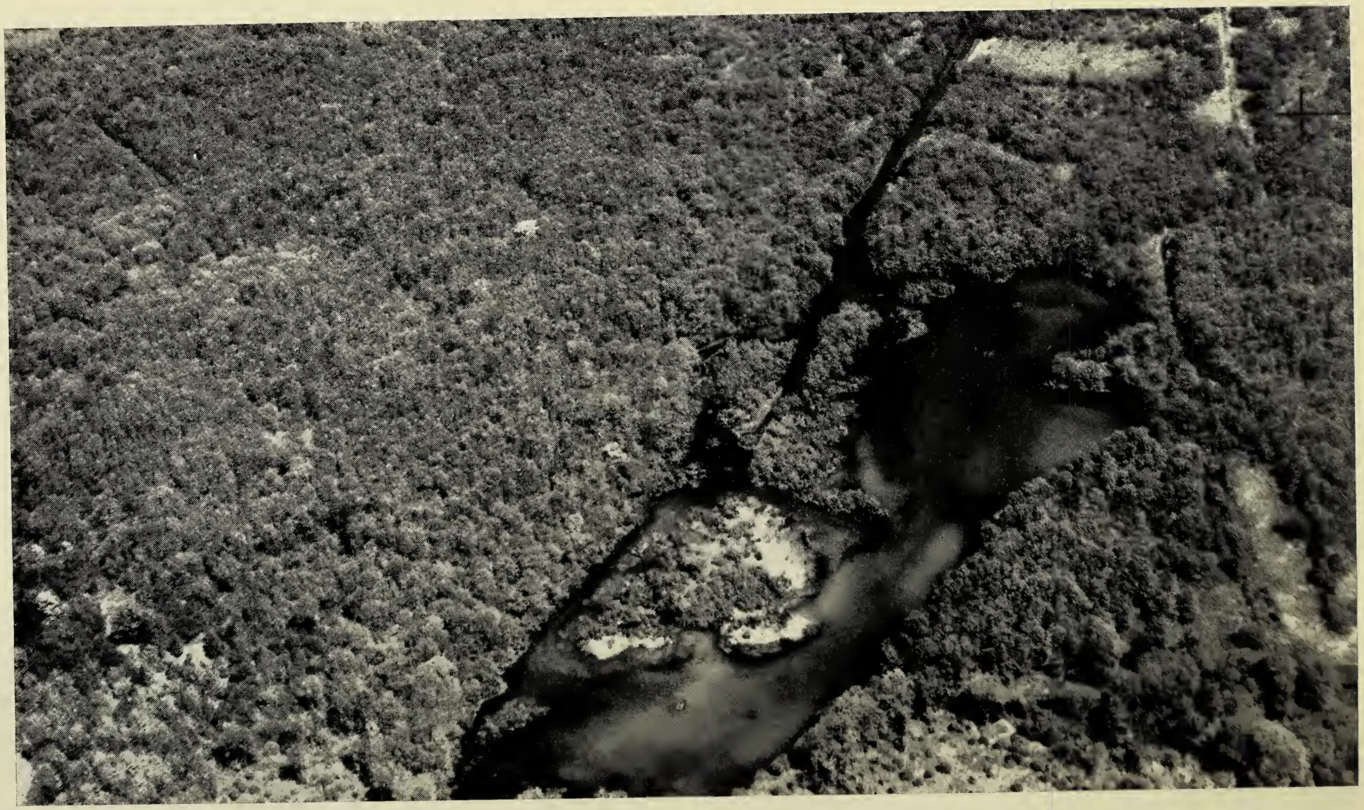


Plate 2. Cockshoot Broad — (Bure Marshes NNR) — Oblique air photograph taken in June 1962. Note that virtually all the marginal reedswamp has disappeared as a result of 'dieback'.

Photographs reproduced with the permission of Professor J. K. St. Joseph, Director in Aerial Photography, Cambridge University.

reedbeds around the margin of Hickling Broad which were formerly harvested regularly, are no longer worth cutting because of their invasion by Bent Grass (*Agrostis stolonifera*) and the depauperate growth of the reed plants during the past three or four years (Beales, pers. comm).

Lambert (1946) has pointed out that in the Yare broads, where the marginal vegetation is dominated by *Glyceria maxima*, *Phragmites* tends to occur only in land-locked pools and as a narrow fringe to the outer, tidally-scoured, edges of the floating rafts formed by *Glyceria.* In these habitats, however, the stands of reed underwent a marked regression during the early 1950's (Ellis pers. comm)

The factors affecting the performance of *Phragmites* have been extensively studied and a voluminous literature exists on the subject; this is listed by Haslam (1972a). In addition to edaphic factors like water regime, temperature and light, this species is affected by numerous biotic influences such as grazing both by coypus and by swans, geese and other waterfowl, trampling, and by the mechanical damage caused by boats being driven into, or moored alongside the marginal vegetation. Observations have shown that all these factors are having an adverse effect on reedswamp in Broadland; so also has shading, which has increased as a result of the growth of trees beside the waterways, particularly where these traverse areas of unreclaimed fen. The relative importance of these factors varies from site to site. Furthermore in many places the marginal reedswamp becomes impoverished, or even disappears altogether for no apparent reason. Whilst it is convenient to use the phrase "dieback" to describe this phenomenon, it is by no means clear what combination of factors is responsible for it.

Although it has been claimed by some continental workers that eutrophication can adversely affect the performance of *Phragmites*, there is as yet no hard evidence for this in Broadland; indeed Haslam (1972b) points out that reed growth becomes taller as the nutrient input increases. Dieback has not been confined to broads used for public boating; it is for example largely absent, not only from Wroxham and Malthouse Broads, but from Hoveton Great and Ranworth Broads, both of which are closed to the general public. Although it would appear from this that the two factors found by Sukopp (1971) to be responsible for the loss of reedswamp from the Havel lakes in West Berlin, namely excessive boating pressure and trampling, are of lesser importance in Broadland, it must be borne in mind that recreational pressure on the Havel lakes is far in excess of anything encountered in Broadland.

Different clones of reed seem to vary in their susceptivility to dieback. Particularly good examples of this were noticed on the river Yare near Reedham in September 1976. In some places the shoots were similar in number and stature to those produced in 1975; a few hundred metres away, however, the growth was relatively depauperate, the shoots being fewer in number and up to half a metre shorter than those of the previous year.

Since reed will not grow in Broadland in water whose depth exceeds about one metre, the width of the reedswamp growing beside a waterway is dependant on the profile of the latter; the gentler the gradient of the batter, the wider the reedswamp fringe. The River Commissioners are aware of this, and aim, when dredging a river to provide a profile of the type shown in Figure 2. In practice most rivers in Broadland have a profile more nearly resembling that shown in Figure 3. In such situations only a very limited area is suitable for the growth of reed. As a result the reedswamp fringe is very narrow and the aerial shoots of the plants are liable to be physically damaged either by wave action or by passing boats. The steep profile also makes the reedswamp susceptible to undermining by the wash generated by boat traffic; this ultimately results in blocks of reedswamp being washed away.

Marginal reedswamp is of very considerable environmental importance. Not only does it form a habitat for species like Reed and Sedge Warbler, Bearded Tit, Coot, Great Crested Grebe and other waterfowl, but as Mason (1976) has pointed out, it may, by absorbing large quantities of nutrients in the spring, and not releasing these until the winter, be fulfilling a useful role as a nutrient regulator.

A broad band of reedswamp also helps to prevent bank erosion, since the closely spaced aerial shoots of the plants cushion the effects of wave action. If the reedswamp is too narrow or if it becomes impoverished as a result of dieback, bank erosion accelerates; in places where the waterway adjoins reclaimed marshland it may then be necessary to provide piling to protect the floodbanks and thus obviate the risk of flooding. In places where there is no flood bank, or where the river is bordered by a wide "rond", the river gradually widens as a result of bank erosion; this increases the amount of sediment in the river, and in narrow heavily used waterways where the muddy bottom deposits are constantly being stirred up, this adds to the turbidity of the water (Moss pers. comm).

Because of the heavy cost, and unattractive "canalised" appearance of piling, the Anglian Water Authority are, in conjunction with the NCC, carrying out some experiments on the river Thurne a short distance upstream from Thurne Mouth designed to find out whether it is possible to re-establish marginal reedswamp. The work will involve reprofiling the river to give a gently sloping batter; reed will grow on the upper parts of this, and where the water depth exceeds about $1\frac{1}{4}$m.the Anglian Water Authority will be trying out various mechanical methods of increasing the resistance of the muddy peat to wave action, and thus preventing the undercutting of the marginal reedswamp.

Other experimentation, notably in relation to the causes of reedswamp dieback, is currently being planned by the NCC.

Eutrophication

It has become apparent, largely as a result of the research carried out during the past few years by Dr. B. Moss and his team at the University of East Anglia, that the Broadland waterways have, in common with many other water bodies both in this country and abroad, become affected by eutrophication. The most obvious symptoms of this phenomenon is the appearance in the water of dense stands of phytoplankton which increase the turbidity of the water and give it a greenish or brownish tinge. The oft repeated statement that the germination and growth of macrophytes is inhibited because the phytoplankton prevents sufficient

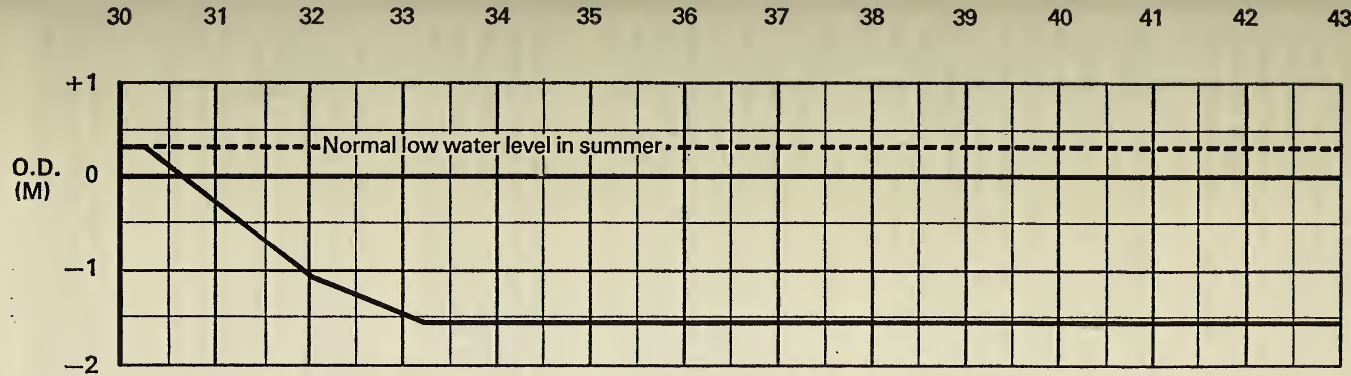


FIG. 2 Normal Dredging Profile used for the North rivers of the Rivers Yare, Bure & Waveney Commissioners. Note that in theory this would permit the development of a band of reedswamp c.2m. wide.

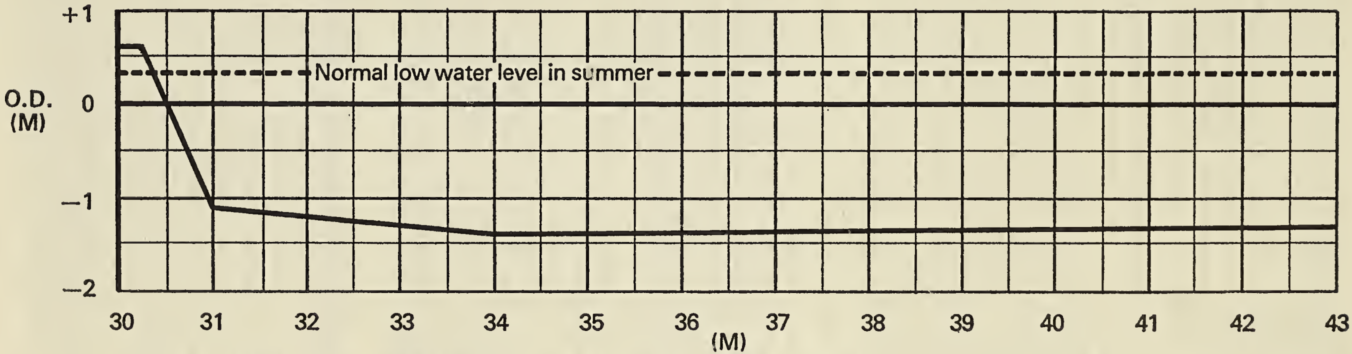


FIG. 3 Profile (CS4) of right bank of River Thurne about half a mile north of Thurne Mouth - Sept. 1976. Note that in theory and in practice this is only capable of supporting a band of reedswamp c. ¾ m. wide.

light reaching these plants and their propagules is probably an over-simplification and Phillips et al (1977) have recently drawn attention to the role which epiphytic diatoms play in this regard. Another symptom of eutrophidation is the loss of diversity in the invertebrate fauna; this too has occurred in Broadland, tubificid worms and midge larvae having largely replaced the varied fauna of leeches, water snails, small crustaceans and numerous other animals which used to occur in the region's waterways.

The eutrophication of the Broadland waterways has been caused by the fact that they are now receiving excessive quantities of nitrates and phosphates. These are derived partly from natural processes, partly from treated sewage effluent and partly from leached agricultural fertilizers; there is some evidence that nutrient rich slurry from piggeries and intensive dairy units is in some places also finding its way into the waterway system. The relative proportions of the nutrients derived from these sources vary from river to river and can only be determined by compiling a nutrient "budget". This involves calculating the input and outflow of nutrients from a waterway, and assessing the amount being utilized by living organisms; in this latter respect the standing crop of algae is of particular importance.

The nutrient budget produced by Osborne and Moss (1977) for Barton Broad suggests that 73% of the phosphorus reaching this site emanates from the North Walsham and Stalham sewage treatment works and that a substantial improvement in the ecological condition of the broad would be achieved if the concentration of phosphates in these effluents could be reduced before they were discharged. Osborne and Moss claim that a diverse community of macrophytes similar to that growing in the broad at the end of the Second World War would reappear if 70% of the phosphates were removed from the effluent, and that some water weeds would recolonize the site even if the concentration could only be reduced by 25%.

Osborne and Moss point out that the flushing effect of the river Ant as it flows through the broad results in nutrients being discharged with the outflow from the latter at a fairly rapid rate. Most broads, for example Wroxham, Hoveton Great, Ranworth and Rockland, are not flushed out to the same extent, and would therefore not respond so quickly as would Barton Broad once the incoming phosphorus load had been reduced.

Experience in Sweden, for example at Lake Trummen, suggests that if such broads are to be restored to their former condition it may be necessary to remove the accumulations of nutrient rich mud with a suction dredger. The investigations being carried out at Brundall Broad, which are described by George (1976b) should show how quickly a mud-pumped broad, which has been physically isolated from an adjoining nutrient rich river, is recolonized by macrophytes and benthic invertebrates. Other water bodies at Brundall which have been mud pumped but which remain in communication with the river Yare are serving as a control to these experiments.

The mud pumping carried out on the dyke system of the Bure Marshes NNR has already yielded useful information about the techniques which can be used to rehabilitate open water sites affected by eutrophication. Dykes which have been mud pumped and which, because they are blind-ending, receive a negligible amount of nutrient-rich water from the river Bure, have been colonized by a diverse assemblage of macrophytes, whilst those dykes which have been similarly treated, but which carry a flow of nutrient-rich water, remain turbid with phytoplankton and are almost devoid of macrophytes. Dams aie now being provided at most of the points where water from the river formerly entered and left the dyke system, and it will be interesting to see whether dykes affected by eutrophication are recolonized by macrophytes and benthic invertebrates once the flow of nutrients into them has been reduced.

Unlike the broads associated with the rivers Yare, Bure and Ant, the great majority of which have been affected by eutrophication since the 1950's, or even earlier, Hickling Broad, Horsey Mere, Martham Broad and other waterways associated with the river Thurne, remained in excellent condition until 1969. In that year, however, the water, first in Horsey Mere, and a few months later, Hickling Broad, lost its limpid clarity and became turbid with phytoplankton. More or less simeltaneously a very serious fish kill took place; subsequent investigations by staff of the East Suffolk and Norfolk River Authority showed that this was caused by toxin released by *Prymnesium parvum*, a common constituent of the phytoplankton found in these, and more recently certain other broads.

Subsequent events did nothing to allay the anxiety felt by conservationists about the condition of Hickling Broad and Horsey Mere. There were further fish kills in 1970, 1973 and again in 1975 (Wortley 1976a); meantime ecological surveys were showing that macrophytes had largely disappeared from both sites, and that the formerly diverse benthic invertebrate fauna was being replaced by chironomid larvae and tubificid worms.

In May 1974, the Norfolk Naturalists' Trust understandably concerned that such changes were taking place in Broadland, and more especially at Hickling Broad, a site which it had safeguarded since 1945 and which had been formally declared as a National Nature Reserve in 1958, drew public attention to the problem in a Press Release. The Trust took the opportunity to urge that the NCC and the Anglian Water Authority should mount a research programme aimed at identifying the factors responsible for the changes, and formulating remedial measures.

Both organisations responded to this request, the NCC's and the Anglian Water Authority's research having been described by George (1976b) and by Wortley (1976b) respectively.

The research commissioned by the NCC from the University of East Anglia involves the installation of two Lund tubes—each 20m in diameter, and other experiments at Heigham Corner in Hickling Broad, the object being to determine the relative importance of nutrient-loading, surface instability of the mud and mechanical damage by boat propellers as factors likely to be responsible directly or indirectly, for the ecological changes which have occurred at this site. It is hoped that the results obtained will enable us to design a programme of manage ment which will lead to the recolonisation of this site by the great wealth of aquatic plant and animal life which once occurred here.

Although the research programme did not commence until May 1976, some useful preliminary data has already been obtained from the intensive programme of monitoring being carried out on the water chemistry, phytoplankton, macrophytes, and benthic invertebrate fauna, both inside and outside the Lund tubes. It is probably significant that seedlings of both *Najas marina* and *Potamogeton pectinatus* germinated over much of the experimental area in the early summer but that only those growing in the tubes survived to the end of the season.

Acknowledgements

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The profiles reproduced in Figures 2 and 3 were kindly made available by Mr. L. F. Fillenham of the Anglian Water Authority, and by Mr. C. Groves of the Rivers Yare, Bure and Waveney Commissioners respectively.

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THE SPATIAL ARRANGEMENTS OF INDIVIDUAL PLANTS AND SPECIES, AND THE RELATIONSHIPS BETWEEN SPECIES MAKING UP A PATTERN IN AN AREA OF BRECKLAND

By George Garrod

Summary

Associations of plants characteristic of acidic and calcareous soils on Lakenheath Warren, Suffolk, have been investigated using the technique of Association Analysis in order to detect associations between pairs of species.

A lattice and a constellation diagram have been constructed which represent the species which are positively associated with each other.

Grouping of plants is clearly discernible after processing the data. Plants typical of chalk grassland form one group and another group is characteristic of sandy soil of low pH. This latter group is less clearly defined, which may reflect temporal vegetation changes associated with cyclic phenomena charactenistic of the 'pattern and process' described by Watt.

The grouping is discussed in relation to cyclic behaviour of some of the species and the edaphic and topographic conditions which will require investigation if causal factors are to be established.

Introduction

Watt (1940) discussed the considerable soil heterogeneity in Breckland associated with the parent chalk and aeolian cover sands. Watt classified these grasslands according to soil pH so that at one extreme Grassland A represented calcareous grassland and at the other end of the edaphic spectrum Grassland G represented acidic grassland. He recognised plant species characteristic of these categories; for example *Asperula cynanchia* was characteristic of Grassland A, whereas *Dicranum scoparium* was characteristic of Grassland F or G. Vegetational heterogeneity within an area, therefore, may be linked to soil heterogeneity.

These studies of Watt were concerned primarily with a large scale of pattern of soils and vegetation, however, it is possible to recognise similar relationships on a much smaller spatial scale such that species characteristic of acidic soils grow in juxtaposition to those characteristic of calcareous soils. The area chosen for this study reflects such spatial variation in the distribution of plant species.

In recent years statistical techniques have been developed to analyse relationships between plants and environmental factors. One of these involves the detection of association between different species. Initially it was postulated that if there was a marked soil heterogeneity within the study site such that acidic and calcareous soils were present then it should be possible to detect groups of species which are characteristic of their respective soil types amongst the total assemblage of species which grow in the area.

Hence the purpose of this study was to establish initially that within a small area there were groups of species characteristic of acidic soils growing in juxtaposition to those of calcareous soils.

Site

(a) The general area in which the site of study is situated forms part of Breckland, a unique area of heathland in Norfolk and Suffolk. Here a thin covering of sand and gravel overlies the chalk. Rainfall is low (c. 60mm) and the diurnal temperature range is high. The barren, sandy soil has a low nutritional status and supports a so-called steppe species flora, which has, in the past been much affected by grazing animals.

(b) The actual site was selected because of its typical Breck flora, large number of species in close proximity, low management stress, its structural uniformity in similar growth habits of the component species and confinement to the herb layer, absence of a marked pattern in the vegetation, and known variation in pH (4.0 - 8.5) and topography. It consists of a small area rather less than 400 square metres on Lakenheath Warren (TM 751808) and typical of a larger area around it. Here the mantle of sand above the underlying chalk is very uneven. Sand mixed with chalky boulder clay in places and leached in others, produces a mosaic of soils of different nutritional status. Nearby is the rabbit-proof enclosure used by Watt (1961) in his study of the effects of rabbit grazing.

The microtopography creates a series of gentle hollows and hummocks with variations of about 7 cm between trough and crest.

Method

Before causal factors in plant associations are investigated it is necessary to establish the spatial arrangements of individuals of a species, and the relationships between different species which make up the pattern.

The method chosen to investigate the latter was a test of Association Analysis based on Kershaw K.A. (1964) Quantitative and Dynamic Ecology.

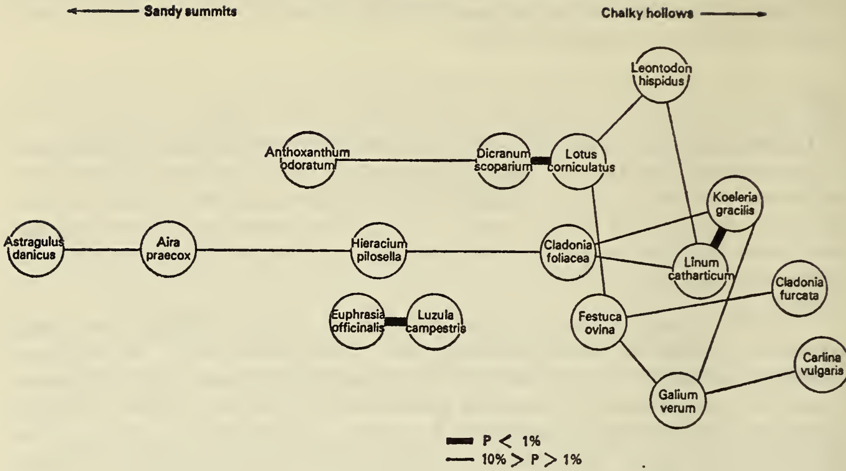
Briefly, an area of about 400 square metres was sampled and the plant species in 400 5cm x 5cm square quadrats recorded on 6/7 July, 1974. Statistical analysis was then carried out to establish positive or negative associations between the different pairs of species.

These are shown in a constellation diagram (Fig. I) where species which are strongly positively associated are placed close together and those with weak associations further apart.

Results and Discussion

Although the data have been subject to statistical treatment, some subjective assessment has had to be used, not only in the collection of data and in the preparation of the species constellation, but in the interpretation of the ecological significance of the data.

FIG 1 – SPECIES CONSTELLATION BASED ON X^2 VALUES



One clearly recognisable group are the plants usually regarded as species of chalk grassland in Gt. Britain (Group 1) which includes *Carlina vulgaris*, *Cladonia furcata*, *Festuca ovina*, *Galim verum*, *Koeleria gracilis*, *Leontondon hispidus*, *Linum catharticum* and *Lotus corniculatus*, and nearly all of these species have two positive associations.

The other associations are plants associated with sandy habitats (again based on visual appearance) and are a loose group which can be sub-divided on the basis of their positive associations as follows:

(a) *Festuca ovina*, *Luzula campestris*, *Euphrasia officinalis*.

(b) *Dicranum scoparium*, *Anthoxanthum odoratum*.

(c) *Cladonia foliacea*, *Hieracium pilosella*, *Aira praecox*, *Astragulus danicus*.

The *Luzula* - *Euphrasia* relationship may be an example of host-parasitic relationship, though Swann, E.L. (personal communication) while not doubting an association, has never observed *Luzula* as a host plant.

With regard to these 3 divisions Watt (1961) investigated cyclic change where the mosaic of patches in the vegetation each represented phases in a cycle where each patch progresses eventually and repeatedly through the same cycle of events. However, although small areas will change over a period of time the overall structure and composition of the community remains unchanged, since each phase is represented by a mosaic of cyclic units related spatially to each other as well as representing a time sequence. Watt uses the relationships between *Hieracium* and *Festuca* to show the wave-like advance of vegetatively spreading plants, numerical increase and vigour being followed by a decline. Hummocks of sand build up around *Festuca* tussocks but fail to remain intact under *Hieracium* invasion as the latter's power to bind the soil is weak—it has no network of fine roots like *Festuca* and on its death the soil-protecting leaves are removed.

Wind and rain then erode the hummocks down to the chalk allowing the *Festuca* to return and re-initiate the hummock. The inorganic environment and the topography is thus often in a state of change. Groups (a), (b), and (c) above may represent a stage of transition in such a process.

In spite of the present stage of study it is evident that in this small area there is a marked heterogeneity between groups of species which appears to be determined by edaphic and topographic conditions.

It should be noted that this is a dynamic and not a static association, being sampled at a point in time. Plants come and go with variation of temperature, rainfall, and grazing. There will be sporadic contributors to the pattern e.g. *Senecio jacobaea*, which in this season has a small number of occurrences.

Further Work

If the work were to continue it is suggested that the next stage of investigation should be to examine more closely the patterns of these different species in relation to soil environmental patterns.

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THE CTENOPHORA, SCYPHOZOA AND ANTHOZOA OF NORFOLK, WITH ADDITIONAL NOTES ON THE HYDROZOA

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Introduction

The present survey includes previously published records together with the results of our own collecting and research on the Norfolk fauna. The records of one of us (RH) began in about 1945, terminating in 1975, whilst those of the other (RBW) began in 1965 and are still continuing; hence this survey represents some 32 years of continuous work. Previous studies on the marine and brackish-water Hydrozoa were carried out by Hamond (1957 & 1963a). Freshwater Hydrozoa of the family Hydridae lie outside the scope of this survey, but the other coelenterate groups, which are mainly marine, are all dealt with here. The ctenophores, although not now regarded as coelenterates (Hyman, 1940), are included here for convenience. The localities searched and the Norfolk marine area have been defined by Hamond (1961, 1963b & 1969a) and collecting methods were as in Hamond (1967a) and Williams (1972a). Local place names, wrecks, offshore stations and landmarks mentioned in this paper may be found in Hamond (1961, 1963a, 1963b & 1969a), Williams (1972a & 1976) or Ordnance Survey maps of Norfolk. Our individual records and comments are identified by initials.

Ctenophora

Pleurobrachia pileus (O. F. Muller). Schulze (1875).

Present all the year round, but least plentiful in spring and most abundant from July to November. An enormous swarm was washed ashore on Brancaster beach in June, 1965 and it was common west of Scolt Head in July, 1974 (RBW). Seen to shed ova in July and August (RH).

Beroe gracilis Kunne. Schulze (1875) as *B. ovata.*

This is the common *Beroe* off Norfolk, occurring in small numbers all the year round, feeding on *P. pileus* (Greve, 1970; RH). Most records are from the winter months (RH). Greve (1970) gives photographs by which *B. gracilis* may be distinguished from *B. cucumis.*

Beroe cucumis Fabricius.

An invasion of numerous large specimens (6 to 8 cm long) took place in July 1965, along with certain other planktonic species (the copepods *Calanus helgolandicus* Claus and *Anomalocera patersoni* Templeton, the amphipods

Parathemisto gracilipes Norman and *Hyperoche medusarum* (Kroyer), and larvae of a euphausiid, probably *Nyctiphanes couchi* (Bell), which at that time of year indicate a strong incursion of the kind of water found normally off Yorkshire and Northumberland. When first seen on a calm sunny day (12 July) they were cruising just below the surface in groups of up to six within an area of approximately 20m square, adjacent groups being 100 or 200m apart (RH).

B. cucumis is of an iridescent mauve colour, whereas *B. gracilis* is usually colourless, or at most, faintly pink (RH). Both species are extremely delicate and it has not been possible to preserve them or to keep them alive in aquaria (RH).

Coelenterata

CLASS SCYPHOZOA

Order Stauromedusae

Garstang (1901) stated "Sheringham has been reported as a good locality for lucernarians, but I have no record of the species found there. A minute long-stalked lucernarian obtained on the Norfolk coast by Mr. Geldart appears to be a young specimen of *Depastrum cyathiforme*, but the record needs confirmation". Geldart collected decapod crustaceans from around Cromer (Hamond, 1971, pp. 95 and 105), so perhaps his lucernarian came from there as well. At West Runton (about 3 km west of Cromer, on the same stretch of rocky shore) Dr. E. A. Ellis found, in about 1935, what appeared to be *Haliclystus auricula* (Rathke), but we have not so far found any lucernarians there or elsewhere in Norfolk waters. Mr. P. G. Corbin (Marine Biological Association, 1969) also failed to find any between Berwick-on-Tweed and Sheringham in August and September of 1968, despite good conditions for observation during the equinoctial spring tides. It may be that silting, pollution, or both have extinguished these animals on the east coast of England (Mayer, 1910, p.537; Marine Biological Association, 1969; RH).

Order Semaeostomeae

According to Russell (1970, p.11), the following four species are the only ones likely to occur here at all frequently, although *Pelagia* enters Dutch waters from the English Channel (van der Baan, 1967).

Chrysaora hysoscella (L.)

Occurs from June to September almost every year, most abundantly in July and August; often in Blakeney Harbour and other inshore waters (RH).

Three specimens, 15 to 22.5 cm in diameter, were found stranded in creeks on Titchwell Marsh on 10 August, 1975 (RBW). They were unmarked except for the brown marginal lappets, one of eight major colour varieties found near Dutch shores by Stiasny (1927). Hardy (1956, pl.7) figures a more well marked specimen from Norfolk. Sorby (1903) also found wide variation in the pigmentation of specimens (as *C. isosceles*) from Essex waters. No parasitic amphipods were found in the Norfolk specimens; although *Chrysaora* sometimes harbours many *Hyperia* in the summer (33 specimens of *H. galba* (Montagu) were counted in a 12 cm diameter specimen from Newton Ferrers, Devon, in August, 1969 (RBW). *Chrysaora* was common at West Runton in August, 1976 (RBW).

Cyanea capillata (L). Pantin *et al.* (1960).

Large specimens of this usually deep crimson to reddish-brown species may be from 20 to 40 cm in diameter. Usually more abundant than *C. lamarckii*, with which it often occurs (RH). Sorby (1903) recorded the colours of Eessx specimens as creamy white to orange.

Cyanea lamarckii Peron and Lesueur. Hamond (1967b, p.141) as *Rhizostoma.*

The blue *Cyanea*, rarely exceeding 10 to 15 cm in diameter in Norfolk waters, occurs in moderate numbers every year in July and August (RH). Hardy (1956, pl.7) figures a specimen from the Norfolk coast. Sorby (1903) recorded the species from Essex as *C. lamarckii* and *C. imporcata.*

Aurelia aurita (L.)

Very small ones are found as early as May, the adults being most common in June and July and finally dying out in September (RH).

Common off Brancaster beach on 29 June, 1974, and large numbers, possibly of the same swarm, were carried into Brancaster Harbour during the following two days (RBW). The mean diameter of 21 specimens measured was 22.1 cm with a range of 15 to 30 cm. None of them contained any *Hyperia*, although *H. medusarum* (Muller) has been recorded from Norfolk *Aurelia* (Hamond, 1967b). *Aurelia* has also been found in Titchwell Lagoon, where some unidentified scyphistomae, probably of this species, were recorded in June, 1965 (Williams, 1972a). Schyphistomae of *Aurelia* were found in Wells Harbour in August, 1976 (RBW).

CLASS ANTHOZOA

Schulze's (1875) and Walton's (1908) stations are discussed by Hamond (1969a, p.214 and fig. 1). At the top of p.214 the phrase "p.105 to p.114 inclusive" should read "P.105 to P.114 inclusive", denoting the stations worked by the "Pommerania" (see Schulze, 1875), mainly in the Norfolk marine area; station P.105, however, lies just outside it.

Sub-class Alcyonaria

Order Alcyonacea

Alcyonium digitatum (L.) Schulze (1875).

Although the "Pommerania" took it only at P.106 (Schulze 1875), the well-known "Dead Men's Fingers" is very widely distributed offshore on stones and dead shells (the latter mostly of the horse-mussel, *Modiolus modiolus*, as also noticed in Danish waters by Roushdy (1962)). Most Norfolk colonies are orange, but in general, about one in four is pale grey and one in twenty is a pale flesh-pink. However, after a severe storm in December, 1974, during which vast numbers of marine animals were washed up on the beach at Cley-next-the-Sea, hundreds of colonies were found, over half of them being of the pale grey variety and the rest orange (RBW).

Intertidally Dr. Ellis has seen *A. digitatum* at West Runton and it is quite common in the wreck of the "Hjordis" and at extreme low-water mark on Hunstanton Scaup (RH). Colonies with embryos have been noticed in August and November. No copepod parasites have ever been found, although every colony taken from early 1962 to late 1967 was cut into thin slices and rinsed with water (RH). (The copepod hoped for was *Enalcyonium rubicundum*, which was found to be common in *Alcyonium* in western Sweden by Bresciani & Lutzen (1962).

Order Pennatulacea

Virgularia mirabilis O. F. Muller. Schulze (1875).

Recorded from just outside the northern limit of the Norfolk marine area, at P.105 (Schulze, 1875). The seabed and its fauna around this station are very poorly known, and the animals from P.105 are therefore included in our Norfolk list, since they probably do, or could, occur actually in the area, given suitable conditions.

Sub-class Zoantharia

Order Actiniaria

Nematostella vectensis Stephenson.

A redescription based on Norfolk and Suffolk specimens has recently been published (Williams, 1975a). *Nematostella* used to be very numerous in Half-Moon Pond at Cley, but less common in Abraham's Bosom and Abraham's Creek at Wells (Williams, 1973a, 1973b & 1976). The species appears to be rather rare and aspects of its ecology, dispersal, world distribution and conservation are discussed in Williams (1973b & 1976).

Nematostella is now known to be dioecious and exhibits both sexual reproduction (Williams, 1975a & 1976; Frank & Bleakney, 1976) and asexual reproduction by transverse fission (Williams, 1975a & 1976; Lindsay, 1975; Frank and Bleakney, 1976).

In Half-Moon Pond, *Nematostella* fed mainly on harpacticoid copepods and midge larvae (Williams, 1976). It was also observed to feed on the amphipod *Corophium volutator* (Pallas), but would not ingest the equally abundant, equally sized isopod *Idotea chelipes* (Pallas) (RH). Despite conservation measures, this anemone is probably now extinct in Norfolk due to the effects of pollution and drought on its habitats. However, the fate of 10 anemones saved from Half-Moon Pond and moved elsewhere when it dried up in 1975 is not yet known (Williams, 1976).

Actinia equina (L.).

The strawberry variety (*fragacea*) does not seem to occur in Norfolk, but the usual variety *mesembryanthemum* is common on the rocky strip of shore in north-east Norfolk. At West Runton (Hamond, 1961), unmarked specimens coloured maroon, light red, olive and dark brown occur, as well as some with electric blue or emerald green flecks. Many such individuals produced live young in June, 1971 (RBW). Similar colour varieties live on the beach at Cromer and one produced 12 young in April, 1973 (RBW). Breeding occurs at least up to October, maybe all the year round (cf. Chia and Rostron, 1970). *Actinia* has also been recorded from Gorleston (Collings, 1938) and Corton (Crisp, 1964), which although in Suffolk, lies within the Norfolk marine area.

Tealia felina (L.).

Four varieties, *lofotensis*, *crassicornis*, *coriacea* and *tuberculata*, have long been recognised within the *Tealia felina* complex. Hand (1955) raised these varieties to specific rank, following a study of Pacific *Tealia.* It has yet to be established whether his findings also apply to British *Tealia*, hence we at present retain the name *T. felina.* Only the varieties *coriacea* and *lofotensis* occur in Norfolk waters.

The var. *coriacea* was found at Gorleston (Collings, 1938), and inside the "Hjordis", on the Reef and Threshold, and on Hunstanton Scaup (RH); offshore, single examples have been found at station Q.2, in a whelkpot at W.17, and in a shrimp-trawl off Caister on 23 July 1959 (RH). The var. *lofotensis* was found at Q.1, and is taken in whelkpots and much less often in dredgings (RH), whilst Collings (1938) recorded it off Yarmouth. Large brightly coloured *Tealia* similar to var. *lofotensis*, with sparse verrucae holding no foreign material, occur below low water level and in pools at low spring tides at West Runton (RBW). They are distinctly different from the *Tealia* with well-developed verrucae holding large amounts of attached material, like the typical var. *coriacea* found in south-west England. *Tealia* similar to those found at West Runton were washed ashore at Cley in December, 1974 (RBW). Norfolk (and other British) *Tealia* require further study for comparison with Hand's (1955) results.

Garstang's statement (1901) that the "Pommerania" took this species off Happisburgh (i.e. at P.108) appears to be mistaken, since it is not listed by Schulze (1875).

Haliplanella luciae (Verrill). Gurney (1923) as *Sagartia luciae;* Stephenson (1935) and Ellis (1935) as *Diadumene luciae.*

This species (first introduced into Britain at about the turn of the century), at a given locality tends to flourish for a time and then to die out or become rare (Stephenson, 1935). It has been recorded at Salthouse and in Wells Harbour by Gurney (1923); in Breydon Water, at Blakeney and in the Yare by Ellis (1935); and in Titchwell Lagoon (Williams, 1972a). It probably does not occur any longer at Salthouse (Williams 1972a & 1973b) and extensive searches on the north Norfolk coast in 1971 failed to reveal it anywhere besides Titchwell (Williams 1973b). It did not appear to be in Breydon in 1975 (RBW), but despite the drainage scheme at Titchwell (Williams, 1972a), it probably still survives there in small numbers (Williams, 1973b). Anemones from Titchwell were used in studies on nematocyst discharge (Williams, 1968), prey analysis (Williams, 1972a) and chemical control of feeding behaviour (Williams, 1972b & 1973c). Recently (August, 1975), *Haliplanella* has been rediscovered in Wells Harbour (RBW) (cf. Gurney, 1923, and a single specimen probably of this species in about 1948 (RH)); these three Wells Harbour records may constitute different introductions on ships. A specimen collected on 1 November 1975 (RBW) possessed catch-tentacles, a very rare condition only reported once previously for English *H. luciae* (Williams, 1975b). The present Wells population seems to consist entirely of males, reproduction being by longitudinal fission, as at Titchwell (Williams, 1972a).

Metridium senile (L.). Pantin *et al.* (1960).

Orange, brown or grey forms of the variety *dianthus* were found (RBW) at Holme-next-the-Sea (on a beached barge, June 1971); on the peat beds at Brancaster beach (August, 1976); on mussels in the Brancaster Harbour Channel

(August, 1976); on the wreck west of Scolt Head (July, 1974 and August, 1975; see also Pantin *et al.*, 1960); and in the mussel-holding pits at Brancaster Staithe (July, 1974). All were small specimens, few having a basal diameter of more than 3 cm However, after the storm of December, 1974, very large grey, orange or pink specimens up to 8 cm diameter were washed up on Cley beach (RBW). One grey individual had two mouths within the same disc and another had 9 catch-tentacles—the first British record of (*M. senile* from the North Sea with catch-tentacles (cf. Williams, 1975b). Cod (*Gadus morhua* L.) caught by anglers off Cley beach sometimes have their stomachs full of *Metridium* (RBW). A similar diet has been recorded for a black bream from Devon (Mattacola, 1976). Collings (1938) found var. *dianthus* on Gorleston breakwater and it regularly occurs inside the wreck of the "Hjordis" and less often on the lowest parts of Hunstanton Scaup (RH). Offshore, small brown ones are often found on rocks, stones and shells, whilst large, usually pink or white specimens occur on wrecks (RH). Three Holme specimens released ova in June, 1971 (RBW). The usual method of reproduction appears to be by pedal laceration.

Metridium is no longer commonly found under Wells Quay as reported by Hamond (1972), but a dwarf form with relatively long tentacles occurs under Wells Rocks (RBW). At least some of these individuals can be assigned to the variety *pallidum*, but further studies are required to define this unusual population more closely. Further specimens of *pallidum* or intermediates between *pallidum* and *dianthus* have been found at Brancaster Staithe and on the Scolt Head wreck (RBW).

Calliactis parasitica (Couch). Schulze (1875) as *Sagartia parasitica.*

This is a southern species whose northern recorded limit to the east of the British Isles is off Belgium (Leloup, 1952). Schulze's (1875) record of a specimen on the shell of a live *Buccinum undatum* at P.115 (just outside the Norfolk marine area) must therefore be viewed critically, since in Norfolk waters large whelk shells, containing living whelks or hermit-crabs, may carry *Tealia* or *Metridium* (see below under *Stomphia*). However, Dr. Ellis saw an anemone in a beach-seine (draw-net) on the shore at Gorleston, about 1929, which he identified as *Calliactis.*

Hormathia coronata (Gosse). Schulze (1875) as *Bunodes coronata.*

In the apparent absence of any other record from the southern North Sea, we are inclined to agree with Stephenson (1935) that the identification of the specimen from P.108 is doubtful.

Sagartia elegans (Dalyell). Pantin *et. al.* (1960); Walton (1908) as *S. miniata.*

This species occurs in small numbers under rocks near low water at both East and West Runton; very numerous in the Threshold and as far up as the Freshes Lays, as well as on Hunstanton Scaup and under the pier (RH). The column of these intertidal examples (var. *miniata*) is pale translucent pink, often tinted dark greyish-blue at the distal end. The colour pattern of the disc and tentacles is extremely variable. Walton (1908) found this species at several places widely scattered in Norfolk waters, but within the BW area it has only been found very close inshore. Records are of between 50 and 60 at D.26; a few at D.24; 10 at D.45; and two small ones in the middle of Blakeney Deeps (53°01'N.

00°58'30"E) on 13 September 1962. Offshore specimens closely resemble those of the intertidal region, although they seldom grow quite so large as those on the shore. However, on about six occasions between 1953 and 1967, single specimens which appear to be the var. *nivea*, were dredged on rough shelly ground offshore (RH). The disc and tentacles are milk-white, sometimes with dull white radiating lines corresponding with the mesenteries, while the upper part of the column is strongly flushed with magenta fading downwards into straw-yellow or orange near the base; the limbus is greyish and there are narrow white longitudinal stripes on the proximal part of the column. The upper column often has scattered pale spots (small areas lacking the magenta pigment) which do not necessarily coincide either with the cinclides or the suckers. One specimen had the base and column dull reddish-brown, without any pale spots or white stripes, but with the disc and tentacles of the usual pure white.

The record of Pantin *et al.* (1960) on the Scolt Head wreck has not been confirmed, despite frequent searches (RBW).

Sagartia troglodytes (Price). Walton (1908) as *S. undata;* Serventy (1934); Pantin *et al.* (1960).

The only offshore record is one dredged by Walton (1908) at HX 6. Intertidally, both the varieties, *decorata* and *ornata*, exist in Norfolk, but *decorata* is uncommon. Fine specimens of *decorata* occurred in June, 1971 in the barge at Holme, where they were attached to stones under the sand and attained a column length of 13 cm and a tentacle span of 7 cm (RBW). Much smaller specimens occur around the breakwaters on the beach at Happisburgh (Williams, 1975b) and in Wells Harbour (RBW). The variety *ornata* occurs in Titchwell Lagoon (Williams, 1972a) (and it is probably this variety recorded by Pantin *et al.* (1960) on the adjacent Brancaster beach peat beds); in Holkham Salts Hole (Hunt, 1971); in Abraham's Bosom (RH, RBW); and under stones at West Runton (Williams, 1975b), Wells Harbour (RBW) and Happisburgh (RBW). Small specimens also occur on the Strond at Morston (RH) and Cockle Bight on Scolt Head (Serventy, 1934; Pantin *et al.*, 1960). The record from Scolt Head wreck (Pantin *et al.*, 1960) has not been confirmed (RBW). Reproduction is by viviparity (as in *Actinia*) all the year round (see Williams, 1972a; also observed at West Runton, RBW).

Sagartia sp. Walton (1908, p.223).

The single specimen from HX 5 could not be referred to any known species by Stephenson (1935, p.392); Walton himself thought it was near to *S. elegans.*

Cereus pedunculatus (Pennant). Schulze (1875) as *Sagartia bellis.*

Records of this species from the east coast of England are usually highly suspect. Schulze (1875) gave no description of his anemone from P.108. *C. pedunculatus* is almost entirely restricted to the south and west coasts of England and Scotland, usually between tidemarks, and is thus very unlikely to have occurred in the Norfolk area at all, let alone offshore; although it has been dredged from slight depths elsewhere (Stephenson, 1935). There is, however, a genuine record for the Blackwater Estuary in Essex from near Bradwell Power Station (Davis, 1967); suggestive of local warming of the water as the reason for its survival (Barnes and Coughlan, 1972). Nevertheless, such a record proves that

Cereus might be introduced into the North Sea, although the means of dispersal is unknown; hence, the Norfolk record from the breakwater south of Gorleston Pier (Dr. Ellis cited by Collings, 1938) needs to be confirmed.

Sagartiogeton undatus (O. F. Muller). Walton (1908) as *Sagartia viduata;* Stephenson (1935) as *Actinothoe anguicoma.*

Among Walton's (1908) numerous records are two from the Norfolk area (two specimens at HX 4 and several at HX 5). His other records came from north of our area, or from the eastern North Sea (towards the Dutch coast and Helgoland) where the species appears to be common. It has not been found in the BW area (but see the next species).

Sagartiogeton laceratus (Dalyell). Stephenson (1935) as *Actinothoe lacerata.*

Small specimens are moderately common in dredgings, on stones and shells in Blakeney Deeps and near the Blakeney Overfalls Buoy (RH). It has not been found here between tidemarks. This species and the last are very much alike, and it is not impossible that some of Walton's *Sagartia viduata* really belonged to the present species (RH).

Stomphia coccinea (O. F. Muller). Walton (1908).

Walton's (1908) record from HX 1 appears to be genuine, and is from within the Norfolk area, so perhaps it occurs closer to our coast. However, all of the large anemones from offshore in the BW area examined in the hope of finding *Stomphia*, *Hormathia* or *Calliactis* (q.v.), proved to be *Tealia* or *Metridium* (RH). A. H. Patterson's record of *Stomphia* from a Yarmouth shrimptrawl on 29 May 1906 noted by Collings (1938) was probably erroneous; the coloured sketch in his notebook is most likely of *Tealia felina* var. *lofotensis* (RH).

CLASS HYDROZOA

One new species is added to the Norfolk list, and recent work elsewhere has frequently had a bearing on Norfolk species. A review of the distribution of certain medusae is given by Edwards (1968); see also the additional notes on Hydromedusae by Russell (1970) and the general paper by Thiel (1970).

Order Hydroida

Sub-order Anthomedusae

Protohydra leukarti Greef.

Found in Norfolk for the first time (23 May, 1975), attached to small fragments of algae in a ditch just to the south of the sea wall bounding the salt marshes at Morston (RH).

Cordylophora caspia (Pallas). Hamond (1967b, p.139); Hunt (1971) as *C.? lacustris*; Gurney (1923) as *C. lacustris* (?—see below).

Recorded at Potter Heigham bridge, at Ludham, and in the Waveney at Haddiscoe on waterlogged wood (RH); it is apparently abundant in the main pipes of the Yarmouth waterworks. A similar hydroid was found by Hunt (1971) in Holkham Salts Hole. It was stated by Hunt (1971) that Gurney corrected his record of *Cordylophora* from Salthouse to *Gonothyraea loveni* (q.v.) However, examination of Gurney's publications reveals that he merely listed

Cordylophora amongst other animals at Salthouse in Gurney (1923), and listed *G. loveni*, again from Salthouse, in Gurney (1929). He made no explicit statement regarding a mis-identification and his two lists differ in other ways besides in the hydroids. Hence, the possibility remains that he found both hydroids at Salthouse, although this must remain doubtful at present (RBW).

Clava multicornis (Forksal). Hamond (1957).

On a mussel from the Scolt Head wreck, 3 July, 1974 (RBW).

Bougainvillia sp. Redeke and van Breemen (1904).

Among medusae taken in Norfolk waters by Redeke and van Breemen (1904, p.127) were *Aglantha digitale* (see Hamond, 1963a) and a *Bougainvillia* species. The *Bougainvillia* was recorded as being very rare on the afternoon of 6 August 1901, in "the northern part of the deep-water channel" (i.e. somewhere approximately south-east of Smith's Knoll, in the south-eastern corner of the Norfolk area); the depth at which the plankton net fished was not stated, but the water depth was 43 m. The identity of this medusa may be deduced (RH) by taking all the species which Redeke and van Breemen would have been likely to refer to this genus, and then to eliminate them progressively on the basis of known geographical, ecological or seasonal criteria (Edwards, 1964a, 1964b, 1966; Hamond, 1957, 1963a; Kuhl, 1962; Russell, 1953; Werner, 1954a, 1954b, 1958, 1961) as follows:—

(1) *Nemopsis bachei* is found in the brackish parts of large estuaries (Kuhl, 1962); Redeke and van Breemen's species was fully marine.

(2) *Bougainvillia muscoides* (=*Thamnostoma* sp. Russell 1953, p.150; see Edwards 1964b, p.741) and *B. principis* do not occur at all in the southern North Sea.

(3) Although common in the southern North Sea, *B. superciliaris*, *B. macloviana* and *Rathkea octopunctata* are all springtime species, most unlikely to be found as late as August.

(4) The capture of *Aglantha* in the same area by Redeke and van Breemen might indicate an unusually strong temporary push southwards by northern water (see above, under *Beroe cucumis*). This would possibly push away from Norfolk the south-eastern North Sea resident *Margelopsis haeckeli*, which only just reaches Norfolk waters (see Hamond, 1963a), and might have the effect of holding up water which would otherwise enter from the Channel and bring with it *Lizzia blondina*. Both these species might therefore be discounted, although the time of year is right for them.

(5) Such an incursion of northern North Sea water would probably have little effect either way on *Bougainvillia ramosa* or *B. britannica*, both of which are characteristic summertime species in many parts of the North Sea other than the Norfolk area; and would only marginally increase the chances of finding the Atlantic-based *B. pyramidata*, whose only certain North Sea record is from Helgoland in September.

Thus, the most likely candidates for Redeke and van Breemen's medusa are *B. ramosa*, *B. britannica*, or possibly *Margelopsis* (RH).

Trichydra pudica Wright. Hamond (1957).

Edwards (1973) has now definitely shown that the medusa of this hydroid is not *Lizzia blondina* but *Pochella polynema*, whose apparent rarity may perhaps be due to its presence in the plankton mainly at the same season (June and early July) as the gelatinous flagellate *Phaeocystis* (see Hamond, 1961) which coats plankton nets with slime and clogs their meshes. The planktonic season for *Pochella* is only slightly longer than this (Edwards, 1973, p.90) and therefore it may have been missed in many places where the hydroid occurs. Edwards (1973) also shows that both hydroid and medusa should now be known as *T. pudica*. It is possible that this hydroid might live foı several years without producing medusae, especially if (as for certain other species; Hamond, 1963a, p.669) the Norfolk area is only marginally suitable (RH).

Sarsia eximia (Allman). Williams (1972a).

Medusae found in Titchwell Lagoon on 30 March, 1970 (Williams, 1972a). This record extends the breeding season (as judged by the occurrence of medusae or fertile hydroids) from late March to early September in Norfolk waters (see Hamond, 1957 & 1963a). An unusual record, since it is so early in the year (c.f. Hamond, 1963a).

Tubularia larynx Ellis and Solander. Hamond (1957).

Abundant on the Scolt Head wreck, 3 July, 1974 (RBW), where Pantin *et al.* (1960) found it in 1959.

Zanclea costata Gegenbaur. Hamond (1957) as *Z. implexa*.

Russell (1970, p.234) stated, "Distribution includes Noıfolk (Hamond, 1957)". However, these specimens came from 54°08'N.00°40'E., just outside the northern limit of the Norfolk area, and may be more appropriately regarded as Yorkshire specimens (RH). Thus, this species appears not to have been yet recorded from the Norfolk area.

Sub-order Leptomedusae

Obelia dichotoma (L.). Hamond (1957) as *Laomedea dichotoma*.

Living on twigs in Titchwell Lagoon (Williams, 1972a), with *Sertularia cupressina*.

Gonothyraea loveni (Allman). Gurney (1929); Williams (1972a).

This species occurs in Blakeney Harbour, especially in the creeks (Hamond, 1957). All the Norfolk records are from rather sheltered conditions. Also from pools at Salthouse (Gurney, 1929); Titchwell Lagoon (Williams, 1972a); and a pool on Cley Marsh on 5 July, 1974 (RBW).

Campanularia gelatinosa (Pallas). Hamond (1957) as *Laomedea gelatinosa*.

For the change in generic name see Cornelius (1975). Previous notes on this species (Hamond, 1957, p.314) were based on few records and were rather misleading. From numerous later observations (RH), it appears that this hydroid lives at the level of low water of neap tides and below; it prefers situations where the colonies can hang continually immersed in a gentle current, and can endure a limited lowering of salinity for just a few hours at any one time. The colonies start to become apparent at the end of December, and increase steadily in size and abundance until the end of May; thereafter, in Blakeney Harbour (in the lowest reach of Morston Creek, and on the undersides of boats and buoys in the Pit) they die away, but large fertile colonies can be washed ashore as late as September (mostly in June and early July). Unfortunately, the years in which these large colonies have been recorded as being cast ashore have not been the same years in which the growth in Blakeney Harbour has been followed. There is thus no proof that subtidal colonies come to their growth climax later than Harbour colonies; but on the other hand, all Norfolk colonies of this species may perhaps reach their climax later in some years than in others. Taking the Morston Creek colonies alone, 1962 and 1963 were good years, 1964 average, 1965 very poor, 1966 average, and 1967 was a marvellous year with thick luxuriant colonies supporting a rich population of the polychaete worm *Proceraea cornuta* (A. Agassiz). The maximum height of the colonies was 25 to 30 cm; that shown in Fig. 1 by Hincks (1868, pl.26) is about life-size, whereas that in Fig.1 of the same plate is very luxuriantly branched and is more likely to have been about one-half or two-thirds of life-size. Although Hincks states "natural size", this would be most unusual if strictly true (RH).

Colonies on the bottoms of boats in the Pit are yellowish-white, but Morston Creek colonies are brown, due to mud and diatoms; the boat colonies are usually somewhat larger. Boat colonies, growing as they do along the line of the keel (as far down as possible below the surface) of those boats so moored as to be permanently afloat, could never be collected until the boat was beached for tarring. When they were collected (after immersion and exposure by at least two successive tides), the colonies were still alive and apparently healthy, but contained not a single *Proceraea*, copepod, or any other of the usual animals associated with the same hydroid about a hundred yards away in Morston Creek (and elsewhere; Hamond, 1968, p.176; Hamond, 1969b, p.444). It was not possible to verify the supposition that the animals, having endured one exposure, deserted the hydroid *en masse* as soon as the next tide covered them (RH).

Campanularia flexuosa Hincks. Hamond (1957) and Williams (1972a) as *Laomedea.*

Titchwell Lagoon (Williams, 1972a). For the change in generic name, see Cornelius (1975).

Sertularia cupressina (L.). Garstang (1901); Hamond (1957); Williams (1972a).

This species was separated from *S. argentea* by Hincks (1868), but with almost the sole exceptions of Hancock, Drinnan and Harris (1956), twentieth century authors have regarded them as conspecific. In Norfolk waters, *S. cupressina* is one of the commonest offshore hydroids, almost all specimens being of the form *argentea* (RH) (cf. Leloup, 1952).

Kirchenpaueria pinnata (L.). Hamond (1957).

Common on mussels on the Scolt Head wreck, 3 July, 1974 (RBW), where Pantin *et al.* (1960) found it in 1959.

Plumularia setacea (Ellis and Solander). Hamond (1957).

Found with the previous species (RBW), but not recorded there by Pantin *et al.* (1960).

Nemertesia antennina (L.). Hamond (1957).

Cast ashore at Cley after the storm of December, 1974 (RBW).

Tiaropsis multicirrata (M. Sars). Hamond (1957 & 1963a).

Russell (1970, p.254) quotes Hamond (1957) as finding both hydroid and medusa here, but only the medusa was from Norfolk; the hydroid (Hamond, 1957, fig.26) was from off Northumberland.

Aequorea vitrina Gosse. Hamond (1957 & 1963a).

The luminosity of this species has now been shown to be due not to ingested dinoflagellates, as supposed by Hamond (1963a), but to a substance manufactured by the medusa itself, aequoiin (Hastings *et al.*, 1969).

Calycella gracilis Hartlaub. Hamond (1957) as Calycellid g. & sp. indet.

Calder (1970) redescribed fertile material seemingly identical with that of Hamond (1957) and Hartlaub, although neither Hamond's colonies nor Hartlaub's were fertile. The possibility that the Norfolk specimens belong to a species that reproduces by medusae instead of sporosacs (as in all known species of *Calycella*) can almost certainly be discounted. With the work of Werner (1968a, 1968b) every likely medusa in the North Sea has now had its hydroid described, except for *Tima bairdi* (see Hamond, 1957, p.322) whose hydroid will probably turn out to resemble that of *Eutonina* (see Werner, 1968b).

Cuspidella (? *costata* Hincks). Hamond (1957, p.308).

From the survey of the distribution of *Laodicea undulata* (Forbes and Goodsir) by Edwards (1968), it seems very unlikely that the Norfolk *Cuspidella* belonged to this medusa. Furthermoie, it was very much like the hydroid of *Staurophora mertensi* (Brandt) illustrated by Naumov (1960, fig. 191—English translation; Naumov, 1969). As very young *Staurophora* are fairly frequent in the springtime plankton (Hamond, 1963a, pp.664-665), the hydroid no doubt lives somewhere in the area; but unfortunately the supposed *Cuspidella* was sterile (RH).

Discussion

Of the species listed above, the lucernarians and *Nematostella vectensis* are now probably extinct in our area, and certain identifications are either probably wrong (*Hormathia coronata* and *Cereus pedunculatus*) or require fresh specimens to be found before confirmation. One species (*Calycella gracilis*) is now definitely recorded for the first time in British waters by name; the others are all well-known North European forms, *Protohydra* being new to Norfolk.

Extensive ecological studies carried out on *Nematostella* before the last surviving natural population at Cley was lost due to drought (Williams, 1976) may have provided enough information to facilitate controlled re-introduction of the species into suitable habitats. The *Haliplanella* population in Wells Harbour should be carefully conserved and studies are being carried out on its spread at this locality. Work is also continuing on the identities of the unusual population of *Metridium* at Wells and the *Tealia* form at West Runton.

It is noticeable that the anemones taken at varying distances from the coast by the "Pommerania" (Schulze, 1875) and the "Huxley" (Walton, 1908) are not very different from those found in the BW area, so that the species found within 10 km of the coast are also liable to be found for at least the next 60 km or more out to sea (as in other invertebrates; Hamond, 1969a). In the outer part of the Norfolk marine area there are only two species, namely *Stomphia coccinea* (substrate unknown) and *Virgularia mirabilis* (soft muddy bottom), that have not so far been found nearer the coast. In this connection, it is noticeable that the few patches of muddy ground which occur here and there near the coast, although still very poorly known, are basically composed of tough grey or black clayey mud, very different from the fine and rather soft deep-water muds that are preferred by *V. mirabilis* and certain other species (Hamond, 1963b, p.21). To judge from the preliminary results obtained with an ordinary dredge when allowed an extra long warp so as to dig in abnormally deeply, further investigation of the muddy and sandy offshore grounds with a specialised dredge that digs in deeply, or with a grab, will increase the list of burrowing species, as distinct from the epibenthos taken by the normal oyster-dredge. Coelenterates to be expected in these samples would be *Cerianthus* and burrowing anemones and, on a microscopic scale in sand or shell-gravel, encrusting or sessile forms such as the Microhydrulidae (Bouillon and Deroux, 1967) and free-living forms such as *Halammohydra* and its relations (Clausen, 1963, 1967; Wolff, Sandee and Stegenga, 1974). Probably few additional species of planktonic coelenterates can be expected to be found here.

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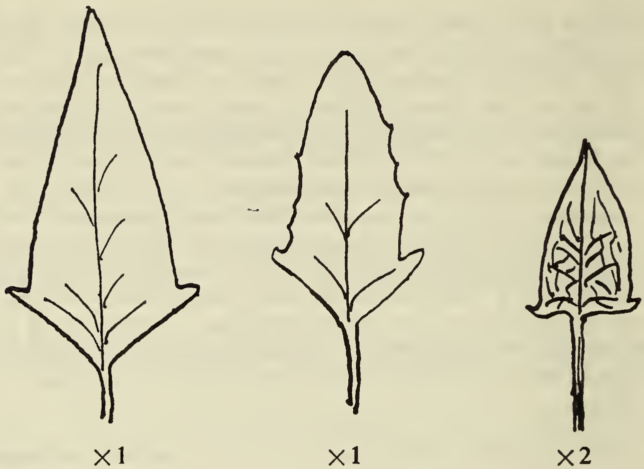
ATRIPLEX LONGIPES DREJ: A NEW NORFOLK SPECIES

by Richard P. Libbey

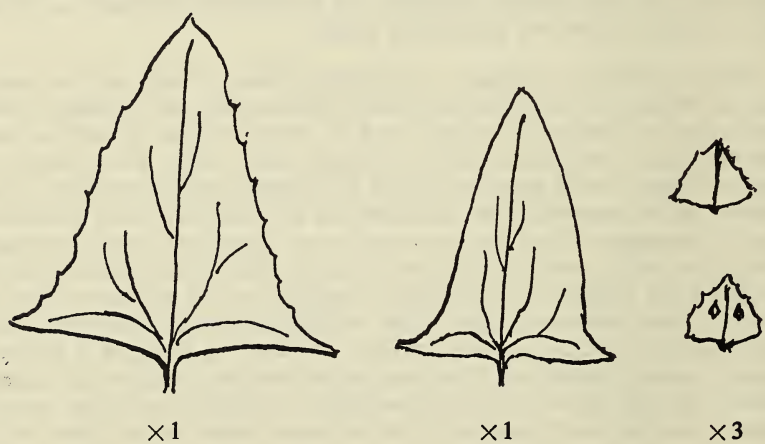
In a recent review of the genus *Atriplex* in *Watsonia* E. M. Jones (1975) referred to plants resembling *Atriplex longipes* growing near the coast at Heacham in West Norfolk. This is a species closely allied to *Atriplex prostrata* (formerly known as *A. hastata*) the hastate Orache, a plant common throughout Britain. Following this report I thoroughly explored the Snettisham and Heacham coastal areas and in September 1975 discovered further plants showing characters of *A. longipes* but not fully matching up with those of this species. P. M. Taschereau, a specialist in this genus, suggested after seeing the plants that it seemed likely that *A. longipes* either is or was growing in the vicinity and that my specimens were probably introgressive hybrids with *A. prostrata*. In September 1976 further searches with P. M. Taschereau were made round the West Norfolk coastline and in addition to more hybrid material, a small colony of *Atriplex longipes* was discovered at Brancaster. This is only the second confirmed report of this species in Britain, the first having been found by Taschereau in Kircudbright in 1975.

This note is therefore written with the dual objective of describing the characteristic and distinguishing features of *A. longipes* so as to assist recognition in the field, and also hopefully to encourage members to re-explore potentially suitable habitats along Norfolk's extensive and varied coastline. Since fruiting material is essential to be sure of identification and this normally takes place in Oraches during September when other more attractive plants are nearly over, it is possible that more time can be spared to examine our coastal belt in search of these less spectacular plants.

Atriplex longipes, although a maritime species, should not be sought along the drift-line of the foreshore, whether this be sand, silt or shingle, where other species of Orache, *A. littoralis* and *A. prostrata* often flourish in great profusion and in bewildering variety. Instead, sites rather more inland but where the water is still brackish should be selected, and in particular those colonised by tall vegetation and dominated by the Common Reed, *Phragmites australis* (*communis*). There are numerous areas—large and small—populated by this grass which occur behind the dunes, in brackish conditions, almost throughout the length of the Norfolk coastline. In this situation plants of *A. longipes* may grow up to 2½ or 3 feet in length but tend to produce rather a straggly growth habit. In just such habitats, however, tall forms of *A. prostrata* commonly grow in abundance. These two species look very similar and frequently hybridize; so that plants showing intermediate characters are often more in evidence than the true *A. longipes*! It is this factor which has no doubt led to confusion and difficulty of identity in the past. In *Flora Europaea*, Vol. I (1964) this species is quoted as 'recently found to be widespread in the British Isles' and adds that the many subspecies and variants are probably more correctly regarded as intermediates between *A. longipes* and other related taxa. Indeed, the limited experience on the West Norfolk coast testifies to the accuracy of this last observation. We know very little about the distribution in Britain of the species itself.



Atriplex longipes. Drej. Two leaves from midway on plant and one axillary bracteole.



Atriplex prostrata. Two leaves from midway on plant and two axillary bracteoles.

As mentioned above, *A. longipes* is closely related to *A. prostrata* and like other species in the group there is considerable variation in leaf shape, changing noticeably from the base to the apex of the plant. The most reliable leaves for diagnostic purposes are those which are produced in the midway region of the main stem. In *A. longipes* these leaves are narrow triangular with a pair of weakly developed out-pointing basal lobes and a cuneate base. The base angle of these leaves is less than 145° giving a leaf length/breadth ratio of 1.3-3.5. By contrast the leaves of *A. prostrata* from a similar position on the plant are triangular hastate in outline, with stronger out-pointing lobes, a truncate base with basal angle of 160 - 230° and leaf length/breadth ratio of 0.9 - 2.0 (Gustafsson, 1975) (See illustrations.) Unfortunately by the time the plant is forming good fruit the middle stem leaves are mature and tend to fall off, so that care in handling is necessary. There is some evidence that *A. longipes* flowers slightly earlier than *A. prostrata* and starts to 'yellow' while the latter plant is still green.

The second important factor which characterises *A. longipes* is to be seen in the axillary bracteoles. These are elongate triangular to rhombic in outline, thin, herbaceous and entire except for a small distinctly developed pointed basal lobe on each side. The surface of the ripe bracteole is often strongly reticulate-veined especially towards the base, and the margins are united only at the base. Some of the axillary bracteoles have characteristic long stalks up to 20 mm. in length. In *A. prostrata* the bracteoles are triangular-hastate to triangular ovate with a truncate to obtuse base. The basal lobes are rounded or sometimes toothed and are often toothed towards the apex. The surface is smooth or tuberculate and lacks the prominent venation of *A. longipes*. The margins are united only at the base. (See illustrations.)

In the preparation of this note the writer is grateful to Pierre M. Taschereau for his help in the field, with identification of plant material and with the detailed taxonomic descriptions cited.

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THREE YEARS' MOTH TRAPPING AT WELLS

by P. R. Banham

Since 1974 a moth trap has been in operation at Wells Field Study Centre, supplied by Rothamsted Experimental Station as part of their national insect survey, but manned by the Centre Staff. The light is a clear 200W bulb, which attracts moths from a smaller radius than a mercury vapour lamp, and the trap is in the Centre grounds, beneath Cedar and Holm Oaks, with tarmac to the South and a garden to the North. Open country is, of course, not very far away but, none the less, the setting is urban rather than rural.

An important feature of this scheme is that the trap functions every night of the year, the catch being identified every day, so it may be assumed that all light-attracted species occurring in the vicinity are likely to be encountered. The total number of species trapped over the three years 1974, 75 and 76 was 143, consisting of 68 *Noctuidae*, 61 *Geometridae* and 14 of other families (Microlepidoptera are not included). 58 (40.6%) of these 143 occurred in all three years. 100 (69.9%) were trapped in 1974, 98 (68.5%) in 1975 and 102 (71.3%) in 1976.

A table of selected results is given below, and a complete list of species trapped is appended.

I should like to record my gratitude to Mrs. Joan Nicklen, of Rothamstead Experimental Station, for help with identification in the first year.

TABLE 1.

	1974	*1975*	*1976*
First Moth	*Alsophila aescularia* 21.3	*A. aescularia* 27.3	*Conistra ligula* 26.1
Commonest Noctuid	*Luperina testacea* 68	*L. testacea* 109	*L. testacea* 206
Commonest Geometer	*Xanthorhoe fluctuata* 97	*X. fluctuata* 144	*Scopula imitaria* 132
Commonest of others	*Spilsoma lutea* 28	*S. lutea* 18	*S. lutea* 34
Last Moth	*Opheroptera brumata* 14.12	*O. brumata* 17.12	*O. brumata* 23.12

The figure following each species is either the appropriate date or the total number of pecimens caught in that year.

NOCTUIDAE

A *Agrochola lychnidis* Beaded Chestnut
A *Agrotis exclamationis* Heart & Dart
A *Agrotis puta* Shuttle-shaped Dart
D *Agrotis segetum* Turnip Moth
B *Allophyes oxyacanthae* Green-brindled Crescent
A *Amathes c-nigrum* Setaceous Hebrew Character

A *Amathes triangulum* Double Square-spot
A *Amathes xanthographa* Square-spot Rustic
F *Amphipyra tragopoginis* Mouse
F *Anchoscelis litura* Brown-spot Chestnut
A *Antitype flavicincta* Large Ranunculus
B *Apamea lithoxylea* Light Arches
A *Apamea monoglypha* Dark Arches
G *Apamea remissa* Dusky Brocade
A *Apamea secalis* Common Rustic
A *Apamea sordens* Rustic Shoulder-knot
C *Apatele psi* Dagger
A *Axylia putris* Flame Ruxtic
A *Caradrina alsines* Uncertain
D *Caradrina blanda* Smooth Rustic
A *Caradrina morpheus* Mottled Rustic
F *Ceramica pisi* Broom Brocade
E *Cerapteryx graminis* Antler
C *Conistra ligula* Dark Chestnut
D *Diarsia brunnea* Purple Clay
B *Diarsia mendica* Common Ingrailed Clay
A *Diarsia rubi* Small Square-spot
E *Diataraxia oleracea* Bright-line Brown-eye
E *Dicestra trifolii* Nutmeg
D *Eremobia ochroleuca* Dusky Sallow
A *Eumichitis lichenea* Feathered Ranunculus
A *Euplexia lucipara* Small Angle-shades
A *Euschesis comes* Lesser Yellow Underwing
D *Euschesis interjecta* Least Yellow Underwing
B *Euschesis janthina* Lesser Broad-bordered Yellow Underwing
D *Gortyna micacea* Rosy Rustic
G *Hada nana* Light Shears
A *Hadena bicolorata* Broad-barred White
E *Hadena lepida* Tawny Shears
F *Hadena rivularis* Campion Coronet
E *Hadena thalassina* Pale-shouldered Brocade
A *Hypena proboscidalis* Snout
A *Leucania impura* Smoky Wainscot
G *Leucania lythargyria* Clay Wainscot
D *Leucania pallens* Common Wainscot
A *Luperina testacea* Flounced Rustic
G *Luspeyria flexula* Beautiful Hook-wing
F *Mamestra brassicae* Cabbage Moth
C *Noctua pronuba* Large Yellow Underwing
B *Ochropleura plecta* Flame Shoulder
A *Omphaloscelis lunosa* Lunar Underwing
A *Orthosia gothica* Hebrew Character
A *Orthosia gracilis* Powdered Quaker
B *Orthosia stabilis* Common Quaker
D *Peridroma porphyrea* Pearly Underwing
A *Phlogophora meticulosa* Angle-shades
G *Plusia chrysitis* Common Burnished Brass
D *Plusia gamma* Silver Y
E *Plusia iota* Golden Y
G *Procus fasciuncula* Middle-barred Minor
C *Procus furuncula* Cloaked Minor
C *Procus latruncula* Tawny Minor
D *Procus literosa* Rosy Minor
A *Procus strigilis* Marbled Minor
D *Rusina ferruginea* Brown Rustic
A *Thalpophila matura* Straw Underwing
E *Unca triplasia* Spectacle Moth
E *Xylocampa areola* Early Grey

GEOMETRIDAE

A *Abraxa grossulariata* Magpie Moth
E *Acasis viretata* Yellow-barred Brindle
F *Alcis repandata* Mottle Beauty
A *Alsophila aescularia* March Usher
C *Anaitis plagiata* Treble-bar
C *Apeira syringaria* Lilac Beauty
E *Biston betularia* Peppered Moth (melanic)
D *Calothysansis amata* Large Blood-vein
A *Campaea margaritata* Light Emerald
B *Chiasma clathrata* Latticed Heath
E *Chloroclystis rectangulata* Green Pug
E *Cidaria fulvata* Barred Yellow
F *Cleora rhomboidaria* Willow Beauty

F *Colostygia pectinataria* Spring Green Carpet
B *Colotis pennaria* Feathered Thorn
A *Crocallis elinguaria* Scalloped Oak
E *Deilinia pusaria* Common White Wave
C *Deuteronomos alniaria* Canary-shouldered Thorn
G *Deuteronomos erosaria* September Thorn
A *Dysstroma truncata* Common Marbled Carpet
C *Earophila badiata* Shoulder-stripe
D *Ectropis crepuscularia* Small Engrailed
G *Ennomos quercinaria* August Thorn
A *Epirrhoe alternata* Common Carpet
C *Erannis marginaria* Dotted Border
A *Euphyia bilineata* Yellow Shell
G *Eupithecia centaureata* Lime-speck Pug
E *Eupithecia linariata* Toadflex Pug
E *Eupithecia succenturiata* Bordered Pug
A *Eupithecia vulgata* Common Pug
A *Gonodontis bidentata* Scalloped Hazel
B *Gymnoscelis pumilata* Double-striped Pug
C *Hemithea aestivaria* Common Emerald
A *Hydriomena furcata* July Highflyer
D *Itame wauaria* V Moth
A *Larentia clavaria* Mallow Moth
E *Lomaspilis marginata* Clouded Border
E *Lycia hirtaria* Brindled Beauty
E *Lygris mellinata* Spinach Moth
A *Lygris pyraliata* Barred Straw
G *Lyncometra ocellata* Purple-barred Carpet
A *Operophtera brumata* Winter Moth
A *Opisthograptis luteolata* Brimstone Moth
A *Oporina dilutata* November Moth
D *Ortholitha chenopodiata* Shaded Broad-bar
B *Ourapteryx sambucaria* Swallow-tail Moth
G *Perizoma albulata* Grass Rivulet
A *Perizoma alchemillata* Small Rivulet
D *Perizoma bifaciata* Barred Rivulet
D *Perizoma flavofasciata* Sandy Carpet
A *Scopula imitaria* Small Blood-vein
A *Selenia bilunaria* Early Thorn
A *Sterra aversata* Riband Wave
B *Sterra biselata* Small Fan-foot
A *Sterra dimidiata* Single-dotted Wave
A *Sterra seriata* Small Dusty Wave
C *Thera obeliscata* Grey Pine Carpet
A *Xanthorhoe ferrugata* Dark-barred Twin-spot Carpet
A *Xanthorhoe fluctuata* Garden Carpet
A *Xanthorhoe montanata* Silver-ground Carpet
A *Xanthorhoe spadicearia* Red Twin-spot Carpet

OTHER FAMILIES

F *Arctia caja* Garden Tiger
E *Cycnia mendica* Muslin Moth
G *Drepanaria binaria* Oak Hook-tip
A *Euproctis similis* Gold-tail
A *Hepialus lupulina* Common Swift
D *Hepialus sylvina* Orange Swift
G *Laothoe populi* Poplar Hawk
A *Lithosia lurideola* Common Footman (=*Eilema lurideola*)
A *Lophopteryx capucina* Coxcomb Prominent
G *Phalera bucephala* Buff-tip
F *Philudoria potatoria* Drinker
F *Poecilocampa populi* December Moth
A *Spilosoma lubricipeda* White Ermine
A *Spilosoma lutea* Buff Ermine

Key A Trapped in 1974, 75 & 76
B Trapped in 1974 & 75 only
C Trapped in 1974 & 76 only
D Trapped in 1975 & 76 on.y
E Trapped in 1974 only
F Trapped in 1975 only
G Trapped in 1973 only

A NOTE ON RAY'S BREAM IN NORFOLK

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Recently there has been increasing interest in records of rare or unusual fishes from northern Europe with the objective of amassing distributional data. A fish which has attracted much attention is Ray's Bream (*Brama brama* (Bonnaterre)). During the nineteenth century, there were apparently only about eight confirmed records from Norfolk (references summarized by Mead and Haedrich, 1965). However, in 1927 and 1952, there were considerable invasions of the North Sea (Mead and Haedrich, 1965), and more recently, *Brama* was remarkably abundant in 1967 (Wheeler and Blacker, 1969), 1969 (Wheeler and Blacker, 1972) and 1970 (Wheeler, Blacker and Pirie, 1975).

The distribution of adults is virtually limited by the 10 °C isotherm and there is a northerly migration beginning in April from off Spain and Portugal, around Ireland and Scotland, into the northern entrance of the North Sea, followed by a southward drift in September and October as the 10 °C isotherm retreats. In November and December, the fish become trapped in the North Sea, and the high percentage of beached specimens suggests that the decrease in sea temperature leads to disorientation and stranding, especially during storms (Mead and Haedrich, 1965; Wheeler and Blacker, 1969). A fair proportion (8-25%) of recorded North Sea specimens occur off Norfolk, probably because the North Sea gyre tends to throw them onto the north coast, those that miss being swept out to sea; this would also explain the rarity of *Brama* on the Suffolk and Essex coasts. Table 1 summarizes data from 1966 to 1971 (from Wheeler and Blacker, 1969 and 1972; and Wheeler, Blacker and Pirie, 1975). The remarkable increase in numbers entering the North Sea during the last decade might indicate some dramatic change in hydrographic conditions, but more data is required to confirm this. Recent reports indicate yet another above average influx during the winter of 1976-77.

TABLE 1

Records of Rays' Bream off Norfolk 1966 - 1971

Year	No. recorded in North Sea	No. and % off Norfolk	No. and % Norfolk specimens stranded
1966	13	1 (7.7%)	0 (0%)
1967	77	13 (16.9%)	12 (92.3%)
1968	8	2 (25.0%)	2 (100.0%)
1969	99	9 (9.1%)	7 (77.8%)
1970	67	9 (13.4%)	6 (66.7%)
1971	28	5 (17.9%)	5 (100.0%)

Recently I have recorded Ray's Bream in Norfolk three times: a 45cm specimen on Cley beach on 13 December 1975, following a storm; a 40 cm specimen on Wells beach on 20 November 1976; and a 40 cm specimen on the marsh east of Brancaster Staithe on 21 November 1976. All three specimens were beached and had obviously died very recently.

I am grateful to Mr. A. Wheeler for his helpful advice in preparing this paper.

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A NOTE ON HOLKHAM LAKE, NORFOLK

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Holkham Lake (National Grid Ref. TF 883435) lies within Holkham Park and is a Site of Special Scientific Interest scheduled under the National Parks and Access to the Countryside Act, 1949. It supports a large population of wildfowl and an interesting rare mineral, vaterite, has been found there (Rowlands and Webster, 1971). Although now fresh-water, Holkham Lake was once tidal, being connected to the sea by a channel leading past Holkham Staithe. In about 1719 the Coke family, owners of the Holkham Estate, had an embankment built which excluded the sea from the Staithe (Purchas, 1965). This same embankment effected the physical and biological isolation of Holkham Salts Hole, which unlike Holkham Lake has maintained a high salinity (74-83% sea water) and supports a peculiar relict marine fauna (Hunt, 1971). It was therefore of interest to carry out a survey of the Holkham Lake invertebrates in order to ascertain whether any of the original fauna had managed to adapt to fresh water conditions during the transition period and now survived as relict species.

The results of this survey, carried out with the kind permission of the Holkham Estate, suggest that the present fauna consists only of fresh-water species which colonised the lake as the salinity fell. None of the specimens collected showed any unusual morphological features. The specimens were as follows: the leeches *Helobdella stagnalis* and *Batracobdella paludosa;* the water louse *Asellus aquaticus;* the water fleas *Daphnia magna* and *Eurycercus lamellatus;* a midge larva of *Chironomus thummi type*; a phantom midge larva *Chaoborus* sp.; the lesser waterboatman *Cymatia coleoptrata;* the alder-fly larva *Sialis lutaria;* the caddis larva *Agraylea multipunctata*; the water beetles *Stictotarsus duodecimpustulatus*, *Potamonectes depressus*, *Enochrus melanocephalus*; the water snails *Valvata macrostoma*, *Lymnaea peregra* and *Gyraulus* (=*Planorbis*) *albus*; the swan mussel *Anodonta cygnea* and a pea cockle *Pisidium* sp. *B. paludosa* and *V. macrostoma* are both rather uncommon in Great Britain.

Identifications were by G. A. Boxshall and Miss J. Ellis (Crustacea); E. G. Easton (Hirudinea); C. H. Lyal, P. C. Barnard, M. J. D. Brendell and P. S. Cranston (Insecta); and R. B. W. (Mollusca).

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ADDITIONAL NOTES ON THE FOOD OF THE OTTER IN THE BLAKENEY AREA

by Vincent Weir

and K. E. Banister

Introduction and Methods

In our previous paper "The Food of the Otter in the Blakeney Area"—Norfolk Bird & Mammal Report 1971, we gave the results of a study carried out in 1969 and 1970 of the food of the Otters inhabiting the coastal strip between the Salthouse Marshes and the Stiffkey River. Information was gained by spraint analysis, by recording remains of Otter meals and by observing the animals while they were feeding. It should be noted however that although this study covered a period of two years the majority of the spraint collections was made during 1969 with only four collections made in 1970, (January, February and March). We stated in that paper that it was our intention to continue this work in the same area and to record water temperatures in an attempt to establish any correlation between water temperature and the absence of Eels in the Otters' diet in winter. We therefore embarked on a further year's study covering the period from the beginning of July 1973 until the end of June 1974. The methods used were similar to those described in the previous paper. Spraints were collected each weekend and the food remains found therein were compared with material in the collection of the British Museum (Nat. Hist.) by one of us (K.E.B.). A total of 1,060 single spraints was collected.

A maximum/minimum thermometer was placed in the main drain on Salthouse Marsh about a quarter of a mile from the East Bank and weekly readings taken (except for the second week in August 1973). It was housed in a wire cage and the cage was sunk to the bottom of the drain. The depth of water above the cage varied between 3 ins. - 1ft. 6 ins. The day time visits to the area differed slightly from those made in 1969 and 1970. Special attention was paid during the study period to the extent of the home range and population size of the Otters and this necessitated covering a larger area during the day than in the past. Otter access and exit points at individual marshes had to be checked regularly and consequently marshes such as Salthouse and Cley were not searched as thoroughly as before. This could in part account for the small number of instances of Otters' meal remains being found during the course of the study.

With regard to sprainting sites discussed in the previous paper, we feel justified in mentioning two additional places which seem exceptional. One was a ring and shackle fixed into concrete above a small sluice upon which the animals frequently sprainted. The other began as a typical site at the bottom of a sea wall and had been favoured for sometime before a Mole raised a hill on the exact spot. The Otters continued to spraint here but now on top of the Mole hill.

Results

The winter of 1973/1974 was generally mild (see Table 1) with no extremes of temperature. We were therefore unable to gain any information regarding a link between water temperatures and the presence or absence of Eel remains in the spraints. Unlike the 1969 results Eel bones were found in all but two of the weekly collections during the winter of 1973/1974.

The results in general followed a similar pattern to the 1969/1970 study. The Three-Spined Stickleback and the Common Eel formed the bulk of the Otters' diet and we estimate, on a volume basis, that the two species together constituted about 85% - 90% of the animals' food as against 80% in the previous study. Eels, however, formed a larger proportion of the food than before, comprising about 40% - 45%, or about half, of the figure given for the two species, compared to a third in 1969/1970.

The remains of cyprinid fishes were found in ten of the spraint collections and Roach was identified on two occasions (November and December 1973). Cyprinids constituted only a very small part of the Otters' diet compared to the fairly regular appearance of these fish in the collections, although only in small quantities, during the previous study. One explanation for this is that during a period of gales and very high tides in November 1971, the road drain through Salthouse and Cley Marshes where the Otters find some of their cyprinids was flooded with salt water and most of the fish, if not all, were killed. It is interesting to note that the ten occurrences of these fish in the spraints were from July 1973 until February 1974 and that they were recorded in each of these months except for January 1974. In 1969 there was a considerable reduction in the amount of cyprinid remains in the summer and early autumn. During this period Crayfish were frequently eaten. However during the recent study Crayfish were only found twice in the spraints (September 1973 and May 1974), compared with nine instances over the period from the end of June to the middle of November 1969. We had thought that this could have indicated a poor year for Crayfish, the Otters supplementing their main diet of Sticklebacks and Eels with cyprinids in lieu of Crayfish during the summer and early autumn. However, Dr. R. Ingle of the British Museum (Nat. Hist.) who monitors Crayfish population changes, informed us that he has no evidence of a decline in Crayfish abundance during this period. We are therefore at a loss to explain the difference between the Otters' diet for 1969/1970 and 1973/1974.

Fish of other families found in the collections included Perch, identified on two occasions (December 1973), Trout on four occasions (November and December 1973 and June 1974), Pike on four occasions (August 1973, March, April and May 1974), Bass once (November 1973) and Flounder once (March 1974). We are glad to have identified Flounder remains, for as we stated in the earlier paper, these fish are common in the area and there seemed no reason why the Otters should not eat them. Otters were also observed by V.W. on two occasions eating fish which without much doubt were Flounders. Remains of fishes of the family Cottidae were found in thirteen of the spraint collections and in three of these Miller's Thumb was identified (July, September and October 1973). The remains in the other ten collections were too broken up for the species to be determined. With regard to Trout, we reiterate our view expressed in the

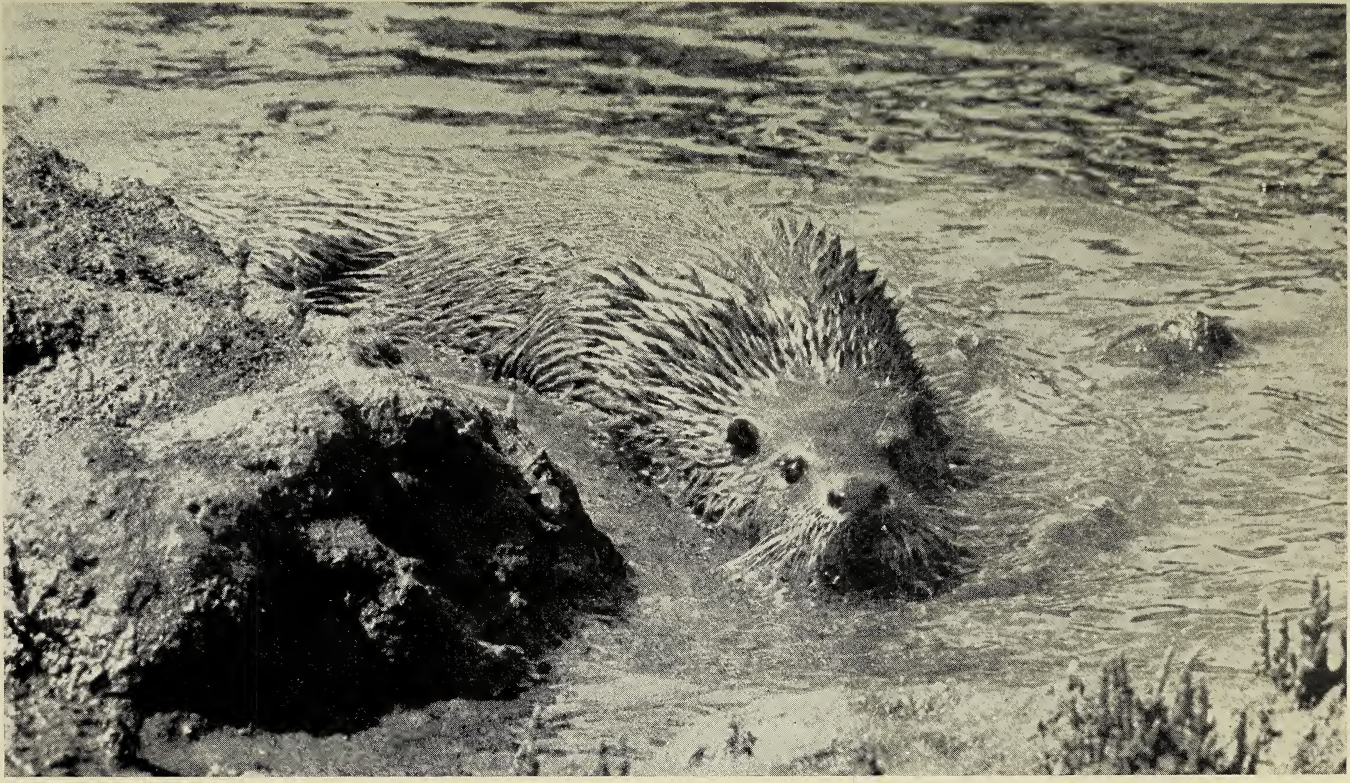
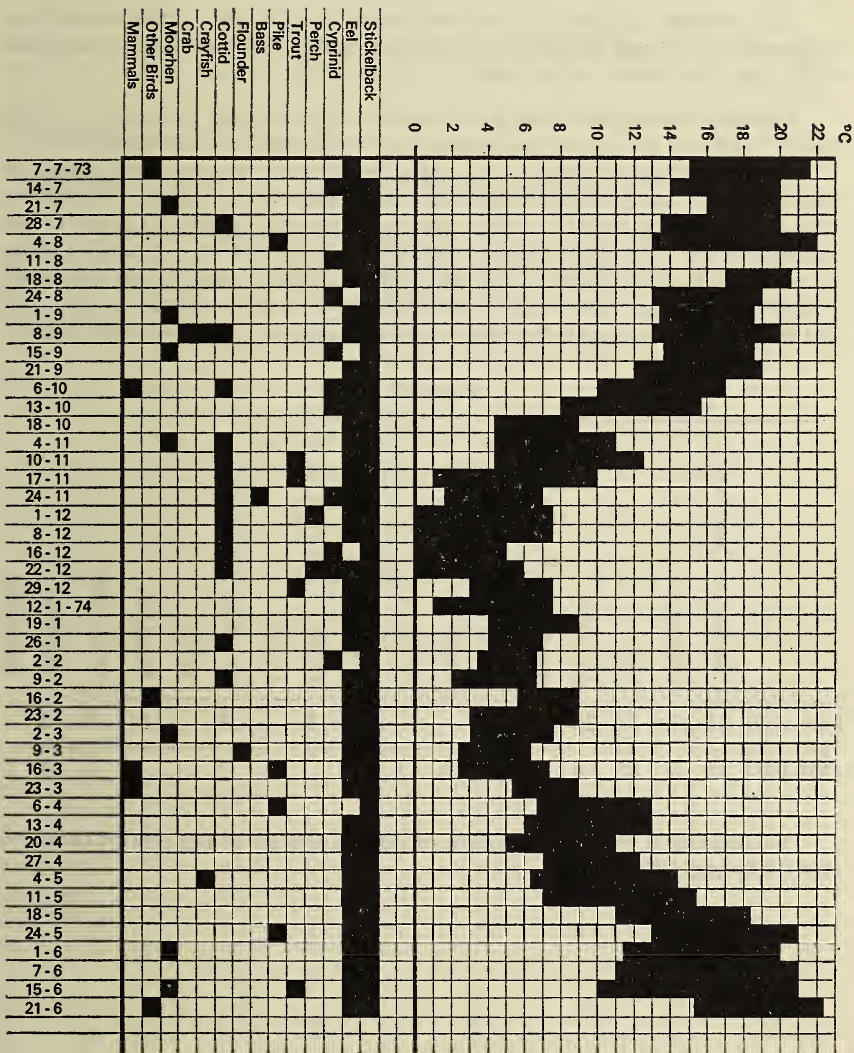


Figure 1. Eurasian Otter (*Lutra lutra barang*) (Photo Philip Wayre copyright)

Figure 2. Eurasian Otter (*Lutra lutra barang*) feeding. (Photo Philip Wayre copyright)

TABLE 1


Mammals
Other Birds
Moorhen
Crab
Crayfish
Cottid
Flounder
Bass
Pike
Trout
Perch
Cyprinid
Eel
Stickelback
0
2
4
6
8
10
12
14
16
18
20
22
°C
7-7-73
14-7
21-7
28-7
4-8
11-8
18-8
24-8
1-9
8-9
15-9
21-9
6-10
13-10
18-10
4-11
10-11
17-11
24-11
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8-12
16-12
22-12
29-12
12-1-74
19-1
26-1
2-2
9-2
16-2
23-2
2-3
9-3
16-3
23-3
6-4
13-4
20-4
27-4
4-5
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18-5
24-5
1-6
7-6
15-6
21-6

previous paper that in waters where both coarse and game fishes occur Otters show a marked preference for the former. A noteable example of this took place on the Glaven River during 1972. In the spring of that year many Trout escaped from a Trout farm on the River and during the summer these fish were common in the Glaven, especially around the sluice at Cley. Spraints were collected in May and June and examined for Trout remains but none was found.

The remains of Shore Crabs were found once in the spraint collectione (September 1973) and evidence that they had been eaten was noted during ons of the day time visits to the area.

Mammal bones were present in three of the collections (October 1973 and March 1974) but they were too broken up for the species to be identified.

Bird remains were found in ten of the weekly spraint collections compared with twenty in our previous study. As before Moorhens were the birds most frequently eaten by the Otters and their remains were present in seven of the samples. In the other three samples the species could not be identified. During the year only two dead birds, a Mallard and a Redshank, were found which had been killed by Otters. In the case of the Mallard there was evidence to show that the Otter returned to the kill the following night and more flesh was taken from it.

TABLE 2

	Number of Collections	Stickleback	Eel	Cyprinid	Perch	Trout	Pike	Bass	Flounder	Goby	Cottid	Crayfish	Crab	Moorhen	Other Birds	Mammals	Frog/Toad
1969-1970	52	52	35	26	3	1				1		9		16	4	2	
1973-1974	47	46	42	10	2	4	4	1	1		13	2	1	7	3	3	3

A comparison of the occurrence of certain species in the diet of Otters in 1969/1970 and 1973/1974.

WEATHER 1975/1976

By T. B. Norgate

Again pressure on space necessitated combining two years into one report and to listing the weather features statistically.

Norfolk Weather 1975 and 1976

	MEAN TEMPERATURE			NO. OF AIR AND GD. FROSTS			SUNSHINE HOURS		
	°C 1975	°C 1976	10-yr. Avge.	1975	1976	10-yr. Avge.	1975	1976	10-yr. Avge.
Jan.	6.2	5.0	4.1	0/11	2/10	8.2/15.2	44.3	60.9	40.2
Feb.	4.3	4.1	3.5	9/22	8/17	10.3/18.6	84.4	53.9	68.1
March	4.7	4.6	5.3	6/17	6/17	6.7/17.3	71.9	116.4	114.5
April	7.8	7.8	7.4	3/11	3/10	3.3/12.1	123.1	175.5	152.6
May	9.8	11.8	11.0	0/8	0/4	.7/5.9	177.4	191.6	184.7
June	13.9	16.7	14.0	0/0	0/2	0/1.0	259.5	276.6	215.5
July	16.7	18.0	15.6	0/0	0/0	0/0	218.4	316.0	196.3
Aug.	18.3	16.8	16.3	0/0	0/0	0/0	251.1	268.2	184.4
Sept.	13.5	13.8	13.6	0/1	0/0	.1/.6	167.5	122.9	147.1
Oct.	9.8	11.5	10.6	0/4	0/1	.1/5.6	116.0	63.1	100.2
Nov.	6.7	6.1	6.5	8/17	4/12	5.8/12.8	72.0	62.1	65.5
Dec.	4.0	1.8	3.9	9/18	16/25	9.4/17.2	35.4	73.9	46.0
Year	9.6	9.8	9.3	35/109	39/98	44.6/105.3	1621.0	1781.1	1515.1

	RAINFALL			DAYS WITH HAIL OR SNOW			DAYS WITH THUNDER		
	1975 mm	1976 mm	10-yr. Avge.	1975 H/S	1976 H/S	10-yr. Avge.	1975	1976	10-yr. Avge.
Jan.	65.0	69.0	53.1	1/0	5/3	2.6/.4	—	—	.1
Feb.	14.7	17.8	41.1	—	1/0	4.1/1.0	—	—	.3
March	97.2	15.6	36.8	10/5	4/0	3.5/.7	1	—	.3
April	54.5	17.7	43.4	8/4	—	1.5/1.8	2	—	1.2
May	49.1	24.6	49.7	—	0/2	.1/.4	—	4	3.4
June	37.8	9.1	35.3	1/1	—	0/.5	1	1	2.0
July	18.4	35.7	58.7	—	—	—	5	3	2.7
Aug.	1.8	52.1	52.1	—	—	—	2	4	2.9
Sept.	84.0	79.4	48.5	—	—	0/.1	3	6	2.4
Oct.	34.4	111.4	56.6	—	—	0/.3	2	3	.8
Nov.	78.5	51.7	84.8	—	0/1	2.2/1.2	—	—	.7
Dec.	37.1	48.5	53.1	2/2	5/1	2.7/1.0	—	—	.2
Year	572.5	532.6	613.2	22/12	15/7	16.7/7.4	16	21	17.0

For year	1975	1976
Max. temperatures Highest (°C) Air	8 Aug. 32.0°	26 June 32.6°
Max. temperatures Lowest (°C) Air	30 Nov/1 Dec. —.8°	30 Jan. —1.4°
Min. temperatures. Lowest Air	16 Dec. —4.2°	9 Mar. —9.4°
Min. temperatures Lowest Ground	1 Mar. —9.6°	28 Jan. —11.1°

1975

January. The mean temperature for Dec. '75 together with the following January, jointly, was the highest for at least 300 years. Rainfall was mostly on the high side, especially in the S.E. corner of the county.

February. Despite high day-time figures many ground and air frosts kept the mean temperature down, but being dry and sunny, it was a pleasant month.

March. Squally showers of sleet, hail or even snow came in from the North Sea. It was the wettest March since 1947, some rain falling on almost every day.

April. Snow fell on 8 days though amounts were small. N.W. Norfolk was the wettest area with heavy showers inland.

May. It was the coldest May since 1955, the coldest night being at the very end with 3 °C of ground frost, but increasing sunshine made some amends.

June. A depression from the Arctic brought very cold weather, and snow stopped play at two county matches. More reports of snow reached the Met. Office than in any "summer" month during the last 87 years. Scattered thunderstorms prevailed but parts of the county were very dry.

July. Again thunderstorms caused patchy rainfall, amounts varying from under 12 mm at Downham Market to more than 10 times as much at Marsham, much of which fell in 90 minutes on the 17th.

August. The mean temperature was the highest for 50 years and the day's max. for the year, 32 °C (almost 90 °F.), was recorded on the 8th. There were 11 days above 26.7 °C (80 °F.), a sure indication of hot weather. The heat-wave ended suddenly in the middle of the month, but not the drought which had just begun.

September. The month started dry enough to complete a drought (15 days), but thunderstorms finally made it the wettest month since March. Over 25 mm fell in many places on the 13th and 14th.

October. Fenland and Breckland escaped thunderstorms and thus the rain, having less than 12 mm, whereas other parts had over 40 mm. Temperatures were reduced by fogs night and morning.

November. Though a wet month, much of it fell in 3 - 4 days in the middle of the month but it was much drier near the coast.

December. Snow lay to a depth of 2 cms (less than 1in.) for a while in the middle of the month around Downham Market. There were no air frosts after the 20th and only slight ground frosts, nor any worth-while amounts of sunshine.

The Year. Though the year's mean temperature was on a par with the average, seasonally there were significant differences. Treating Dec., Jan. and Feb. as Winter; March, April and May as Spring, etc., the Winter of 1975 was over 2 °C on the warm side, Spring slightly cool, Summer up by 1 °C (thanks to August) and Autumn was fractionally below normal. Rainfall was nearly 60 mm (over 2¼in.), about 10 per cent, below average in central Norfolk; but thunderstorms in Summer and Autumn gave wide variations. These ranged from over 700 mm (28in.) at Colkirk and Bradfield to 480 mm (19in.) in the Fens and West Norfolk. Spring lacked sunshine otherwise the year was sunnier than usual.

1976

January. Westerly weather dominated until the 22nd/23rd when it became much colder. Air and ground frosts occurred each night during the last week and the maxima did not rise above freezing on either of the last two days. Up to 12½ cms (5in.) of snow fell during the last 10 days, some of which lasted until early next month. A whole page could be devoted to the gale late on January 2nd when a hurricane-force wind of 90 knots (104 mph.) was recorded at Cromer and 89 knots in Norwich where 3000 council houses were damaged.

February. Several days of light rain and snow showers persisted during the first week and again later, but the last 10 days were warm.

March. A drier month though there were several light showers and some snow during the first week. The weather alternated between easterly and westerly, neither becoming well-established.

April. A further dry month, the year's rainfall so far being under 50 per cent of normal and more than 75 per cent of it fell on the 13th. The last 10 days were the coldest of the month with 7.8 °C of ground frost near the end.

May. Blowing top-soil was reported during the 1st and 3rd weeks in The Fens. Thunderstorms occurred during the end of the month but the total rainfall so far this year was still 75 mm (3in.) below average.

June. The mean temperature was nearly 3 °C above normal and was believed to be the warmest June since 1846 with a max. over 31 °C in several places during the last week. It reached 32.6 °C (90.7 °F) at Morley, the highest ever recorded by the Norfolk Agricultural Station in 26 years. There were 8 days with maxima above 26.7 °C (80 °F). It was also the driest since 1921 and drought conditions prevailed for most of the month.

July. Another month with record-breaking temperatures, only one day in the first 12 failing to reach 26.7 °C. This figure gives an indication of a "good" summer. Thunderstorms on the 15th and 16th, with up to 35 mm (nearly 1½in.) of rain at Salle, broke the drought.

August. There were more thunderstorms at the beginning and again at the end, particularly during 4 days in the last week. Rainfall was near or above average in most of the county, and R.A.F. Marham recorded almost 125 mm (nearly 5in.), over 47 mm (nearly 2in.) falling on Bank Holiday. Despite this there was a 22-day drought and it was the sunniest August for 29 years with only one completely sunless day.

September. Intermittent showers persisted throughout the month with six thundery days in the second half. The Fen District was the driest with just over 50 mm and Houghton, near Walsingham, the wettest with a total of over 152 mm. (6in.).

October. It was a wet month with rain falling on 23 days, and with thunderstorms at the beginning. Amounts of rainfall were very uneven, varying from 90 mm (3½in.) near Norwich to over 160 mm (6½in.) in the Northrepps area. During the last week of the month there were 5 consecutive sunless days, the first time since March.

November. This was a dreary month but fairly dry so far as rain measurement was concerned. But there was little "dry" in the ground which restricted farm work. The barometer was well below 1013 mb. (30in.) for the fiist half of the month and below 980 mb. (29in.) at the very end, dropping at the rate ot 2mb. (.06in.) per hour. Despite this there was little wind and fogs were frequent.

December. The coldest month of the year yielded 17 air frosts and 26 on the ground. The mean temperature was ½ °C cooler than the last cold December of 1968 and .1 °C warmer than Dec. 1962. Slight snow showers in the second half of the month did not last long. The mean ground temperature was —.5 °C for the month, unusually low, and Morley recorded surprisingly low mean earth temperatuies at various depths: 10cms (4in.) .4 °C; 20 cms (8in.) .7 °C and at 30 cms (12in.) 1.8 °C.

The Year

Winter 1975/76. With the same definitions for seasons as before, Winter, though cooler than last year, was still ½ °C above the recent average. Rainfall was almost identical with last year's, i.e. about 20 per cent down, while sunshine was rather lower than last year, but still nearly 10 per cent above normal.

Spring. The mean temperature was only just above average while sunshine was about 8 per cent above. Rainfall was noticeably low, more than 50 per cent down.

Summer. Rainfall being 30 per cent below normal, the drought was made more serious as it followed an even drier spring. A mean temperature 2 °C above average, coupled with outstandingly high sunshine hours made it a memorable summer. Almost half the year's sunshine total was recorded during the three summer months and was over 60 per cent above average. It is reckoned that the sun shone for 59 per cent of the possible number of hours for this latitude.

Autumn. This season made some amends for the lack of rainfall, being over 50 per cent above normal, though overall the year's total was still about 11 per cent on the low side. Most of the restrictions on water consumption were able to be lifted. Temperatures were just about normal and sunshine was a mere 5 per cent down.

1976 Summary. This year has been such an unusual one with so many broken records. Everyone will remember the summer drought and heat-wave. Dry conditions began even towards the end of January, and by June the first three official summer droughts was experienced. It has been reckoned that by the end of August it was the driest three-month spell for 250 years, or even longer. Dried-up reservoirs and a serious drop in the water-table were general.

Coupled with the drought, 1976 was the warmest and sunniest summer this century. There were 24 days with temperatures reaching 26.7 °C (80 °F) which compares with 14 days in 1975—in itself considered to have been a "good" summer.

NOTES TO CONTRIBUTORS

1. All manuscipts submitted for publication should be sent to Dr. E. A. Ellis, Wheatfen Broad, Surlingham, Norwich.

2. Manuscripts should be typed double spaced on one side of the paper. Latin names of genera and species should be underlined. Dates should be in the form 1 January 1972. Text figures should be referred to as Fig. 1, etc.

3. All Latin names should be followed by the authority when the name is first mentioned in the text or table.

4. References should be in alphabetical order at the end of the paper, in the form of :

Bloomfield, E. N., 1905. Fauna and flora of Norfolk. Trans. Norfolk & Nor. Nat. Soc., 8. 117-37.

5. Tables should be set on separate sheets and numbered in arabic numerals.

6. Drawings should be in jet-black indian ink. Shading should be in lines or dots but not in half-tone washes.

7. Page-proofs only will be sent. They should be returned with the least possible delay, and the minimum of essential correction should be made.

8. Authors are supplied with 15 offprints gratis. Additional copies may be ordered when the proofs are returned.

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5. 246

Norfolk Bird & Mammal Report 1976

Published by The Norfolk Naturalists Trust
and The Norfolk & Norwich Naturalists Society

Vol. 24 Part 3

Norfolk Naturalists' Trust Properties

Date Acquired		Acreage		Status*
	On the Coast			
1926	Cley Marshes	435	Gift	S.S.S.I.†
1937	Duchess's Pightle, Burnham Overy	1	Gift	——
1937	Great and Little Eye, Salthouse	10	Purchased	S.S.S.I.
1945	East End of Scolt Island	76	Purchased	N.N.R.
1955	The Eye, Salthouse	21	Purchased	S.S.S.I.
1965	Holme Dunes	400	Purchased, Gift & Agreement	S.S.S.I.
1971	Salthouse Marshes	200	Agreement	S.S.S.I.
	Broadland			
1928 and 1974	Starch Grass (Martham)	43½	Purchased & Gift	S.S.S.I.
1930	Alderfen Broad	72	Purchased	S.S.S.I.
1945 and 1969	Hickling Broad	861	Purchased	N.N.R.
1945	„ „	500	Leased	N.N.R.
1945	Barton Broad	355	Half Gift &	S.S.S.I.
1952	„ „		Half Purchased	S.S.S.I.
1948	Surlingham Broad	253	Purchased	S.S.S.I.
1949	Ranworth Broad	124	Gift	N.N.R.
1949	Cockshoot Broad	12	Gift	N.N.R.
1964	Firs Marsh, Burgh St. Peter	2½	Leased	——
1971	Martham Broad	103	Leased	S.S.S.I.
1972	Hardley Flood	90	Leased	——
1972	Chedgrave Common	10	Leased	——
1974	Barton Marshes	10¼	Gift	——
	Breckland			
1938	East Wretham Heath	362	Purchased & Gift	S.S.S.I.
1942	Weeting Heath	343	Gift	N.N.R.
1949	Thetford Heath	250	Gift	N.N.R.
	Other Areas			
1957	Thursford Woods	25	Gift	——
1960	Hethel Old Thorn	⅛	Gift	——
1961	Scarning Fen	10½	Gift	S.S.S.I.
1962	Hockham Fen (Cranberry Rough)	20	Purchased	S.S.S.I.
1963	Roydon Common	140	Purchased	S.S.S.I.
1966	Stoke Ferry Fen	25	Agreement	S.S.S.I.
1968	Lenwade Water	37	Agreement	——
1968	Dickleburgh Pightle	1	Agreement	——
1972	Smallburgh Fen	19	Leased	S.S.S.I.
1972	Ringstead Downs	26	Agreement	S.S.S.I.

(Continued on inside back cover)

Norfolk Bird Report - 1976

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Norfolk Mammal Report - 1976

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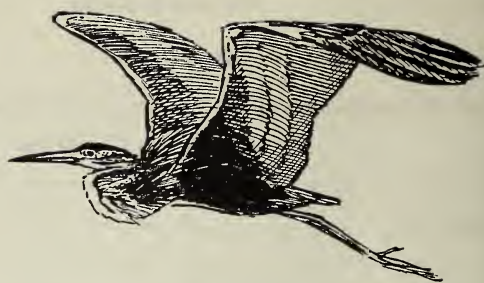
NORFOLK BIRD REPORT 1976



Editorial

The Council of the Norfolk Naturalists Trust, in co-operation with the Norfolk and Norwich Naturalists' Society, is pleased to present the annual report on the birds of Norfolk.

Review of the Year. In the early months of the year short cold spells frequently benefit Norfolk birdwatchers (as opposed to prolonged periods of cold which the County has fortunately not experienced for a number of years). Such conditions often attract an influx of birds from the continent and also result in maritime species appearing inland. This happened in 1976 with a noticeable increase in species such as Goosander and Smew at the beginning of February; Ormesby and Filby Broads were well visited during this period with excellent views being obtained of Great Northern Diver and Red-necked Grebe.

The highlight of the winter and possibly the most surprising event of the year was the discovery of a male Black-throated Thrush at Coltishall on Feb. 21st which stayed until April 3rd. Bird-watchers from all parts of the country came to see the bird which was remarkably tame. Despite the cold spell earlier in the month it is more likely that it had arrived the previous October with other Asiatic vagrants.

In recent years spring, as far as the bird-watching calender is concerned, has been relatively late in reaching Norfolk and 1976 was no exception. There was a predominence of cold easterly winds in both March and April and summer migrants were slow to arrive, especially on the coast. However, in compensation winter visitors were still in evidence up to the end of April including both Goshawk and Red Kite.

The main arrival of summer visitors, and passage migrants, occurred in May. As usual this month produced an interesting selection of vagrants including Purple Heron, Glossy Ibis, Black Kite, Red-footed Falcon, Great Snipe and Serin. Most rarities during May are rarely seen for more than one day but the Great Snipe at Hardley Flood for four days was a noticeable exception, giving many observers very close views from one of the hides.

The most interesting record in June was a Lesser Golden Plover at Breydon. Whereas most records of this species in this country relate to individuals on grassland this bird remained entirely on the mudflats, mostly in the company of a small flock of Grey Plovers.

The breeding success of the County 'specialities' was somewhat variable. The most worrying tend, however, was the dramatic decline in the number of 'booming' Bitterns.

Apart from a Roller in the Brecks, July was a generally uneventful month, characterised as usual by the main commencement of the autumn wader passage.

The second half of August and September produced, compared with recent years, an above-average number of 'falls' of continental passage migrants on the north and east coasts. Wrynecks were much in evidence and the variety of migrants included 4 Aquatic and 3 Greenish Warblers. Other vagrants seen during this period included Fan-tailed Warbler (the first British record), Bonelli's Warbler, Radde's Warbler (a very early date and the first record of this species on the east Norfolk coast), Lesser Grey Shrike, Tawny Pipit and Little Bunting. Rare waders were virtually absent in the autumn apart from Great Snipe, with 3 further records, obviously arriving in association with other continental migrants.

There were several noticeable sea-watches in the autumn for those dedicated few observers brave enough to face the onshore gales. Several high counts of Shearwaters, Skuas and Little Gulls were obtained.

As opposed to 1975, October was generally disappointing owing to the lack of easterly winds. Nevertheless a number of vagrants were seen including a Roller, single Savi's and Arctic Warblers, and Richard's Pipit. The 'hoped-for' fall of Asiatic vagrants eventually occurred at the end of October when 3 Pallas' Warblers, an Olive-backed Pipit, and two Tawny Pipits (of one of the eastern races) were seen. Two observers were also fortunate to see two Cranes land briefly at Holkham during this period. The late autumn was also noticeable for the lack of immigrant Redwings and Fieldfares, which arrived in considerably smaller numbers than normal, a situation which still applied at the year's end. In contrast the end of December saw the arrival of considerable numbers of Wigeon in the eastern part of the County, following south-easterly gales.

Acknowledgements: Thanks are due to G.M.S. Easy for the Black-throated Thrush cover drawing and for text illustrations; also to Dr. A. Beaumont, R. J. Chandler, A. L. Howes, R. Ludford, R. Powley and D. I. M. Wallace for photographs and vignettes; to Holme Bird Observatory N.O.A. for access to their records, to the Norfolk Naturalists Trust Wardens; to the National Trust (Blakeney Point); to the Nature Conservancy (Scolt Head, Holkham, Bure Marshes (Woodbastwick) and Hoveton Great Broad); to the Cambridge Bird Club; to the Gt. Yarmouth

An Olive-backed Pipit remained at Holkham five days. It is the second county record.

Naturalists Society; to D. A. Dorling and P. R. Allard (for compiling the annual record cards); to Mrs. M. Dorling, J. T. Fenton; P. D. Kirby, Mrs. P. A. Rix and Mrs. M. J. Seago for valuable assistance and to all other contributors.

Recording. Records for the 1977 Report (including field descriptions of rarities) should be sent *by the end of January* to Michael J. Seago, 33 Acacia Road, Thorpe St. Andrew, Norwich NR7 0PP. Contributors are requested to submit notes in the order followed in B.T.O. Guide 13 (*A Species List of British and Irish Birds*). In order to minimise the work involved, records will not normally be acknowledged. The names of all contributors will be included in the Report. Following boundary adjustments in April 1974, this Report includes records from localities formerly appearing in the *Suffolk Bird Report.* Following the notification of the establishment of a County Records Committee in the 1975 Bird and Mammal Report, the Committee has considered all submitted records of semi-rare birds seen in the County in 1976. The response for descriptions has been most encouraging and where no details accompanied submitted records, 'follow-up' letters asking for such details resulted in only three negative replies.

Nevertheless the Committee would particularly request that where records of birds are submitted, and also seen by other observers, that the names of the other observers should also be submitted if known. Whilst many birdwatchers visit the County at week-ends and on holidays only a relatively small proportion submit any records (a situation which hopefully will improve). In considering records for 1976 several instances occurred where a description was requested, only to ascertain that the bird in question was seen by many other observers.

In view of the ornithological attraction of the County and the number of observers who kindly submit records, the Committee has had, by necessity, to be selective in asking for written descriptions. In the 1975 report it was stated that such descriptions are required unless the bird or birds were seen by three or more observers. Having had the opportunity of assessing 1976 records in this context it is not proposed to alter this general rule. However, it must be stressed that not all birdwatchers who visit well-watched localities such as Cley are experienced in identifying certain problematical species and the Committee, in the future, will continue to ask for further details in certain instances. This situation occurred in a small number of cases concerning 1976 records and in two instances the Committee reluctantly determined that the written descriptions were not acceptable.

Having regard to the total number of descriptions submitted only a very small proportion was rejected. The Committee felt that only in a few instances had birds been misidentified; in most cases it was concluded that the written descriptions were inadequate to positively identify the particular species. For example, in the case of Black-throated and Great Northern Divers and Pomarine Skua, records were rejected as the birds were apparently only identified on the basis of their size in flight. With no other species nearby for comparison, size can be deceptive and can lead to misidentification. Sooty Shearwaters, especially if identified at long range, can be confused with dark-phase or immature Artic Skuas, especially if the latter species is seen in gale conditions when their method of flight is similar to a Shearwater. Whilst most records of birds of prey included details of plumage, few included any reference to their method of flight, wing action etc.; these factors can help to positively identify one species from another.

In relation to records for 1977 and thereafter observers are requested to enclose written descriptions where necessary of those species listed in the 1975 report with their records, in order to reduce the administrative burden and cost of postage in requesting further details.

Largest numbers of Greenshank were at Snettisham where as many as fifty assembled in July. *Photo R. J. Chandler*

Little Stint autumn passage began in mid-July with a straggler lingering at Breydon Water until the year end. *Photo R. J. Chandler*

BLACK THROATED THRUSH

Vagrant from the Taiga Forest

The rarity—be it American or Siberian—is always sought with a zeal and determination peculiar to the avid birdwatcher. Rare warblers and pipits are encountered with some regularity, but the vagrant thrush or lark is distinctly rarer. It was not therefore surprising that the rumour of a Black-throated Thrush seen in Holkham Wood on 21st October, 1975, heralded a mini invasion of 'twitchers' from all parts of the country. Many visitors were understandably disappointed when it left the area after only three days. That was the fifth accepted record of the species in this country, and only the thirteenth record of an Asiatic thrush of the genus 'Turdus' since the first bird recorded was trapped in Sussex in 1868.

The unexpected however always occurs; especially in the world of birds. After a cold spell the following February which drove thousands of starving redwings south from northern England, a male Black-throated Thrush was found on 21st February in a meadow at Coltishall, conveniently just a few yards from a public footpath. This brought a major invasion of bird watchers with numbers estimated at over a thousand in the first three days—and nobody went home disappointed.

This handsome thrush, although superficially similar to the fieldfare is closer in habit to the ring ouzel, being about the same size as the ouzel with the same mode of stance and movement. Its plumage is uniform grey-brown on the head, mantle and back, with much paler rump. The throat and upper breast are black in summer but in the wintering bird this area is heavily streaked black. The belly is white with a slight smoky wash, legs brown, bill dark brown above and orange below.

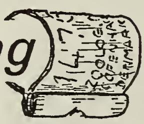
In their native Siberian breeding grounds Black-throated Thrushes prefer areas of coniferous woodland with clearings and glades. They nest in a young pine or larch, the eggs numbering five or six and similar in appearance to those of the blackbird. The young leave the nest in mid-June migrating southward to northern India, Nepal and Iran in August. The vagrant to Britain usually arrives in October onwards, and one can only wonder at how much farther westward it would travel, fearing that such birds must perish in the Atlantic. A small proportion of the population in the southern extremes of their range are residents descending from the higher slopes to find refuge in the towns and villages. In the winter they search shallow streams, feeding mainly on animal matter, but also taking berries in severe weather. The extreme south-east of the breeding range overlaps with that of the red throated thrush and interbreeding takes place.

This Black-throated Thrush delighted a great many observers during its six-week stay at Coltishall. It is a vagrant from Asia added to the county list as recently as 1975.

Photos by Dr. A. Beaumont and A. L. Howes (inset)

To return to our Coltishall bird—to my knowledge he fed exclusively on worms for in all my visits to the site I never once saw him eat anything else. He was exceptionally tame and would allow observers to watch from very close by—some fencing and bales of straw providing an excellent observation point. Aggressive in manner, he could not abide blackbirds, but was more tolerant of the smaller thrushes. At times he seemed quite taken with his growing fan club and could be seen perched on a nearby drinking trough, puffing out his chest with pride as he surveyed his newly acquired winter territory. Often, when roosting in nearby trees he would sing to himself in sub-song, like a Sylvia warbler. He seemed to gain weight during his 37 day stay—not surprising since he took little exercise apart from his aggressive assaults on invading blackbirds. About half way through his stay he was ringed, and afterwards was noticeably less tame—probably a good thing for he would have been easy prey for the village cats. Towards the end of his stay he was observed to leave the area for a few hours at a time and at the first warm spell he was gone.

George Dormer

Bird Ringing  Report

THIS YEAR'S report includes the first fruits of some comparatively new projects in Norfolk: the ringing of Canada Geese while flightless at Holkham, and the regular working of the coastal sites at Happisburgh, Sheringham and Titchwell. The Wash Wader Group on the other hand was established nearly twenty years ago, and the number of birds ringed together with the biometric data on them, is mounting fast. Recent movements to South and West Africa, and to the far north of Canada are mentioned in the Report.

There are plenty of surprises in the following list. Who could have imagined that the swallow they were ringing, weighing and measuring would eventually be found in Bulgaria, or the Jackdaw to Sweden, Robin to Algeria or Firecrest to the far north of Scotland? There are interesting controls of foreign-ringed Sand Martins, a Goldcrest and a Siskin...

Pullus means a nestling, and a control is a bird that is handled by a ringer when it is already carrying a ring fitted elsewhere.

Fulmar

The first long-distance recoveries of our breeding stock for many years:

Sheringham (pullus) 6.8.73	Ardrossan, Ayr (dead) 14.4.76
Sheringham (pullus) 3.8.76	South Shields, Durham (dead) 5.10.76

Cormorant

Iles St. Marcous, Manche, France (pullus) 26.5.73	Breydon Water (dead) 26.12.76

Gadwall

The first Czech Gadwall to be found in Britain; another was found a week later in Lincs.

Divcice, Czechoslovakia (pullus) 27.6.75	Stanford Water (shot) 15.12.75
Abberton, Essex 18.8.75	Salthouse (shot) 1.12.75

Wigeon

Late reports from earlier years include these two ringed further afield:

Kholmogory, Archangel, USSR (pullus) 8.8.68	Snettisham (shot) 3.1.69
Loch Moraig, Scotland (ad. female) 10.7.74	Burnham Market (shot) 24.9.75

Shelduck

Salthouse 9.2.72	Heringsand, W. Germany 27.9.76
Salthouse 4.2.73	Kroonspolders, Netherlands (dead) 9.12.75

Canada Goose

Of over 900 caught at Holkham 11.7.76, 16 had previously been ringed at Holme 2.7.75, when 47 were ringed in moult. Of the 500 ringed at Holkham—the rest being released without ring—19 have since been recovered shot or found dead, the furthest being four in the Bury St. Edmunds area of Suffolk during the autumn or winter.

Oystercatcher

The following from well north of the Arctic Circle were found dead in breeding areas.

Heacham (juv.) 14.11.70	Skavnakk, Finnmark, Norway 1.5.75
Snettisham (ad.) 19.8.67	Sorvik, Troms, Norway 29.7.75

Lapwing

King's Lynn (pullus) 22.6.74	La Haye d'Ectot, Manche, France 1.2.76

Ringed Plover

Illustrating the complexities of wader migrations:

King's Lynn (juv.) 12.8.73	St. Louis, Senegal 20.3.76
Bawsey (pullus) 9.7.75	Sunderland, Durham (injured, died) 1.3.77

Turnstone

Terrington 28.8.72	Alert, Ellesmere Is., Canada (control) 3.6.75

Redshank

Terrington 20.7.74	North Sea drilling rig 53°08'N, 3°19'E (dead) 8.5.75
Posthuiswad, Netherlands (juv.) 25.10.75	Breydon Water (dead) 14.2.76

Knot

North Wootton 31.7.73	Langabaan, Cape, S. Africa (control) 23.12.73

Dunlin

Birds controlled at Terrington July-August 1975 include individuals from Mauritania (Paris ring) and Czechoslovakia. Both had been ringed in autumn

Sanderling

Snettisham (ad.) 31.7.69	Aloen, Ghana (killed) Nov. 1975

Great Skua

From Britain's largest colony:

Foula, Shetland (pullus) 15.7.76	Haddiscoe Marshes (injured) 6.9.76

Common Gull

Illustrating the extent of breeding area represented amongst our autumn/ winter birds:

Kunnati, Estonia (pullus) 7.6.75	Holt (control) 19.12.76
Maasvlakte, Netherlands (pullus) 5.7.75	Salthouse (dead) 2.8.76
Sheringham 3.2.76	Holm Lake, Vasternorrland, Sweden (shot) 24.6.76

Black-headed Gull

Recorded movements fell into the pattern shown in the map on page 29 of the Norfolk Bird Report 1975. 22 foreign recoveries were reported.

Common Tern

A long-lived example:

Coquet Is., Northumberland 25.6.65	Holme (dead) 10.7.76

Sandwich Tern

Trischen, Schleswig-Holstein, Germany (pullus) 26.6.68	Brancaster (long dead) 26.8.75

Barn Owl

Note the age of this bird also:

Salthouse (pullus) 27.7.67	Matlaske (dead) 19.12.75

Swallow

Brough, Yorks 28.9.74	Happisburgh (control) 3.5.76
Sheringham (on passage) 8.5.76	St. Osyth, Essex (control) 4.8.76
Happisburgh 19.5.76	Pop Gruevo, Tolbukhin, Bulgaria 31.8.76

House Martin

Ritthem, Zeeland, Netherlands 26.5.72	Starston (found dead) Oct. 1975

Sand Martin

The movements from Switzerland are probably unprecedented; other movements involved parts of East Anglia, with single birds travelling to Dorset and Berks.

Yverdon, Vaud, Switzerland 16.4.75	Watlington 12.7.75
Locarno, Switzerland 10.5.75	Middleton 12.7.75
De Dikkenburgh, Netherlands 15.6.75	Downham Market 10.7.76

Jackdaw

A totally unexplained movement of a bird ringed in winter at a rubbish tip; note also its age.

Salhouse 27.12.66	Skaraborg, Sweden (shot) 1.5.76

Blue Tit

Titchwell 25.10.74	Selly Park, Birmingham (control) 22.12.75

Coal Tit

Titchwell 13.10.75	Gaywood (cat) 18.6.76

Long- tailed tit

Six birds ringed at Trimingham 11.10.75 were controlled together at Sheringham the following day.

Bearded Tit

Movement around the Norfolk and Suffolk coastal area continues to be recorded.

Titchwell 22.8.75	Goole, Yorks. (control) 6.11.75

Song Thrush

Juvenile birds moving well south again, one Norfolk-bred, the other almost certainly on migration when ringed:

Ridlington 12.6.75	Armacao de Pera, Portugal (ring only found) Feb. 1976
Trimingham 11.10.75	Eymet, Dordogne, France (killed) 5.12.75

Redwing

Holme 21.10.75	St. Saviour, Channel Is. 23.11.75

Blackbird

Recoveries were reported from France and other localities north to Sweden and two long-distance movements within the U.K. were to Antrim and Inverness.

Stonechat

Happisburgh 16.10.64	Hornsea, Yorks. (control) 7.2.76

Robin

The 1976 'fall' of Robins produced an impressive list of recoveries: from Holme, from Wicken, Cambs., and from Rochester, Kent, all within the month. Also the following:

Torham, Sweden (juv.) 16.10.76	Sheringham (control) 30.10.76
Sheringham 2.11.76	Tigzirt, Algeria (dead) 14.1.77

Reed Warbler

One of the Reed Warblers mentioned in the Norfolk Bird Report 1975 as controlled at Bexhill was back at Titchwell July 1976.

Blackcap

Note the movement after landfall of an autumn immigrant:

Sheringham 23.10.76	Titchwell (control) 25.10.76

Whitethroat

Happisburgh 21.5.75	Purbeck, Dorset (control) 6.9.76

Goldcrest

From the ringing station on the S.W. coast of Norway:

Revtangen, Norway 19.10.76	Sheringham (control) 30.10.76

Firecrest

No comment!

Holme 13.10.75	Wick, Caithness 11.2.76

Meadow Pipit

Sheringham (pullus) 5.7.76	Cauna, Landes, France (dead) 20.10.76

Starling

Many recoveries from France, N. Europe and USSR, and one from the Ekofisk Field.

Goldfinch

Shoreham, Sussex 5.8.75	Sheringham (control) 8.5.76

Siskin

Bras-Menil, Belgium 19.10.75	Titchwell (control) 23.11.75

Redpoll

Recoveries involve movements to Belgium (3), Netherlands and W. Germany. Others show seasonal movement in Eastern England.

Mealy Redpoll

Hadleigh, Essex 7.3.76	Sheringham (control) 30.3.76

Chaffinch

Downham Market 20.12.75	Helgoland, W. Germany (control) 9.4.76
Terjevann, Vest Agder, Norway (pullus) 1.6.76	North Sea (dead on platform) 23.9.76

Brambling

A bird from Ipswich, Dec. 1974, was controlled at Downham Market, Feb. 1976, and two from Downham Market, ringed late in 1975, were found in Beds. and Derbys. (ring in owl pellet) later the same winter.

Titchwell 24.11.75	Helgoland, W.Germany (control) 18.4.76
Mintlyn 15.2.75	Aunay sur Odon, Calvados, France (dead) 24.3.76

Classified notes

These notes are based on *Birds of Norfolk* (1967) where fuller details regarding status, distribution, migration and ringing recoveries may be found. Important records for Wisbech Sewage Farm (part of which is on the Lincolnshire side of the county boundary) have been selected from the files of Cambridge Bird Club. Fuller details of Fens records may be found in the *Cambridge Bird Club Report* for 1976.

The order used is that of the B.T.O. Guide *A Species List of British and Irish Birds* (1971) and English names follow current practice. Observations refer to 1976, unless otherwise stated. To save space, all but the most essential initials have been omitted. Records are of *single* birds unless otherwise stated.

Black Throated Diver: North/Wash: Hunstanton Feb. 8th and 17th, March 5th and April 3rd. Holme March 20th and April 18th. Snettisham G.P. Jan. 18th, Wells March 19th. Stiffkey Binks (dead) April 22nd. Sheringham April 14th, 1-2 Oct. 17th to Nov. 20th, dead Dec. 4th. Cley Feb. 29th and Dec. 24th. Weybourne Oct. 30th/31st. East: Winterton Sept. 21st.

Great Northern Diver: North/Wash: Hunstanton, Jan. 4th, Feb. 17th, March 6th, Oct. 9th-10th. Holme, Sept. 23rd, Oct. 6th and 31st. Snettisham G.P. March 9th. Blakeney Nov. 14th. Cley Oct. 7th, 9th, 21st and 24th, 2 on Nov. 23rd. Sheringham May 26th, 2 Sept. 30th, Oct. 30th and Nov. 21st. West Runton, Oct. 30th. East: Winterton 4-7, Nov. 14th. Broads: Flegg Broads Feb. 5th-15th, Martham Feb. 8th, Lower Bure near Breydon Nov. 20th.

Red Throated Diver: North: Sheringham 63 East in 1¼ hours Jan. 11th with 68 East in 1½ hours Jan. 24th. Broads: 1-2 Flegg Broads Feb. 14th-April 4th. Breydon Feb. 14th and 25th, East Somerton March 28th. Haddiscoe New Cut Feb. 23rd-March 8th.

Great Crested Grebe: East: Breydon high midsummer counts include 18 in June, 56 in July and 38 in August.

Red Necked Grebe: North/Wash: Holkham Nov. 13th, Snettisham G.P. March 14th, Hunstanton 3, Feb. 7th, Sept. 26th/27th. Wells Oct. 16th, Holme Sept. 26th, Sheringham 2 May 29th, Sept. 30th, Oct. 5th and 30th. Cley Dec. 24th, Salthouse Sept. 12th. East: Winterton Nov. 14th. Broads: Ormesby Feb. 5th-March 26th. Inland: Swanton Morley G.P. Jan. 28th.

Slavonian Grebe: North: Hunstanton up to 3 in Feb., 4 in March and singly Nov. 11th and 17th and Dec. 18th. Cley Dec. 3rd. Holkham 5 Nov. 11th. Holme Feb. 29th. Heacham March 10th. Sheringham March 7th and Sept. 30th. Wash: Snettisham G.P. Feb. 9th. East: California Feb. 11th and 12th.

Black Necked Grebe: North: Hunstanton March 20th and April 16th. Blakeney Harbour in breeding plumage April 30th. Cley Jan. 10th/11th. Broads: Ormesby Feb. 12th-14th and March 10th.

Little Grebe: Breck: 50 Fowl Mere July 25th with 17 on Mickle Mere indicate good breeding success. Wash: Maximum of 48 at Snettisham G.P. in Dec. Broads: Up to 12 at Martham in Feb., at least one pair bred Ormesby with 1-2 pairs in Muck Fleet area. Breydon. 5 pairs bred in adjacent dykes.

Fulmar: North: Total of 48 young counted on cliff ledges between Weybourne and Cromer as follows (JCM): Weybourne to Sheringham 20: Sheringham to West Runton 7; West Runton-East Runton 5; East Runton-Cromer 16. First back in autumn Oct. 23rd. One blue phase bird at Sheringham Nov. 20th. Wash: 50 pairs at Hunstanton from Jan. 7 young in Aug. East: 5 pairs at Happisburgh in June but no evidence of breeding. 1-3 Hopton cliffs in May/June. Inland: Felbrigg June 20th.

Manx Shearwater: North: Holme-Sheringham 1-2 April 22nd-25th and May 13th. 79 east July 28th followed by many records of up to 14 together until mid-Sept. with maxima of 30 off Blakeney Point and 94 off Sheringham Sept. 2nd. Titchwell 5 May 16th, Hunstanton 6 June 19th, 7 Sept. 2nd. Snettisham 6 Aug. 28th, 3 Oct. 10th, Thornham 2 Sept. 15th. East: Waxham Oct. 15th, Bacton 12 July 31st, 5 Aug. 1st. Winterton 4 July 31st.

Sooty Shearwater: Autumn total of over 70. North: Cley/Salthouse 8 Aug. 27th, 5 on 28th, 5 Sept. 2nd. Blakeney Point 2 Aug. 28th, 10 Sept. 2nd, 3 on 3rd/4th. Sheringham 2 July 31st, Aug. 27th, 2 on 28th, 17 west and 4 east on Sept. 2nd, 10 on 3rd and 1 Oct. 30th. Cromer 2 Aug. 27th, Holme 3 Sept. 4th, 4 on 5th, 1 Oct. 3rd. East: Winterton Aug. 28th.

Leach's Petrel: North: Holkham Sept. 10th (TD).

Cormorant: East: Oct. maximum of 158 at Breydon (a record for the estuary) with 14 in July and 18 in August. Broads: Filby, 77 Jan. 4th. Fritton Lake roost, up to 22 in Feb. and 20 in March. Wash: Ouse Mouth, up to 50 present. Fens: Welney, 32 in Dec. roosting on wires. North: Holkham Lake roost of 36, March 14th.

Shag: Many coastal records with maximum of 22 Hunstanton Nov. 7th. 16 at Yarmouth harbour entrance Feb. 4th and 10 roosting on Sheringham cliffs during Oct. Broads: Hickling, singles on May 31st and in Sept./Oct. Breydon, Sept. 20th. Fens: 1-2 on Relief Channel, Denver and on Ouse at Ten Mile Bank, Jan.-Feb.

Grey Heron: The following heronries were counted: Borders of Wash-Snettisham, 19 nests. Fens: Hilgay 33, Islington 51, Denver Sluice 3. Brecks: Didlington 10, Shadwell 6, Hockham Fen, 1. Broads: Belaugh 4, Upton 7, Wickhampton 14, Strumpshaw 1, Barton 7, Fritton Warren 3, Hemsby Common 1, Reedham Park Carr 5.

Purple Heron: Broads: Cantley immature May 22nd (PRA). Additional 1975 records: Wells Nov. 8th (SCJ & NW), Salthouse Nov. 3rd (JBK).

Bittern: A dramatic decline, with only 9 booming in Broadland and an unmated male at Cley.

White Stork: South: Waveney Valley, bird present in June 1975 stayed until March 20th.

Spoonbill: Broads/Fens/Wash/North Coast: ones, twos and threes between April 3rd and September 12th.

Glossy Ibis: Fens: Wisbech S.F. May 16th-19th (KN, TT *et al*). First county record since 1952.

Garganey: Spring arrival from April 2nd at Sparham and subsequently at Cley, Breydon, Cantley, Hardley, Hickling, Strumpshaw, Tottenhill G.P., and Winterton. Only breeding records from Ranworth and Breydon.

Gadwall: Brecks: largest counts 150 Stanford August 13th and 65 Fowlmere Sept. 18th. Wash: Snettisham area, 42 on Nov. 21st. Broads: Strumpshaw, 45 June 15th. Filby 32 Aug. 12th. Breydon duck with 7 ducklings.

Wigeon: Fens: Welney, 16,000 in Jan. and no less than 35,000 by late Dec. East: Buckenham 4,500 Feb. 8th. Thurne Levels 1,500 Feb. 22nd. Breydon 6,000 Dec. 31st after SE gales.

Pintail: Fens: Welney 800 at beginning of year and 1,000 in late Dec. Brecks: up to 6 at Stanford, Fowl Mere and Mickle Mere. East: Breydon peaks of 171 Feb. 9th and 123 Dec. 27th. North: Cley c.250 Feb. 2nd and 200 Dec. 26th. Central: Swanton Morley G.P. 5 Jan. 5th.

Shoveler: Breck counts include 32 at Mickle Mere Feb. 8th. Fens: Welney 800 in late Dec. Broads: Filby 95 Jan. 28th, increasing to 146 Feb. 8th and still 115 March 19th.

Scaup: East: Breydon maximum of 23 Feb. 28th; Winterton 23 south Sept 26th. Broads: Filby, Rollesby, Ormesby and Bure at Stracey Arms ones and twos until May 30th and from Nov. 11th. North: Wells 8 Feb. 17th.

Tufted Duck: Breeding records—21 pairs at 4 sites in Brecks, elsewhere a minimum of 10 pairs at 9 sites.

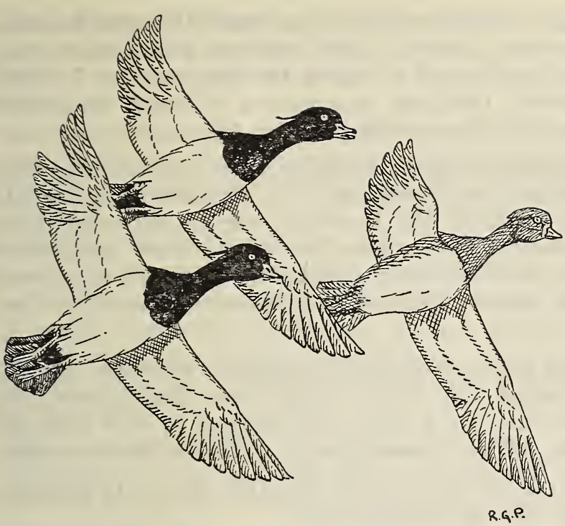
Pochard: Few breeding records submitted, but surprising total of 70 birds of the year at Filby Aug. 7th.

Goldeneye: Maxima as follows—North: 65 at Scolt Head. Wash: 55 at Hunstanton. East: Lound Waterworks 22. Broads: 39 at Ormesby, Rollesby, Filby group.

Longtailed Duck: Wash: Hunstanton monthly maxima—Jan. 17, Feb. 26, March 70, April 20, Oct. 3, Nov. 10 and Dec. 20. Snettisham April 12th and Oct. 31st—Dec. 29th. North coast: occasional records of up to 13 until April 30th and from Oct. 30th. Brecks: Thompson Water 2 Nov. 7th. East: Winterton Oct. 31st and Yarmouth Jan. 3rd. Broads: Hickling Nov. 13th.

Velvet Scoter: Wash North coast: recorded monthly except June/July: maximum 20. East: Gorleston 5 Feb. 10th with 3-4 until April 5th. Yarmouth Feb. 13th and Winterton 2, Oct. 31st.

Common Scoter: Wash: Hunstanton maxima 3,000 in Nov. and 2,000 in Dec. Broads: Ranworth 8 May 30th. Inland: Lyng G.P. April 11th.



Eider: Coastal records each month and largest flocks for main localities given below: East: Gorleston 22, Feb. North: Scolt Head 26, Sheringham 21 in Sept. Wash: Snettisham-Heacham 228 Feb. 1st and Heacham 250 March.

Red Breasted Merganser: No numbers reported apart from the Wash where 58 at Snettisham in Feb. and 40 at the end of the year. East: Breydon 8 Jan. 4th. Fens: Denver Sluice/River Ouse at Ten Mile Bank parties of 5 and 9 in Feb.

Goosander: Winter observations from 21 localities including 11 at Breydon, 6 at Fritton and Stanford, 7 at Sheringham and 8 at Didlington.

Smew: Winter records of up to 4 at 14 localities, with up to 9 at Hickling Feb. 8th when arrivals noted elsewhere.

Shelduck: Wash: Snettisham maximum of 2,087 in Feb. Total of 150 young, Vinegar Middle June 27th. East: Breydon, winter peak of 729 Dec. 26th where interesting easterly exodus of 32 June 11th. Breeding records include 2 broods at Hickling, 105 young at Cantley B.F., 76 young at Hardley Flood, single broods at Hoveton Great Broad and Stanford Water, and several broods at Welney.

Egyptian Goose: Reported at Sparham, Swanton Morley, Lenwade, Bayfield, West Runton, Holkham, Wells, Salthouse, Gunton Park, Filby, Fritton and Hardley Flood.

Grey-lag Goose: East: Breydon, gaggle of 14 of the pink-billed Eastern race joined feral birds Jan. 26th-30th.

White Fronted Goose: East: Breydon area, 1-3 in Jan./Feb. Maximum of 146 Dec. 30th with 93 next day. Elsewhere in Yare Valley up to 16 Jan./Feb. and 7 in Dec. Broads: Hickling 58 Feb. 22nd and 26 Dec. 17th. North: Cley, 6 in Jan. 13 in March and 38 in Dec. Holkham, 80 in Jan. up to 150 in Feb. and March and 173 in Dec.

Bean Goose: East: up to 91 in usual area until Feb. 21st. 15 returned Nov. 1st with 33 on 4th and 71 by Dec. 9th. Breydon, up to 4 between Feb. 1st and March 20th and 5 Nov. 27th onwards. California, one dead on beach Feb. 12th. North: Holkham 2-8 between Feb. 1st and March 5th and 5 in Dec. Holme, 5 Feb. 14th. Cley up to 3 Jan. 30th-Feb. 17th and 4 Dec. 24th-29th. Fens: Welney, one during Feb. Wash: Snettisham 14 Jan. 10th.

Pinkfooted Goose: East: Single with Beans, Halvergate March 15th-20th, but none wintered. Wash: Snettisham area, peaks of 3,500 mid-Dec. and 2,710 in Jan., leaving second week in Feb. Last flock of 65 March 1st. Returned Oct. 27th (40) and 2,300 by end of Nov. North: Holkham, maximum of 18 March 5th and 250 Dec. 27th. Cley, 32 west Nov. 11th. Fens: Welney, 40 Dec. 6th.

Brent Goose: Maximum numbers at regular localities were: Breydon 121, Wells 1,800, Blakeney 1,350, Salthouse 250, Brancaster 1,200, Hunstanton-Holme 300, Snettisham 970 and Terrington Marsh 130. Recorded every month except June/July. At Cley exceptional numbers offshore Jan. 23rd when 740 west in 1½ hours off Sheringham and 730 west there Nov. 14th. Unusual Sept. movement north off Winterton where total of 162 between 19th and 26th. Inland: Colney G.P. 6 Jan. 31st.

Barnacle Goose: East: Horsey 28 Feb. 29th with 2 at Breydon same day. Hardley Flood Dec. 26th onwards. North: Cley, 4 Oct. 30th, 8 Nov. 23rd, 14 Nov. 29th 12 Dec. 5th-8th, Salthouse 4 Nov. 1st, 8 Nov. 20th, Stiffkey, 17 Nov. 17th and West Runton, 10 Nov. 13th. Wash: Snettisham, 4 with Pinkfeet Nov. 20th.

Whooper Swan: Recorded up to March 21st and from Oct. 30th at 10 localities, with largest herds at Welney (48) and Hickling (46).

Bewick Swan: Recorded up to April 27th and from Oct. 13th. Largest concentration at Welney Washes where 1,000 in early Jan. and again at end of year. Elsewhere most impressive assemblies on Lower Bure marshes (219 Dec. 26th), Acle Bridge (117 Feb. 8th), Halvergate (118 March 20th), Heigham Holmes (100 March 14th), Clippesby (68 March 14th) and Filby Broad (51 March 20th). In Brecks, maximum of 9 at Fowl Mere. Easterly March exodus noticeable on 17th (50+ Sheringham) 19th (Cley 31) 23rd (Cley 18) 24th (Cley 11) and 26th (Breydon 12).

Buzzard: North: Felbrigg May 11th, Holt March 13th, Sheringham Feb. 8th-28th, Sept. 21st-Nov. 4th. Holme Oct. 24th and 28th/29th. Cley Sept. 7th. Wash: Snettisham Sept. 20th. Fens: Wisbech S.F. Sept. 28th. East: Breydon Nov. 9th, Fritton March 8th, Ormesby Feb. 29th, Hickling March 21st, Winterton April 4th-11th with 3 on 17th and Nov. 9th, Haddiscoe Dec. 26th.

Rough Legged Buzzard: East: Halvergate March 1st, Hickling Jan. 14th and May 1st, Caister-on-Sea April 29th, Ebridge Mill 1-2 April 19th, Winterton 4 April 17th, 3 on 24th, 1 on 29th, May 9th and Nov. 7th.

Sparrow Hawk: recorded from 32 localities but only known to have bred successfully at two sites. Migrants at Winterton April 4th-May 2nd with at least ten on first date.

Goshawk: Brecks 1-2 between March 21st and May 28th with a juvenile Sept. 26th. East: Winterton 2 April 24th, 1 May 2nd and another in from the sea Oct. 31st. Additional 1975 record: Brecks Dec. 21st.

Red Kite: An exceptional year. East: Breydon May 5th (PRA) Halvergate April 4th (LR) Gorleston March 26th (CHB) Hickling April 11th (JRW, SL), North Walsham/Ebridge April 1st (KB). North: Holme and Titchwell May 15th (HBO), Foulden June 15th (AJH). Doubless some of the records relate to the same birds.

Black Kite: Broads: Horsey May 2nd (BPO, MDO, PW, RW).

Honey Buzzard: North: pair present at one site from May 22nd, no proof of nesting but up to 4 present in August. Wells Oct. 11th-16th observed tearing out a wasp's nest at close range. Holme Sept. 16th, 2 Oct. 6th. Holkham Oct. 12th. Cley/Blakeney Nov. 7th, Blakeney Point Sept. 17th. East: Winterton Sept. 26th.

Marsh Harrier: Five pairs nested at 4 sites, 3 pairs were successful rearing a total of 8 young to free-flying stage. North: Titchwell, 6 east to west May 3rd. Wash: at least 15 roosting in one area Aug. 31st. Birds dispersed in early Sept. with last one Oct. 21st.

Hen Harrier: Recorded up to May 6th (Winterton) and 15th (Holme) and from Sept. 12th (Winterton). Many records from coastal localities, including 6/7 in Scolt Head/ Titchwell area March 8th. Other totals include 3 at Winterton/Horsey and 4 Roydon Common.

Montagu's Harrier: North: female at former breeding site on 3 dates early/mid May. Cley May 5th and 15th/16th when doubtless same individual at Sheringham and between Hunstanton and Heacham. Wash: Snettisham May 12th. East: Winterton May 15th, Horsey June 26th and Hickling May 14th and Aug. 22nd.

Osprey: Recorded between April 30th and Oct. 15th at Catfield, Cley, Holme, Horsey, Hunstanton, Rockland, Snettisham, Strumpshaw, Wells, Wheatfen and Wisbech S.F.

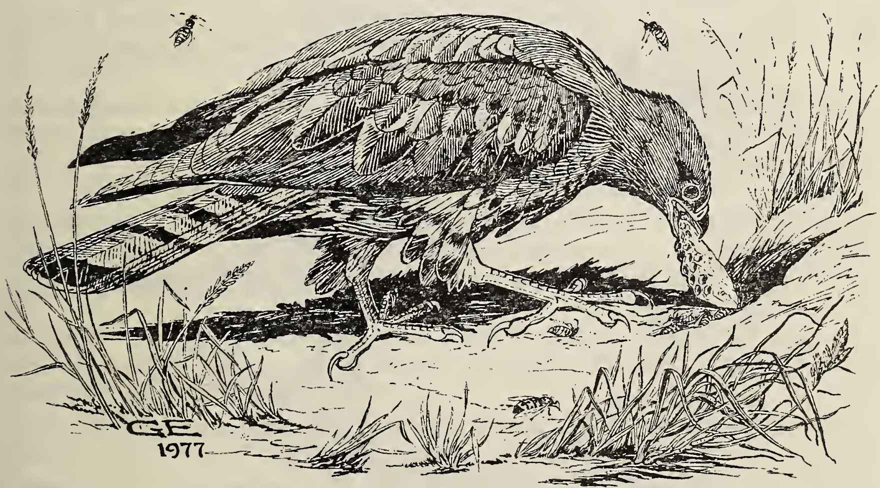
Hobby: North: Cley 1-2 almost daily throughout summer. Holkham May 30th, Sheringham on 12th and 18th, Holme on 24th and Aug. 4th and Holt June 24th. East: Hickling 2 Aug. 19th and Happisburgh April 25th. Central: Barnham Broom injured Aug. 27th.

Peregrine: North: Old Hunstanton June 5th, Hunstanton Oct. 17th and Sheringham May 15th. East: Winterton/Horsey Feb. 29th, April 4th, 11th and 17th and May 12th. On two occasions bird carried falconer's jesses.

Merlin: Recorded at Postwick, Martham, Holkham, Breydon, Winterton, Horsey, Roydon Common, Hickling, Holme, Yarmouth, Wells, Sheringham, Titchwell, Wisbech SF, East Wretham and Snettisham, up to April 13th and from Sept. 18th. Mainly singles but 3 at Roydon Common and 4 at Winterton.

Red Footed Falcon: North: Holme May 15th (HBO) and Salthouse Heath on 17th (DHS).

Quail: Calling during summer at Felthorpe, Cley, Alderford, Morston and Titchwell.



A Honey Buzzard stayed at Wells six days, where many observers watched it tearing out a wasp's nest.

Golden Pheasant: Recorded from East Wretham, Wayland Wood, Thompson, Great Cressingham, Swaffham Heath, Brettenham Heath (30-40 in Nov.) and St. Helen's Well.

Crane: North: 2 Holkham Oct. 29th (GD).

Spotted Crake: Fens: Wisbech SF Aug. 31st, Oct. 10th and 23rd.

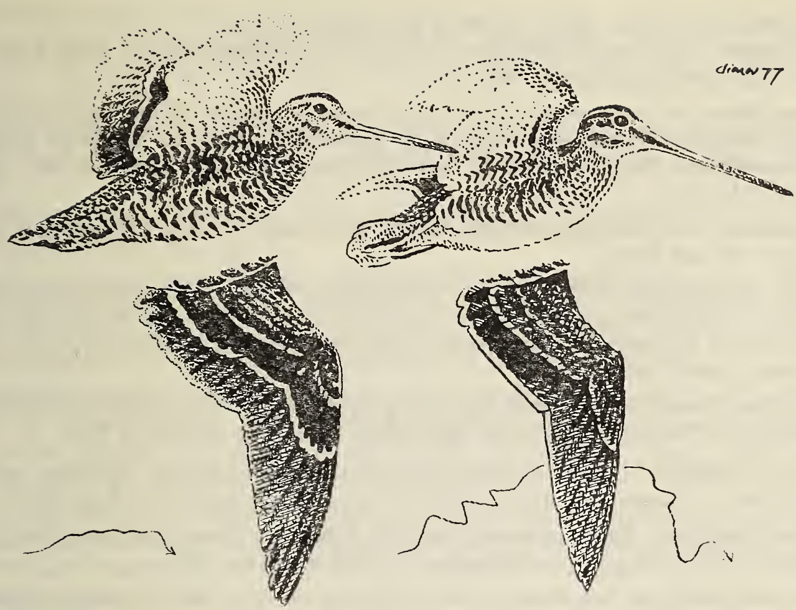
Coot: Broads: Totals of 556 Filby Broad Feb. 8th and 381 Aug. 7th.

Oystercatcher: Breeding records of pairs include: East: Breydon area 5 (including 2 pairs for the first time on the actual estuary). North: Weybourne 3, Blakeney Point 200, Stiffkey Binks 23, Wells 13, Burnham Overy Channel 5, Bob Halls Sands 4 and Scolt Head 160-165 (only 40 young reared). Maximum count of 12,900 at Snettisham in Jan.

Lapwing: A large exodus March 13th when 6,000 per hour passing east at Sheringham.

Ringed Plover: Breeding records of pairs include: East: Yarmouth North Beach 1, Hemsby 1, Winterton-Horsey Gap 10-12, Waxham 1 and Happisburgh 2. Broads: Hickling 1 (successful). North: Blakeney Point 160, Stiffkey Binks 5, Wells 6, Burnham Overy Channel 5 and Scolt Head 120-130. Wash: Snettisham 12 and Lynn Point-Ongar Hill 2. West: Tottenhill GP 1, Bawsey 1 and Mintlyn 2.

Dotterel were recorded at Happisburgh, Hunstanton and Blakeney Point.



Great Snipe (left) and Snipe. Note on former greater bulk and broader wings, shorter bill, axillaries and under-parts barred overall (lacking prominent white belly of Snipe). Note also on Great black central wing panel with obvious white borders (but lacking very dark secondaries with white trailing edge of Snipe). Birds illustrated are immatures in autumn. This figure corrects that of flying birds in *British Birds* (69: 377-383). Arrowed lines indicate manner of escape flight, short and ending in sudden fall in Great.

Little Ringed Plover: Breeding: 16 pairs at 10 sites rearing a minimum of 14 young but undoubtedly under-recorded. First recorded at Swanton Morley GP March 27th but apart from Hardley Flood few records of migrants in spring away from breeding localities. More widespread in autumn with maxima of 7 at Wissington BF and Cley, 6 at Hardley Flood and 5 at Hickling and Wisbech SF, where latest Oct. 9th (2).

Kentish Plover: East: Breydon May 1st. and 18th/19th and June 8th/9th. Winterton female June 2nd-4th and 13th. Broads: Hickling May 20th. North: Cley April 11th-14th, irregularly May 2nd-26th, June 16th and July 31st. Blakeney Point May 9th and Aug. 28th, with a pair for a fortnight from June 7th.

Grey Plover: A late Spring passage with up to 420 at Snettisham in May. A noticeable exodus at Titchwell May 26th with 200 flying north-east. In Autumn peak of 560 at Snettisham in Aug. and an unusually high number of 104 at Breydon Oct. 5th.

Golden Plover: Largest concentration of 3,100 St. Benet's Level/Upton Level Oct. 9th. One of the Northern form in summer plumage on Breydon Saltings May 16th until the late date of June 19th.

Lesser Golden Plover: One in full breeding plumage at Breydon with Grey Plover June 8th-17th (PRA *et al*). The second county record.

Dotterel: East: Happisburgh 10 May 12th decreasing to 6 the next day. North: Hunstanton golf course 3 May 24th-27th and Blakeney Point 2, followed by a single bird, all flying westwards Sept. 17th.

Turnstone: Maximum count of 760 at Snettisham in Jan.
Jack Snipe: A late bird at Winterton May 1st. First autumn records, Filby Broad 2 Sept. 15th and Hickling on 16th.

Great Snipe: An unprecedented number of records: Hardley Flood May 25th-28th (JCE, DJH, *et al*), Blakeney Point Aug. 28th (CRH *et al*), an immature shot at Salthouse Sept. 18th (specimen in Norwich Castle Museum) and Holkham Sept. 26th (GJJ *et al*).

Whimbrel: East: Recorded at Breydon on most days in June with maxima of 7 on the 5th and 26th.

Black Tailed Godwit: Fens: at least 6 pairs bred at Welney. Elsewhere 3 pairs bred. Winter records, Breydon Jan. 21st. Cley Feb. 15th and up to 5 Snettisham until end of year. Passage birds between Feb. 28th and Nov. 13th with maximum of 14 at Wells Sept. 30th.

Bar-tailed Godwit: East: Breydon spring peak of 121 April 20th with autumn maximum of 50 Sept. 20th. Wash: Snettisham maximum of 2,600 in Sept.

Green Sandpiper: Largest autumn concentrations recorded at Hickling, where maximum of 32 Aug. 8th and Cantley BF, where maximum of 20 Aug. 22nd.

Wood Sandpiper: Spring passage May 4th-June 3rd. Two Cley June 21st. Few autumn records received; maximum of 8 Hickling Aug. 15th.

Common Sandpiper: Maximum of 40 at Wisbech SF Aug. 14th. Late birds at Breydon Nov. 27th and Dec. 27th.

Redshank: North: Breeding records include 22 pairs Blakeney Point and 30 pairs Scolt Head. Largest numbers noted at Breydon where up to 1,500 in second half of March. A dead bird at Breydon March 2nd was of the Icelandic race.

Spotted Redshank: Earliest record, Breydon March 18th. Main passage commenced April 22nd with, as usual, a considerable number of records in June including 4 summering birds at Breydon. Largest autumn passage noted at Hickling, Cley and Snettisham where up to 25 in early Sept. Wintering birds in Dec. at Breydon and Cley.

Greenshank: Winter records from Holme and Titchwell in Jan. and Thornham in Feb. Passage April 18th-Nov. 17th including birds throughout June. Largest numbers recorded in autumn at Holme and Snettisham, where over 50 in July, up to 34 in Aug. and 25 in Sept.

Knot: Maximum count of 20,000 at Snettisham in Oct. Inland records include 7 at Hickling April 19th and one at Hardley Flood July 30th.

Purple Sandpiper: Regularly recorded at the traditional wintering localities in the Wash (up to 6 at Snettisham and Hunstanton and up to 4 at Heacham) and at Sheringham (up to 2 in first winter period). Noted up to April 19th with isolated records also from Yarmouth, Winterton, Overstrand and Morston. Apart from one at Bacton on Aug. 6th birds in second winter period recorded only in Wash and along North Coast. A noticeable number of mainly single birds flying westwards along North Coast in Aug. and Sept.

Little Stint: One at Cley on Jan. 1st. Spring records: Hickling 3 April 23rd, 14 June 8th and 6 June 10th. Breydon 5 June 17th with 4 next day and Cley singles May 16th and May 30th-June 1st with 4 June 13th and 26th. Autumn passage commenced July 14th culminating in peak numbers at end of Sept. when at least 100 at Cley. One at Cley on Dec. 11th with another remaining at Breydon until Dec. 29th.

Temminck's Stint: North: Cley May 12th-19th, May 30th, July 14th-18th, July 26th and Aug. 7th-11th. Salthouse May 15th and Holme May 21st. Broads: Hickling July 28th and Aug. 25th. Fens: Wisbech SF July 17th/18th. Inland: Sparham GP May 20th-23rd.

Pectoral Sandpiper: North: Cley Sept. 17th-Oct. 10th. Broads: Hickling Sept. 9th-26th. Wash: Snettisham juvenile trapped Oct. 24th. Fens: Wisbech SF Sept. 15th-25th.

Dunlin: East: Breydon maximum spring total of 2,000 April 30th. Wash: Snettisham maximum of 8,000 in Aug.

Curlew Sandpiper: Only one spring record received—Breydon May 28th. One in summer plumage Cley July 4th. Main autumn passage of adults commenced July 25th with juveniles from Sept. 11th; numbers generally low with maxima of 10 at Breydon and Wisbech SF. A late bird at Breydon Nov. 19th.

Sanderling: Wash: Snettisham, up to 360 in May and 650 in July. East: an interesting series of records of up to 64 birds feeding regularly on grass-covered Gorleston Cliffs Feb. 9th-March 22nd. Inland: one standing in the road between A1076 and Weston Longville following severe gales Jan. 30th.

Ruff: Recorded at a variety of localities in winter months including Yarmouth, Caister, Cley, Hardley Flood, Halvergate Marshes, Hickling, Lower Bure Marshes and Welney, where up to 100 early March. Breeding: a few pairs may have nested at Welney but no proof.

Avocet: East: Breydon Jan. 16th, April 19th, 3 May 7th/8th, May 19th/22nd and Oct. 11th. Broads: Hardley Flood April 4th and 7 April 23rd. Hickling April 28th and 2 June 7th. North: Cley Feb. 28th, 1/2 April 2nd-June 16th, 3 Oct. 9th. Holme Dec. 5th. Wash: Snettisham May 14th, 4 May 15th and May 16th-18th.

Grey Phalarope: East: Breydon Jan. 24th (PRA, CJG). North: off Blakeney Point Sept. 13th (MAB), Cley Oct. 14th (GC) and Oct. 30th (BWJ).

Red-necked Phalarope: East: Winterton flying south Sept. 26th (PRA, ADB, TEB). Broads: Hickling July 12th and 31st (SL).

Stone Curlew: A Nature Conservancy survey revealed a Breckland total of 61 pairs including 30 pairs on the Norfolk Breck.

Great Skua: An unusual number of winter records:- Cley Jan. 4th, Sheringham Jan. 25th, between Snettisham and Heacham Feb. 1st and Hunstanton Dec. 19th. East: singles off Winterton Sept. 12th, 19th and 21st and Gorleston Oct. 18th. One released at Yarmouth Sept. 7th (ringed on Foula) having been injured the day before at Haddiscoe Marshes by striking power lines. North/Wash: autumn records Aug. 28th-Nov. 14th with large weather movements on Sept. 2nd when 231 east off Sheringham in $10\frac{3}{4}$ hours. 14 over Ouse Mouth flying westwards inland on Sept. 10th.

Pomarine Skua: One winter record, 2 east at Sheringham Jan. 3rd. East: Winterton Aug. 28th, Sept. 5th and Oct. 10th. Yarmouth Oct. 18th. North: West Runton 14 Oct. 30th and one Oct. 31st. Sheringham Aug. 28th, two Sept. 2nd, Sept. 3rd, two Sept. 10th, Sept. 12th and 15th, 5 Oct. 25th, Oct. 28th, 15 Oct. 30th, two Nov. 13th, 7 Nov. 22nd and one Nov. 23rd. Weybourne 3 Oct. 25th and 4 Oct. 30th. Salthouse 3 Sept. 2nd. Cley two Aug. 28th, Aug. 29th, Sept. 12th and 15th, Oct. 10th and 25th, 5 Nov. 17th and one Nov. 23rd. Blakeney Point 3 Sept. 2nd. Wells 6 Oct. 30th. Holme Aug. 13th, Sept. 16th (flying inland) and Oct. 28th. Wash: Hunstanton 2 Sept. 2nd and one Oct. 24th.

Arctic Skua: One spring record, Cley May 26th. East/North/Wash coasts: main autumn passage July 25th-Nov. 23rd with largest gale movements on Sept. 2nd when 150 east off Blakeney Point and 165 east off Sheringham. A late bird at Holme Dec. 12th. Brecks: one flying south over Foulden-Watton Road Sept. 12th.

Long-tailed Skua: Blakeney Point Aug. 30th (RMC), Sept. 12th (AJL) and 13th (PNC) and Salthouse Sept. 2nd (BWJ).

Lesser Black-backed Gull: An unusual concentration of 91 adults (mostly showing characteristics of the Scandinavian race) and an unknown number of immatures in a field at Rollesby Sept. 16th.

Herring Gull: Yellow-legged birds at Sheringham May 15th and Breydon July 21st.

Common Gull: North: a pair nested at Blakeney Point rearing one young.

Glaucous Gull: East: Yarmouth Feb. 19th and 23rd. North: The regular adult in the Cley-Sheringham area up to April 16th and from Aug. 18th; also occasional records of immatures including 2 at Cley Jan. 3rd and Scolt Head March 28th. Wash: Hunstanton immature Jan. 4th with an adult and different immature Feb. 4th.

Iceland Gull: A second-year bird at Holme Feb. 14th (HBO).

Mediterranean Gull: A total of 7 records. A first year bird at Morston Jan. 24th (DJH, SCJ), a second-year bird at Yarmouth Feb. 18th (PRA), a second-year bird west at Sheringham April 3rd. (JCM, DHS, KBS), a first-year bird also west at Sheringham June 1st (SA), an adult in summer plumage at Cley July 4th (JHM) and immatures at Winterton Aug. 8th (PRA) and west at Cley Sept. 12th (KB).

Little Gull: In early part of year only four records received:- Chedgrave Jan. 11th, Sheringham Feb. 2nd, Filby Broad April 19th and Sheringham April 23rd. Passage birds May-Nov. with unprecedented numbers in Sept. and Oct. North: at Sheringham in Sept. 21 east on 22nd, 35 on 23rd, 21 on 24th and 32 on 26th; in Oct. a total of 238 east on 30th in a north-easterly gale with 39 on 31st, when 42 also east at West Runton. East: 32 north at Winterton Sept. 26th, 23 south at Yarmouth Oct. 2nd, 21 south-east at Cart Gap in one hour Oct. 16th, 33 south at Yarmouth Oct. 18th and 44 south-east at Waxham in half an hour Oct. 19th.

Black-headed Gull: Successful breeding noted at Cantley BF where approximately 100 pairs present. No information from other sites.

Sabine's Gull: An adult in summer plumage east at Sheringham Aug. 20th (JMH, PP, KBS).

Black Tern: Spring passage May 5th-June 14th with only one noticeable movement, 38 east at Breydon May 24th. Only a very small-scale autumn passage from Aug. 18th (no flock exceeded 10 birds) with late records at Swanton Morley GP Oct. 17th and Yarmouth on 19th.

White-winged Black Tern: North: Cley adult west June 14th (JBK).

Common Tern: Pairs at breeding sites (number of fledged young in brackets where known) include:- Wash: Snettisham 75 (only 5). North: Scolt Head 450 (320), Bob Halls Sand 13, Stiffkey Binks 130, Blakeney Point 1500-1600, Cley NNT reserve 9 and Salthouse 4. East: Scroby Sands 50. Broads: Ranworth 29, Martham 3, Ormesby 5 (5), Hardley Flood 11 (27), Hoveton Great Broad 4 (8) and Cantley BF 1. Inland: Swanton Morley GP 1 (1). A late bird at Lenwade Nov. 6th.

Arctic Tern: Breeding: Two pairs each at Scolt Head and Blakeney Point. 5 north at Sparham GP April 25th. A bird of the 'Portlandica' phase at Winterton June 8th. An unusual number of birds off Cley in Sept. and Oct. (latest on 26th) with maximum of 27 Sept. 12th.

Roseate Tern: Only one accepted record, one west at Cley Sept. 4th (NJR).

Little Tern: Breeding records (number of fledged young in brackets where known) include: North: Thornham 25-30, Titchwell 32, Brancaster 14, Scolt Head 72 (17), Overy Channel-Wells 40, Stiffkey Binks 28, Blakeney Point 170-200 and Salthouse 4. East: Scroby Sands 15 (first time since 1963), Sea Palling-Waxham 11 (15), Waxham-Horsey Gap 3, Horsey-Winterton 45 (15), Winterton 4 (unsuccessful), Winterton-Hemsby 5 (1) and Caister-on-Sea one (unsuccessful). Broads: Hickling 3. An inland spring record at Downham Market May 6th. A late bird at Holme Oct. 17th.

Sandwich Tern: Breeding: North: 4,000 pairs at Scolt Head (minimum of 4,000 flying young) and 45-50 pairs at Blakeney Point (6 flying young). East: 200 pairs on Scroby Sands. Earliest record, Sheringham March 28th. Inland: two at Tottenhill GP June 19th and one at Lenwade GP Sept. 23rd. Last recorded at Weybourne Oct. 27th.

Razorbill: North: Sheringham 196 east April 23rd.

Little Auk: North: Cley Nov. 1st, Sheringham Jan. 3rd, 25th and Oct 31st.

Black Guillemot: North: Holme and Hunstanton March 20th, Wells Jan. 3rd-29th and Dec. 19th.

Puffin: North: Holme to Sheringham parties of up to 8 recorded Jan., Feb., April, May and Aug. to Nov. East: Winterton (dead) Feb. 21st, Horsey (dead) May 1st and Caister-on-Sea April 25th.

Woodpigeon: North: Sheringham 1,100 west May 22nd. East: Winterton 72 headed out to sea with jackdaws April 4th.

Turtle Dove: North: Holme, remarkable total west May 15th with one flock of over 500. Sheringham 221 west May 16th, 253 west on 22nd and 253 west June 5th. Wash: Snettisham 500 late Aug./early Sept. East: Yarmouth/Gorleston 1-2 with Collared Doves Oct. 9th-30th with one till Dec. 16th.

Collared Dove: North: largest gathering 150, Holkham in Feb.

Barn Owl: Recorded at 74 localities. East: Hemsby, one with characteristics of the dark-breasted race April 18th (PRA).

Little Owl: Recorded at 31 localities.

Long Eared Owl: Single pairs bred at Weeting Heath, and East Wretham. Breeding season records from Brancaster, Hardley Flood, Brandon, East Somerton, Trowse, Felthorpe and Haveringland. Elsewhere recorded at 18 localities including up to 4 roosting at Massingham and 10/11 roosting at Brancaster. One on a gas production platform 40 miles N.E. of Yarmouth first week of Feb.

Short Eared Owl: Breeding season records at Rockland, Upton and Fleggburgh Common. 1-2 migrants in coastal localities until May 16th, only 2-3 autumn sightings. Maximum winter totals 5 at Wickhampton and 4 at Breydon.

Nightjar: Singing males noted from May 21st as follows: Brecks: Grimes Graves 3, Snakes Wood 2, Croxton Park 2, Home Mere 2, Thorpe Belt 1, Devil's Punch Bowl 1. West: Roydon Common 2, Leziate 1. North: Salthouse Heath 6. East: Winterton 1, a new locality. Central: Horsford/Felthorpe 5.

Swift: North: Hunstanton 3-4 pairs nested in the cliffs. Autumn exodus later than usual, with almost 50 October records from well scattered localities, the majority coastal. The latest at Holkham, Nov. 2nd.

Alpine Swift: 1975 record not previously published, Salthouse Heath, June 19th (JPG *et al*).

Kingfisher: Breeding confirmed at only 3 localities—Cantley BF, Strumpshaw and Wheatfen. Please notify all definite breeding records.

Roller: Brecks: Hilborough July 20th (TA). Broads: Upton Oct. 4th (AJD).

Hoopoe: 6 records as follows: Yarmouth April 18th, Holme April 20th-26th, West Walton May 4th, Horsey May 6th, Snettisham May 8th and Belton July 2nd-8th.

Wryneck: In Spring reported in May at Holme and Hunstanton GC on 1st; Wells, Weybourne and Sheringham on 2nd; Narborough on 6th and Happisburgh on 18th. In Autumn, two main influxes, the first during the last week of August with birds at Brooke, Cley/Blakeney Point (10), East Tuddenham, Fleggburgh Common, Gorleston, Hickling, Holme (3), Hunstanton GC (3), Morston, Sandringham, Scarning, Sheringham (5), Snettisham, Titchwell, Wells (3), Winterton (2), Wolferton, Worlingham and Yarmouth (5). The second influx mid to end of September with birds at Burnham Overy, Cley/Blakeney Point, Cringleford, Holme (3), Holt, Mulbarton, Overy Staithe, Sheringham (3), Swanton Abbot, Thetford, Wells, West Beckham and Yarmouth (2). A late bird at Blakeney Point Oct. 24th.

Woodlark: Recorded during breeding season in Brecks at Brandon, Broom Covert, Frog Hill, Lynford, Santon Downham, Santon Warren, St. Helen's Well and Weeting (2 sites). In North Brancaster Jan. 10th (2), Wells March 21st and Holme Oct. 9th. In East, one singing at Winterton March 1st.

Shorelark: North: extreme dates May 4th and Oct. 9th. Reported from following localities, with maximum counts in brackets—Holme (5), Titchwell, Holkham (5), Stiffkey (17), Blakeney/Cley/Salthouse (35) and Sheringham (7). East: extreme dates May 2nd and Oct. 31st. Reported from Happisburgh, Waxham, Hickling, Winterton and Breydon (9).

House Martin: An albino at East Wretham Sept. 19th. November records included a late brood at East Tuddenham, which left the nest on 1st, 15 at Sheringham on 9th and the last at Thetford on 13th.

Sand Martin: Spring arrival from March 14th (Salthouse). A very pale, almost white, leucistic bird, with brown axillaries at Cley Aug. 1st. Four October records with the last at Cley on 21st (2).

Golden Oriole: North: Wells, male singing, May 24th (IAP).

Hooded Crow: Maximum winter counts: West: Dersingham Common 72 Feb. 11th and 50 Dec. 5th. Sandringham Common 30 Jan. 20th. North: Weybourne 32 Nov. 1st. East: Winterton 79 April 3rd; Breydon 26 Nov. 4th. At Sheringham one interbred with a carrion crow, rearing five young.

Jackdaw: East: Winterton, Spring emigration as follows, with parties of birds flying out to sea: 105 March 28th, 73 April 4th and 11 April 17th.

Wren: A complete albino at Acle, Oct. 19th.

Bearded Tit: North: Bred at Titchwell (15 pairs), Overy Staithe (2 pairs) and Cley. Broads: Bred at Cantley (10 pairs), Strumpshaw (1 pair, a new site), Hardley Flood (2 pairs), Hickling (perhaps 100 pairs) and Horsey.

Black-Bellied Dipper: In first three months of year recorded as follows: North: *Glaven* at Hempstead Mill Jan. 3rd-Feb. 17th. Broads: Ormesby Jan./Feb. Central: *Wensum* at Taverham Mill Jan. 16th-Feb. 27th and at Lyng Feb. 1st. *Bure* at Buxton Mill Jan. 14th-24th and Feb. 29th, Horstead Feb. 15th-23rd, Crostwick Bridge Feb. 18th to March 14th, Spixworth Bridge Feb. 21st. *Tud* at Honingham Jan. 1st-29th and Costessey Feb. 21st-23rd. In December recorded on *Yare* at Barnham Broom Dec. 18th and Keswick Mill Dec. 28th; on *Tud* at Honingham mid-Dec.

Fieldfare: East: a pair summered in a coastal locality, also recorded at Hickling May 29th and June 4th. First autumn bird Cley Aug. 23rd.

Redwing: Extreme dates May 8th (Holme) and Sept. 1st (Wells). In addition a pair summered in a locality in East Norfolk, at which the male was heard singing on a number of occasions.

Black-throated Thrush: Central: Coltishall male Feb. 21st-April 3rd (RML *et al*). The second county record of this vagrant from Asia, appearing only four months after the first.

Ring Ouzel: Spring: recorded April 3rd-May 8th, with maximum of 9 at Wells and Winterton May 2nd. A late male at Winterton May 31st-June 3rd. Autumn: recorded Sept. 18th-Nov. 5th, with maximum of 4 at Cley/Blakeney Point Sept. 25th/26th and 4 at Yarmouth Oct. 30th.

Wheatear: Spring arrival from March 6th (Snettisham). Bred at Weeting Heath (35 pairs) and Salthouse (1-2 pairs). An unusual number of late autumn sightings, with 6 in November (Breydon and Snettisham 3rd, Norwich Airport 5th, Stoke Ferry 6th, Sheringham 9th and Gorleston 13th).

Stonechat: Breeding pairs at Weybourne in North, and from East at Horsey/Hemsby (10) and Breydon (2). Maximum winter count, 10 Holme Feb. 29th, while a total of 24 (7 ringed) passed through Happisburgh Oct./Nov.

Whinchat: During breeding season a pair at Fowl Mere May 16th, but no evidence of nesting. Very late birds recorded at Breydon Nov. 9th-13th and Upton Nov. 20th.

Redstart: Extreme dates April 24th (Winterton) and Oct. 31st (Holkham and Sheringham). Recorded during breeding season in Brecks at Cressingham Arms (1 pair), Two Mile Bottom (2 pairs), Weeting (1 pair) and Thetford Forest (1 pair in nesting box); and in North at Felbrigg (male in song in May).

Black Redstart: Breeding: Yarmouth 10 singing males with proof of breeding at 2 sites, autumn song Sept. 27th-Oct. 17th. Norwich 2 singing males, but no evidence of nesting. Hunstanton immature in town garden July 18th. Migrants: maximum spring count 6 Winterton April 3rd and autumn 7 Happisburgh Oct. 26th.

Ten singing male Black Redstarts spent the summer at Yarmouth.

Nightingale:The B.T.O. National Nightingale Survey revealed the following singing males in the county: Brecks: Brandon/Santon 4, Didlington 3, Foulden Common 7, Narborough 5, Quidenham 1, St. Helens Well 1, Thetford 2 and Weeting 1. Fens: Stoke Ferry 3. West: Roydon Common 2. North: Salthouse Heath 7 and Weybourne 1. Central: Alderford Common 1, Costessey 1, Lenwade Common 2 and Ringland Hills 1. Negative returns were received from Braconash, Attleborough, Felbrigg and West Runton.

Bluethroat: Spring: Titchwell May 15th-17th (male red-spotted). Autumn: Winterton Aug. 22nd, Blakeney Point Aug. 28th (2) and Sept. 16th-20th, Holme Sept. 19th, Overy Staithe Sept. 26th-28th. Additional *1975* record, Burnham Overy Sept. 13th.

Robin: Two significant autumn falls, each involving several hundred birds, at Sheringham Sept. 25th and Happisburgh last week of October.

Grasshopper Warbler: Spring arrival from May 1st (Caister). More breeding season records notified than for several years including singles at East Tuddenham, Massingham Heath, St. Helen's Well and Thetford Warren.

Cetti's Warbler: Broads: a total of 22 singing males in the Yare valley. Elsewhere, single males in song at Hardley Flood, Burgh Castle and near Beccles.

Savi's Warbler: North: Holkham Oct. 13th (GPC). Broads: Hickling one singing May 9th (PRA, ADB). Martham one singing May 24th (JC, JD). Hardley one singing May 29th-June 3rd (GED, JCE). Additional *1975* Broads record July 31-Aug. 1st (JC).

Reed Warbler: Spring arrival from early date of April 16th (Welney), with last autumn record Oct. 10th (Winterton).

Sedge Warbler: Extreme dates April 17th (Martham Broad) and Oct. 3rd (Winterton).

Aquatic Warbler: North: Cley Aug. 15th-23rd (DJH *et al*). Blakeney Point Aug. 14th (JK *et al*), 22nd (ES *et al*), 30th (SH, GKR) and Sept. 26th (MSC, KMM *et al*).

Icterine Warbler: North: Blakeney Point Aug. 22nd (2-3) and 23rd. Hunstanton GC Aug. 31st. East: Yarmouth Aug. 15th. Winterton Aug. 15th and 29th. Paston Aug. 30th

Blackcap: January record: Sprowston 3rd. December records: Holme up to 4 all month, Sheringham 10th, Holt 11th and 29th, Morston 11th (2), Gaywood 14th, Holkham 15th and Blakeney 23rd. Wintering blackcaps were recorded in some numbers throughout Britain.

Barred Warbler: North: Hunstanton GC Sept. 5th. Holme Aug. 15th-16th, 24th-31st, Sept. 2nd-8th (up to 2), 16th-18th, 19th-24th (2) and Oct. 18th. Blakeney Point Aug. 28th with 2 on 29th. Cley Aug. 23rd, Sept. 12th and 16th. Sheringham Sept. 13th and 21st. East: Trimingham Sept. 5th. Waxham Aug. 24th. Winterton Sept. 4th-7th. Happisburgh one ringed Nov. 13th, an extremely late date.

Lesser Whitethroat: North: Sheringham, one of Siberian race, *S.c.blythi*, ringed Sept. 16th. Late bird at Wells Oct. 31st.

Fan Tailed Warbler: North: Cley Aug. 24th (JND) and Holme Aug. 29th-Sept. 5th (JC, OM, PRC *et al*). The first British record of this diminutive grass warbler which has spread dramatically across Europe since 1970.

Greenish Warbler: North: Blakeney Point Aug. 14th (GED, DJH). Wells Aug. 21st-22nd (TB, GJH, ET *et al*). Holme Aug. 28th-Sept. 3rd (SCJ *et al*).

Chiffchaff: A wintering bird at Bradwell Jan. 21st-28th. North: Sheringham, singles of the two Northern races ringed Oct. 2nd (*abietinus*) and 26th/27th (*tristis*). East:

Three Pallas's Warblers occurred on the North coast.

Yarmouth, an influx of birds showing the characteristics of one of the Northern races Oct. 28th/29th, with a maximum of 6 and a single bird remaining until Nov. 15th. Winterton, one of Northern race, Nov. 7th.

Wood Warbler: A spring migrant at Wells May 9th. Breeding season records of singing males from Dersingham, Sandringham (2), Foulden Common, Kelling (2), Felbrigg (3) and Ringstead. Autumn passage migrants at Blakeney Point Aug. 15th, catching flies in tea-house. Holkham Aug. 21st and 30th. Wells Aug. 21st, 22nd and Sept. 26th. Yarmouth Aug. 28th and Stiffkey Aug. 29th.

Bonelli's Warbler: North: Holkham Sept. 5th (KVP, CM). The fourth county record.

Arctic Warbler: North: Holme Oct. 14th-19th (PRC *et al*). The seventh county record.

Yellow-browed Warbler: North: Holme Sept. 23rd. East: Yarmouth Sept. 25th-27th (2).

Pallas's Warbler: North: Wells Oct. 29th-31st (SCJ *et al*). Cley Oct. 31st (many observers). Sheringham Oct. 31st-Nov. 1st, trapped and ringed (DHS, KBS, MPT).

Radde's Warbler: East: Waxham Sept. 26th (JW). The sixth county record and the first away from the north coast.

Dusky Warbler: North: two additional records, to those already published in NBR, bringing the county total to seven. *1968*—Holme, a different bird, Nov. 10th (JAWM *et al*). *1973*—Holkham Oct. 7th (SMG).

Firecrest: Spring: singles at Cley, East Tuddenham, Sheringham and Wells, with 2 at Holme April 2nd. Autumn: singles at Happisburgh, Hickling, Holkham, Honingham, Yarmouth and Waxham, while one which arrived at East Tuddenham Oct. 11th, remained in area for 3-4 weeks and was joined by at least 2 others Oct. 28th.

Spotted Flycatcher: East: Winterton Aug. 15th, a fall of 100 birds is worthy of mention.

Pied Flycatcher: Only 3 reported in spring: Blakeney Point May 9th, Knapton 10th and Holme 29th. Notable autumn influxes at Yarmouth and Sheringham in August. Late bird at Yarmouth Oct. 16th.

Red-breasted Flycatcher: North: Blakeney Point singles Sept. 12th, 16th, 25th and 26th. Titchwell Sept. 17th.

Richard's Pipit: North: Weybourne Sept. 29th (D. Burkitt) and Oct. 2nd (RL, SL).

Tawny Pipit: North: West Runton Oct. 26th-31st (MPL *et al*). Blakeney Point Aug. 25th (FKC *et al*) and Oct. 30th (SCJ). East: Winterton Sept. 27th (MJI). The first year ever in which Tawny observations have outnumbered Richard's pipit.

Olive-backed Pipit: North: Holkham Oct. 31st-Nov. 4th (GBB, CAEK *et al*). The second county record of this vagrant from Asia, following the first in 1975.

Rock Pipit: Very late bird of British race, Breydon May 24th. Reported in autumn from Sept. 12th (Holme).

Water Pipit: Reported from Hickling (March, April, Oct. and Nov.), Snettisham March 11th-22nd) and Titchwell (April 6th).

Pied Wagtail: A nest constructed in Norwich Union building, Westlegate (Norwich) was 70 feet above ground level. At Coltishall a reed-bed roost contained up to 400 birds in Oct./Dec.

Grey Wagtail: Only 5 breeding records received, all from Central Norfolk, at Honingham, Horstead, Lyng, Marlingford and Taverham.

Blue-headed Wagtail: North: Cley May 1st and 7th. Holkham May 8th. Broads: Hickling April 26th, May 2nd and 17th. Ormesby May 1st.

Grey-headed Wagtail: North: Wells May 9th.

Waxwing: All records are given. Snettisham Jan. 3rd. Gaywood Jan. 8th-Feb. 5th (up to 11). Sheringham Jan. 31st. Gorleston Feb. 4th-March 2nd (up to 5) and Dec. 30th (4). Not since 1969 have so few been reported.

Great Grey Shrike: Usual number of sightings up to April 24th, but noticeably fewer in autumn from Sept. 24th. Recorded at 35 localities.

Lesser Grey Shrike: North: Cley Sept. 5th/6th (JHWR *et al*). The second autumn record in successive years.

Red-backed Shrike: Breeding season: A total of 9 pairs known to have bred in the county, but records from Breckland incomplete. Spring migrant(s) noted at Holme and Titchwell May 11th. An unprecedented autumn passage, at least for recent years—North: Hunstanton Sept. 25th. Holme 1-2 on seven dates Aug. 14th-Oct. 19th. Titchwell Oct. 24th. Holkham/Wells 1-2 on three dates Sept. 4th-18th. Blakeney Point 1-2 on four dates Aug. 21st-Sept. 18th. Cley Sept. 8th. Weybourne Sept. 18th. Sheringham Aug. 7th and Sept. 28th. East: Waxham Sept. 26th/27th. Ridlington Common Sept. 11th-15th. Winterton Aug. 15th-Sept. 21st, with peak influx of 7, Sept. 5th-8th. Yarmouth Aug. 22nd. Gorleston Aug. 25th. Broads: Hickling Aug. 1st, 19th and 29th.

Hawfinch: All records are given. Brecks: East Wretham Jan. 18th (6), Feb. 22nd (20), Aug. 19th (juvenile), Oct. 13th (3) and 27th (2). Santon Downham April 10th (10) and June 12th. St. Helens Well May 7th. Weeting Heath and Cockley Cley June/July (2). Cranworth Nov. 28th (6). North: Wiveton Sept. 19th. East: North Walsham March 28th. Central: East Tuddenham March 2nd (2), Arminghall 24th, Keswick 26th and Colney Hall 28th. Swannington Common April 1st (2). Norwich May 4th. Felthorpe Aug. 24th (juvenile). Broads: Salhouse May 1st (2).

Goldfinch: Impressive totals of birds on spring passage included records in the North from Sheringham of 600 west May 1st and 520 west May 11th; from Happisburgh in the East of 750 north April 30th and 2000 south May 10th.

Siskin: Only one report suggesting breeding, a female trapped Aug. 14th in the late stages of moult, at South Runcton. Maximum numbers during the first part of the year—Sandringham up to 50 in Jan., Norwich 15 Jan. 1st, Horsford 30 March 21st, St. Helen's Well 25 March 21st and 15 May 18th, Sheringham 107 ringed March—May. Holkham 6 Oct. 28th, were the only ones reported in the latter part of the year.

Linnet: Impressive spring passage noted at two localities in the East. Winterton northerly movement recorded April 4th-May 1st, with peaks April 18th (1000), 19th (1000) and 25th (5000). Happisburgh peak of northerly passage April 30th (2000).

Mealy Redpoll: Wash: Snettisham 15 Jan. 12th. North: Holme 6 May 9th. Wells 5 Jan. 3rd. Sheringham 51 ringed March-May.

Arctic Redpoll: North: Sheringham 2 trapped and ringed March 21st (DHS, KBS, MPT). Additional *1975* record Blakeney Point Oct. 13th.

Twite: North: Maximum concentrations Titchwell 500 wintering, Holme to Thornham 200 Nov. 7th and Cley/Salthouse 100 Oct. 31st and Dec. 28th. East: maximum counts in each winter Breydon 70 Feb. 17th and 30 Oct. 10th. Inland: Buckenham Feb. 21st.

Serin: North: Holme singles April 9th and May 24th (PRC). Additional *1975* record Holme May 15th-19th (GBB, PRC, DMW).

Brambling: In early part of year 300 in Jan. at Titchwell and 300 April 26th in Thetford/Santon Downham area (including 100 at St. Helen's Well). At Caister refuse tip a remarkable build up occurred with 300 Feb. 4th, 1000 on 5th and 2000 on 15th remaining until 20th. During latter half of year very scarce despite excellent beech-mast crop, with maximum at Felbrigg 50 Dec. 11th.

Corn Bunting: Noted during breeding season at Breydon, Cley, Cockthorpe, Happisburgh, Hemsby, Horsey, Horsford, Martham, Rackheath, Overy Staithe, Santon Downham, Swaffham, Swafield and Waxham. Jan. peak of 44 at Breydon.

Ortolan Bunting: North: Blakeney Point singles Aug. 14th, 16th/17th, 31st, Sept. 12th, 16th and 19th. Morston Sept. 17th.

Little Bunting: North: Cley Sept. 27th (SJR, MJG).

Lapland Bunting: North: Cley 14 Jan. 18th-March 13th and 9 Oct. 5th. Elsewhere up to 6 at Blakeney Point, Holme, Kelling, Morston, Sheringham, Stiffkey and Wells, extreme dates April 18th and Sept. 12th. East: up to 3 at Breydon, 2 at Bacton and singles at Winterton.

Snow Bunting: Extreme dates May 16th (Winterton) and Sept. 12th (Cley). North: maximum counts Holme 250 Jan. 1st and 300 Dec. 4th; Titchwell 200 Nov. 9th; Brancaster 100 Jan. 5th; Cley 150 Feb. 17th and 300 Nov. 2nd. East: Happisburgh up to 30 in Oct. and Winterton 33 Nov. 17th.

Ring-necked Parakeet: A pattern is already emerging of a peak during the autumn. Brecks: Downham Market Aug. 3rd. North: Holme Sept. 29th and Oct. 1st. Salthouse Heath Oct. 1st. Sheringham singles flying west April 11th, May 22nd, Sept. 29th, Oct. 4th, 5th and 10th. East: Caister: Sept. 28th and Nov. 9th (2). Fritton 2 Dec. 5th. Broads: How Hill Aug. 27th and Sept. 1st. Hickling 1-2 on several dates. Additional *1975* records—Stiffkey June 3rd, Holme Aug. 7th and Yarmouth Nov. 29th.

The following, not mentioned in the Classified Notes, were also recorded in 1976 (*breeding species in italics*): Gannet, *Mallard*, *Teal*, *Canada Goose*, *Mute Swan*, *Kestrel*, *Red-legged Partridge*, *Partridge*, *Pheasant*, *Water-rail*, *Moorhen*, *Snipe*, *Curlew*, Great Black-backed Gull, Kittiwake, Guillemot, *Stock Dove*, *Cuckoo*, *Tawny Owl*, *Green Woodpecker*, *Great Spotted Woodpecker*, *Lesser Spotted Woodpecker*, *Skylark*, *Swallow*, *Carrion Crow*, *Rook*, *Magpie*, *Jay*, *Great Tit*, *Blue Tit*, *Coal Tit*, *Marsh Tit*, *Willow Tit*, *Long-tailed Tit*, *Nuthatch*, *Treecreeper*, *Mistle Thrush*, *Song Thrush*, *Blackbird*, *Garden Warbler*, *Whitethroat*, *Willow Warbler*, *Goldcrest*, *Dunnock*, *Meadow Pipit*, *Tree Pipit*, White Wagtail, *Yellow Wagtail*, *Starling*, *Greenfinch*, *Redpoll*, *Bullfinch*, *Crossbill*, *Chaffinch*, *Yellowhammer*, *Reed Bunting*, *House Sparrow* and *Tree Sparrow*.

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NORFOLK MAMMAL REPORT 1976

Editorial

The Editor is pleased to present the 21st Norfolk Mammal Report. Even though this particular number has lost some of its former significance it is pleasing to note that this junior section of our publication has come of age.

The report owes its existence to the observations and records submitted by members and friends and our thanks go to all contributors. All information, however small in quantity and seemingly trivial in content, is received gratefully. Indeed, the Editor's greatest difficulty is eliciting more scraps about the common-place. The House Mouse is a good example of a widespread and numerous species that is under recorded. The official distribution map for the whole country is largely blank! The Wildlife Youth Service of the World Wildlife Fund is running a special project during 1977 in an attempt to make the map more realistic. Other lines that members may wish to follow may be found in the Classified Notes.

Road casualties noted on a particular stretch of road that is used regularly can give interesting and useful figures. Many previous Bird as well as Mammal Reports have listed the casualties found on the A47 Yarmouth to Stracey Arms stretch. During 1976 mammal fatalities were: Rat 97, Rabbit 78, Hare 28, Stoat 6, Coypu 1. Regular checks in a garden, a length of hedgerow, taken over a period of years, give data that may help in assessing local trends.

Our last Report gave an ultra-brief account of the work of Chris Mason and Sheila MacDonald on the status of the otter in Norfolk, based on the publication of their findings. The Editor felt that our members deserved and needed a full, clear statement by the researchers themselves detailing their methods, findings and proposals. Time did not permit inclusion last year and since then they have been quoted, misquoted and contradicted many times in the public debate that continues. We are most grateful to them for contributing a special article for this report that should ensure our members are fully conversant with the evidence and able to judge for themselves the importance and urgency of the actions they suggest should be taken.

Loss of habitat is having a marked effect on more than one species as can be seen in the Classified Notes. On the other hand, certain features of the changing landscape of Norfolk are beneficial to others. If Greater Norwich includes the radiating dormitory suburbs with their pockets of woodland, parks, cultivated and neglected grounds, together with the hedges and shrubs attendant upon the dwellings, then Norwich is comparatively rich in species. Of course, a temporary haven can succumb rapidly to human pressure when, for instance, a small wood is taken into corporate ownership and is opened to the public.

Mention must be made of the increasing number of young mammals that are being fostered. The vastly increased and intelligent interest in wildlife has led to many more people being prepared to take practical action when they see distress, and this is wholly admirable. However, many of these supposed waifs and strays may well be retrieved by their natural parent if left alone and the human element removed. The time has to come when the young animal is released into the wild and the preparation for this major event in its life is a highly complex and specialist task, with an unhappily low expectation of success. The greatest possible care should be taken to ensure that human intervention is necessary or desirable.

Special thanks go to Philip Wayre for his fine photograph of an otter that enhances our major article and to Morris Gosling for bringing us up to date on coypu control. The Editor records his personal thanks to Bill Vaughan, Seal Research Division, Institute for Marine Environmental Research, to Rex Whitta, Wildlife Ranger for the Forestry Commission, to Arthur Woodhams, Pest Control Officer, M.A.F.F., for their invaluable specialist contributions and finally to John Goldsmith for his constant practical assistance. John continues to answer queries addressed to him c/o The Castle Museum, Norwich, NR1 3JU. Tel: Norwich 22233 ext. 649.

Contributions for the 1977 report should be sent to R. C. Hancy, 124 Fakenham Road, Taverham, Norwich, NR8 6QH, by the end of January, 1978.

Classified notes

INSECTIVORA

Whether or not the drought had any marked effect on the population it does seem probable that the parched state of our gardens forced many **Hedgehogs** to forage where conditions were more suitable. Many of our hedgehog watchers report markedly fewer visitors and fewer road casualties during the whole of the summer. Their fears were probably allayed during the following spring but the proof will be seen when the next annual records come in. Many of our small mammals drink little water as such. If their normal food plants or prey species can be found most of their requirement is met by its consumption. A more serious threat is highlighted by a contributor from central Norfolk who notes a marked decline possibly due to hedgerow removal and the reclamation of rough ground and field corners for farming.

Three adult opportunists, no doubt topping up their intake, were seen at the height of the drought drinking from a bird-bath in Saxthorpe. Another moved in with a pet tortoise in Norwich and produced three young.

After carefully selected garden plants had been given measured rations of bath water it was frustrating to see them uprooted by **Moles.** On a larger scale, definite moves to lower, moister ground were apparent in certain districts.

The only **Water Shrews** reported were from West Norfolk. This is a fascinating mammal to watch hunting in the clear water it favours. It is said to be particularly fond of water-cress beds though it is quite versatile and can be found some distance from a stream. Bird of prey pellets collected from possible habitats would be welcomed for analysis.

CHIROPTERA

Information on this group is scarce in the extreme. Bats on the wing are impossible to identify with certainty but members can be assured that non-specific reports are most acceptable. Even the most general comments from defined areas, if repeated over a number of years, are valuable. While hard facts are difficult to come by, comments to hand do indicate that a marked decline in overall numbers has been continuing in many districts for some time.

The Thetford experiment with bat boxes continues promisingly. At Ludham the **Noctules** again used the box for a short period before leaving for another roost several yards away. The highest evening count, adding those emerging from the box to those from an adjacent natural site, stood at 64. This has been a successful and encouraging experiment. Yet a big question remains. Where are the bats in winter?

A great deal of time has been spent locating and examining possible winter roosts, with very little success. This is still a very mysterious group and a great deal of work has to be done to understand them enough to give the help they may well need, but this is another case where our thirst for knowledge must be tempered with discretion. Temperature and humidity must be within fairly close limits and can easily upset. Disturbance of habitat already under pressure is as we know a major contribution to the decline of many species.

An interesting coincidence featured in a report of their years observations submitted jointly by two friends living in North Norfolk. One reported a **Long-**

eared bat caught by a cat in Holt during May and the other noted a parallel incident in Itteringham during August.

LAGOMORPHA

With a number of strains of myxomatosis in the county and **Rabbit** colonies developing varying degrees of immunity, the pattern is very confused. In some areas disease has almost eliminated the population but in others is reported to have exercised virtually no control, with varying degrees of effectiveness between these two extremes. The most casual observer is almost bound to see them in the county and one small colony is reported to be established in gardens quite near the city centre. A frequent query during 1976 linked the **Hare** with myxomatosis. We have no records of this species being affected but are assured that one case is on record from the early onslaught of the disease in this country. The occurrance must be extremely rare due to the method of transmission. Locally abundant, and increasing in South-West Norfolk, there are very large areas, particularly in Central Norfolk, where numbers of hares continue to fall. One corrspondent suggests that the leverets are very easy pickings for the foxes which quarter the fields in the district he reviews.

RODENTIA

The **Short-tailed Field Vole** is probably a frequent visitor to the ground below our bird tables but is infrequently observed. A Taverham contributor however has seen them regularly and has been impressed by their turn of speed. Another regular contributor whose car is in effect a mobile hide, watched a field vole running aimlessly up and down beside her vehicle and on another occasion saw one attacked by a Jay as it crossed the road. Their presence can be detected by characteristic runs between the lowest stems of the grasses and of course in owl pellet remains.

The status of the **Water Vole** continues to improve. They have been found along the Tud and the middle Wensum, indeed, sightings have been reported from Norwich Yacht Station. At Hockham Fen a Heron fed young to its nestlings.

The Editorial mentions the difficulty of compiling accurate distribution maps for our small mammals. Many interesting questions remain unanswered including

some on the relationship between the **Wood Mouse** and the **House Mouse.** For instance, has the former filled niches vacated by the latter? At Lyng, a trapping campaign at the end of the year produced equal numbers of the two species. At nearby Honingham, the Wood Mouse proved a persistent nuisance in the apple store. Outside in the same village, good numbers of **Harvest Mice** were found in ricks. A roadside nest was found at Aldborough and another on the fringe of the golf course at Norwich. A real mystery mammal, so far as Norfolk is concerned, is the **Yellow-necked Mouse.** Somewhat larger than the Wood Mouse and rather more clearly marked, its yellow collar is its distinctive feature. Colonies often share habitats with Wood Mice. If unusually large mice are noted or suspected, please contact the Editor or the Castle Museum.

The current **Coypu** situation is very clearly set out in this special note from Dr. L. M. Gosling, Coypu Research Laboratory, M.A.F.F.. "After reaching a peak in late 1975, the East Anglian coypu population is currently declining. The reduction is due to an increased trapping force (eighteen men since 1975) and an improved overall control strategy. In the six months from October 1975, when the improved strategy commenced, to March 1976, a total of 8,127 coypus were killed. In the comparable period ending in March 1977, a total of 5,616 were accounted for. The decline of 31% reflects a similar reduction in the live population. Numbers are expected to fall again in the coming winter leaving an adult population of less than 3,000 in the spring of 1978. The range of the population expanded slightly during 1975 when the population reached its maximum size and small colonies have recently been detected in north Essex and west Suffolk. These colonies are currently being trapped and further emigration will probably cease as the total population is reduced."

It is very gratifying to hear that our native **Red Squirrel** prospered during the year in at least one part of the county. Thetford Forest contains so much ideal habitat that it may well be one of the final national strongholds for this species. Elsewhere the news is less hopeful. Many reports speak of fewer sightings in old strongholds, though the link with the presence of greys is not necessarily made. One correspondent watched, on separate occasions, one collect beech nuts, one collect acorns and another sit down beside her husband and eat a mushroom. However, in the year under review the **Grey Squirrel** really demonstrated that it is here to stay and its pest potential. Many would-be controllers found it to be a most elusive quarry and any killed were quickly replaced by others moving in. Keswick Hall park was until recently a red stronghold but the only sightings were of greys. Norwich suburbs provide more records and their regular appearance at bird tables and garden feeding stations can soon be expected. Their boldness and superficially engaging ways may well make kind-hearted folk overlook what they are likely to do to their bird nesting-boxes in the spring.

CARNIVORA

Judging by the many accounts of widespread steady increases, the **Red Fox** is the one large land carnivore that can cope with life in twentieth century Norfolk. Their territories vary in size, but they can, and do, travel long distances. Apparent seasonal increases in adults, however are more often due to greater pressure to take prey where there is more chance of being detected and a decline in natural cover. There are strange gaps in the county distribution map—the presence of more rabbits does not necessarily lead to an abundance of their obvious predator. Attempts to read signs could be fruitful. Mention has been made of criss-cross tracks over the fields in one district. Runs through hedges and under low barbed wire should be examined for tell-tale hair.

The reappearance of a **Badger** in setts long unused has given some cheer but is no cause for complacency. Stocks are very low and even if everything were in their favour it would be some time before badgers reached a level approaching the county capacity.

The **Otter** is the subject of our major article and depressing as the situation it portrays may seem, reports submitted for 1976 do nothing to relieve the gloom. Contributions from entirely reliable observers from certain key areas speak not just of no sightings but of no signs during the year. The recent publicity given to this mammal has made almost everyone in the county aware of the problem and in spite of the blinkered attitude of a minority, created an enormous amount of goodwill. This benevolence has yet to be channelled into positive restraint by all users of our waterways and active conservation attitudes by the essential minimum proportion of those who control them.

Stoats had a good year, in fact rather too good at Scolt Head Island where a female and five young wrought havoc among tern chicks. Two reports from central Norfolk say they are more common than for several years. **Weasels** too were frequently observed. One was found eating a dead hare on a road near Thetford and another was seen swimming the river at Hunworth. One found dead in a Saxthorpe garden was thought to have come off second best in an encounter with a cat.

The rare glimpses of **American Mink** including one with young, confirm that this potential pest is still with us, but its true status is difficult to assess. At least

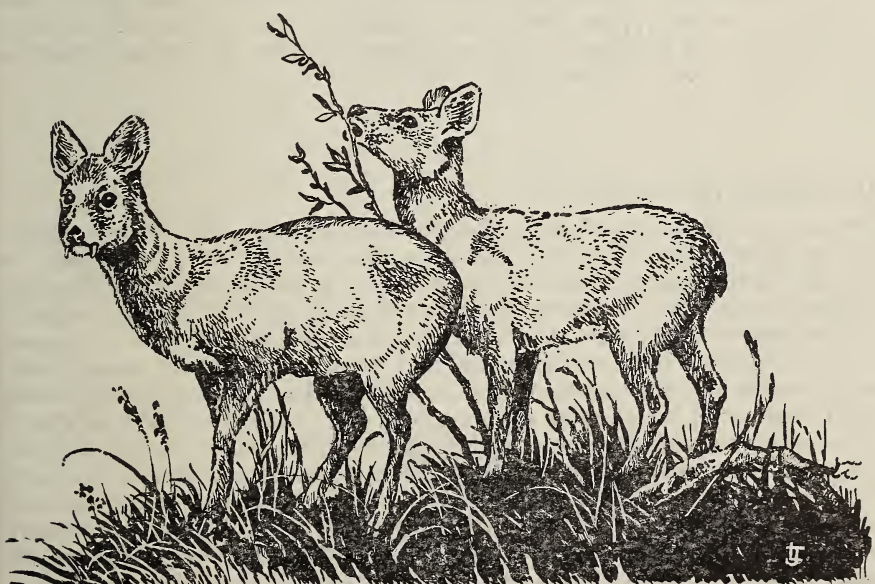
there are no indications that this quiet and elusive predator is causing obvious damage at present.

Dr. R. W. Vaughan of the Seals Research Unit sums up the East Anglian seal news as "situation normal". Numbers in the Wash show no significant change. At least one **Common Seal** made an up-river excursion and was seen in the Yare at Berney Arms on December 23rd. The Editor would be interested to hear from members with a literary or historic interest who have found references to seals in rivers in parish documents or any other unpublished material.

The entire world population of the **Grey Seal** is much lower than that of the Common Seal and the British Isles provide its most important breeding grounds. We are fortunate that our small Norfolk colonies appear to be well established.

ARTIODACTYLA

The **Red Deer** that met an unfortunate end in Catton during the summer was probably one of the group that had been seen from time to time for several years on the eastern outskirts of Norwich. New reports have come from Horsford. An unexpected confrontation with one of these beasts can be equally alarming for both parties but in a suburban area the excitement caused by their presence usually means trouble for the deer. The Thetford herd is in a very healthy state and, generally, deer in Norfolk are thriving. **Chinese Water Deer** are well-established and the **Muntjac,** with its tiny footprints so difficult to trace, appears to be increasing its range. Great interest was aroused in the Felthorpe, Horsford, Taverham area during the autumn by the all white, young **Fallow** buck, presumably from the local herd, which was seen by many locals. As it was just about to pass into local legend it reappeared during the following spring and could be seen running with a herd of young bullocks. The experiment with colour coding **Roe Deer** in Thetford Forest to monitor movements can be followed by visiting the Forestry Commission Office at Santon Downham. members can help by passing on their observations if they are fortunate enough to see any of the animals concerned.



OTTERS
IN NORFOLK

C. F. Mason and S. M. Macdonald

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INTRODUCTION

Norfolk waterways should provide optimum habitats for otters. The rivers are slow moving, weedy and support dense populations of coarse fishes which form the preferred food of otters. The country also has large areas of fen and reedswamp, especially in Broadland, which are ideal for otters, and the extensive salt-marshes on the northern coast provide additional feeding areas.

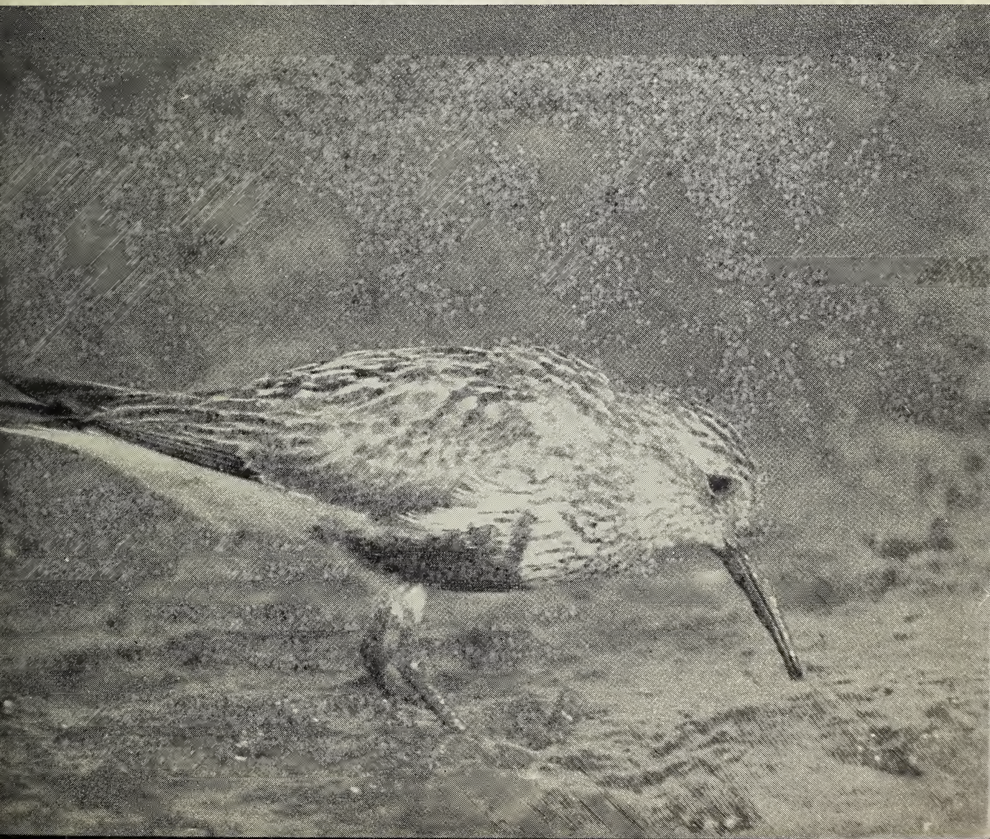
Early reports tend to confirm this suitability of Norfolk for otters. Stephens (1957) described the species as numerous, though her results were based on hearsay rather than on survey, and Hewer (1974) considered that otters were holding their own, based on reports from the local otter hunt. However, the Norfolk Mammal Report for 1972 stated that, "no-where in the county do otters occur as frequently as they did even ten years ago", though again this is based on casual observations. In 1974, Dr. S. Erlinge, who has studied otters in Sweden for a number of years, visited England and, after examining three areas of Norfolk, concluded that the population was very sparse. We decided, therefore, that a comprehensive and objective survey of the whole county was urgently required and this we undertook during late 1974 and the first half of 1975.

THE NORFOLK SURVEY

Otters are exceptionally difficult animals to count, owing to their extreme shyness and nocturnal habits. However they leave sweet-scented scats, or spraints, in prominent sites along watercourses and which act as recognition and home-range markers among otters. The banks of Norfolk rivers are relatively free of prominent sites and are too deep for emergent stones etc. to act as sprainting sites. In contrast, the debris which collects around bridges and the structure of many bridges themselves provide ideal places to deposit scats. We therefore examined the area around and beneath every bridge along a water-course. Each bridge was examined at least twice during the period, in winter and spring, and watercourses where otters were not recorded, received one or two additional visits. We looked carefully for scats, foot-prints and food-remains. Dr. Erlinge (*in litt.*) considered that this method gave a reliable estimate of the otter population in Norfolk. In addition, records received at the Castle Museum during the period were included in the results, together with observations by people (reserve wardens, etc.) spending long hours in the field.

Long distance travellers, Turnstones ringed on The Wash have been recovered in Greenland, Iceland, Greece and Guinea Bissau. *Photo R. J. Chandler*

In addition to visiting coastal mudflats, Dunlin may be found at beet factory settling ponds, sewage farms and Broadland wader grounds. *Photo R. J. Chandler*



Such records were especially valuable in Broadland and on the grazing levels where surveying was difficult. Some 270 man-hours were spent in the field, mainly at week-ends.

Our results (Macdonald and Mason, 1976) confirmed that otters were indeed scarce in Norfolk. Of 233 sites visited, equivalent to 774 km by length of watercourse, only 32 (14%) had evidence of otters and even at these sites the number of scats was always small, indicating a very low density. Eight additional records were received. Most otters were in central Norfolk with the rivers around the edges of the county being low in numbers or devoid of otters. Male otters have a large home-range. Erlinge (1967) observed a range of 15 km in Sweden, while it is estimated that there is one male/10 km in England (Stephens, 1957). Females and cubs have more restricted movements within this home-range. We estimated from our detailed distribution map that there were 17 territories in Norfolk. Assuming each territory contained a male and a female, the carrying capacity of Norfolk can be estimated as 52-77 pairs and the upper end of this range seems likely when one considers the large area of potentially prime habitat in Broadland. The population of otters in Norfolk is thus seriously depleted.

There seems little doubt that the decline in Norfolk has occurred fairly rapidly. We recorded no otters on some rivers where they were known to occur only a few years before. The species is, however, also very mobile and individuals are likely to re-appear in areas where we were unable to locate them. Thus one, maybe two, otters were found on the Waveney in 1976 (Philip Wayre, pers comm) where we found none regularly present after an intensive search in 1975.

Perhaps not surprisingly our results have been criticized by those who hunt otters locally (see, for example, in King et al 1976, p.30). We have already argued (Macdonald and Mason, 1976) why hunting returns give an unreliable estimate of abundance.

Otters appear to have declined over much of lowland England, though good data are lacking. West (1975) reports a low density in Suffolk and King et al (1976) review the present situation. The species stronghold appears to be in the uplands of the west and north, where the population is necessarily low due to the sparse food supply. Scotland is still stated to hold many otters but such reports are based on scattered observations from few people. Such a view was generally held in Norfolk until a full survey proved the contrary, so complacency concerning the Scottish situation may be unfounded.

REASONS FOR DECLINE

The decline of the otter in England took place almost un-noticed, but a number of reasons for it can be advanced. Several factors, operating together, seem likely. These include:—

1 watercourse management and reclamation
2 increased disturbance through recreation
3 pollution
4 hunting
5 other persecution
6 hard weather
7 disease

Watercourse management and the reclamation of fens may seriously alter the habitat of otters. Weeds are mechanically, and sometimes chemically, cleared from rivers each year and bankside vegetation is cut down. Overhanging and rotting trees are also felled. As well as changing the ecology of the river (which is often largely dependent on material entering from bankside vegetation) management also removes the otters' hide-outs and breeding places and may also make their movements more conspicuous.

Otters appear extremely sensitive to disturbance and the recreational use of rivers has increased drastically in recent years to the detriment of the species. Boat-traffic in Broadland is inimical to the survival of the otter over much of the area and even such apparently harmless craft as canoes are quite dense on some Norfolk rivers e.g. in Breckland. The number of people fishing has also multiplied rapidly over the last two decades and regularly spaced anglers along the length of a river for much of the day and sometimes at night place severe constraints on the activities of otters.

Now that the otter is so scarce, inquisitive naturalists undoubtedly add to this disturbance and we entreat people to refrain from searching for signs of otters in the county unless they are involved in the official Mammal Society Survey.

Pollution has also been implicated in the decline of the otter. The rivers of Norfolk are largely free of gross pollution and all carry stocks of fish capable of supporting otters. More insidious forms of pollution, such as pesticides or heavy metals do however occur and it has been suggested that the major decline of otters coincided with a decline of avian predators, which has been proved to have been due to toxic chemicals. Any relationship is purely circumstantial and tenuous in the case of the otter. The welcome increase in birds of prey that has taken place with the phasing out from use of some of the more damaging chemicals has not been mirrored in the otter population.

It is unlikely that hunting, which has been carried out for centuries, is alone responsible for the decline of the otter but, now that the population is so low, hunting is a pressure that the species could well do without. The loss of, say, half a dozen otters per year out of a population of thirty-four is serious. Hunting also causes much disturbance and pregnant females or females with cubs may be particularly vulnerable. Hunting intensity is little related to the size of the otter population, such that at low density individual animals are likely to receive more harrassment whether or not they are eventually killed.

Shooting and to a lesser extent game fishing are big business in Norfolk. It is known that otters are still killed on at least one trout stream in west Norfolk. Otters feed primarily on course fish and eels so that they are likely to be beneficial to game fishing interests by removing the competitors and predators of trout. When shooting estates abut onto watercourses (i.e. most of Norfolk) it is likely that many gamekeepers treat the otter in the same manner as they still do the badger and the tawny owl. Such persecution is totally unwarranted.

Disease has been suggested as a cause for the decline in otters but there is no evidence for this. Similarly, a suggested decline during the hard winter of 1962-63 is not backed by reliable data. Many rivers remained un-frozen during the period and an abundance of debilitated prey should have provided easy pickings for otters.

It is river management and increased disturbance which are probably having the most detrimental effects on otter populations at the moment (Chanin, 1976).

CONSERVATION MEASURES

With such a low population conservation measures are urgently required to maintain and increase stocks of otters in Norfolk. A priority is complete protection. The otter does not normally conflict with man's interests and persecution is unjustified. The species has been afforded legal protection in most other European countries.

Conservation measures are difficult to implement because of the otter's large home range and extensive movements. However the Dutch appear to have had considerable success with havens and Chanin (1976) has described how these may operate. There could be a network of small areas in which the otter gets seclusion and complete protection, where it is given priority over management and recreation interests. Linked with these would be stretches of watercourse which the otter could successfully exploit provided it could return to the maximum security refuge for resting and breeding. In management programmes, vegetation should be cleared on one bank only, or in strips on alternate banks, thus leaving the otter plenty of cover.

It has been suggested that some rivers could be designated protection areas, hunting being allowed over the remainder of the county. The two aims would

however be incompatible. Breeding may occur freely in the protected zone but a single river could never carry a large enough population to be viable in the long term. Youngsters would disperse into adjacent waterways where they would be under increased hunting pressure, protected waters being closed to the hunt. Havens would be providing improved sport for the hunt rather than ensuring the long-term survival of the otter. We really need an otter population in Norfolk near to the carrying capacity of the habitat, so that recolonization of adjacent counties where the species is virtually extinct (e.g. East Midlands) can take place.

The otter is a species peculiarly vulnerable to the activities of modern man. If we could rebuild and sustain a thriving population of otters in this country despite the dense human population, it would be a fitting monument to the strength of our conservation movement.

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1973	East Winch Common	80	Gift	S.S.S.I.
1974	Sparham Pools	30	Agreement	——
1974	Buxton Heath	159	Agreement	S.S.S.I.
1975	Pope's Drift	8	Agreement	——
1975	Wayland Wood	80	Purchase	S.S.S.I.

In addition, the Trust shares with the National Trust in the management of the coastal reserve at Blakeney Point (1,335 acres), and it manages Arnold's Marsh, Cley (29 acres) on behalf of the National Trust.

By arrangement with the Nature Conservancy Council, Scolt Head Island, Ranworth Broad, Hickling Broad and the Breckland Heaths now form part of the National Nature Reserves.

*Status: N.N.R. denotes National Nature Reserve
S.S.S.I. „ Site of Special Scientific Interest

†In 1966 Cley Reserve was established as a Bird Sanctuary under the Protection of Birds Act, 1954.

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TRANSACTIONS OF THE NORFOLK AND NORWICH NATURALISTS' SOCIETY

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Editor Dr E. A. Ellis

CONTENTS

FULL OF HIS GLORY

Read by the President, Miss Dorothy Maxey, to members of the Norfolk and Norwich Naturalists' Society at a meeting held in the Central Library Lecture Theatre, Norwich, on 7th December, 1977.

First of all I must say that I am deeply conscious of the honour paid to me by this Society in asking me to be your President. I agreed without much thought of the Presidential Address but as time went on it began to loom rather larger and when the Secretary asked me for a title—very large indeed. Knowing that this Society numbers amongst its members many learned and expert people, it ruled out an address with a strong scientific basis. I realised too that the Society also contains many expert photographers and artists so that made me doubtful as to how well I would stand up in that company. Fortunately I remembered that also amongst its members are many people who belong simply because they take a delight in our beautiful county and who want to know more about its rich fauna and flora and who wish to ensure that its wild life continues to flourish. In this company I felt much more at home.

The title I chose made our Secretary blink, I rather think he thought you were in for a sermon. In reality the quotation comes from one of the earliest nature poems, written over two thousand years ago, a passage in Ecclesiasticus. There is a cave painting of a spider on its web much older than that and together these two things should remind us that even in the earliest days some people realised that there was a spiritual value in the natural beauty of the plants and creatures which cohabit this world with us. That it was not simply how much food they could get from them or how much these things worked against the interests of man. We must beware of those who denigrate the spiritual value of this natural beauty.

There is a moral issue too. Man is as yet, unable to bring to life even so simple a creature as an amoeba, what right has he then to cause to become extinct such beautiful creatures as tigers, or nearer home, otters. The acceleration of extinctions, not only of large animals but also of small animals and plants, is frightening and causes me to wonder how long some of the things we now regard as common will remain with us.

We live in a materialistic society, not necessarily a happier one, however, for all the things it possesses. Much of the trouble, not all, can be attributed to finance or to put it crudely money and this infects every one of us. There are those who, in order to gain a little more personal wealth, destroy our woodlands, waterways, heaths and roadside hedgerows and the life within them. But what about the rest of us? We know that sewage and detergents are important contributory factors to the destruction of our waterways and the Broads as we knew them. Very few of us would like to be without these conveniences. We are told that processes are available which would help to clean up the rivers and more careful planning would avoid some of the problems from the beginning, but how are we to foot the bill? I hope the time will come when the public will be educated to expect proper sewage disposal as a matter of course.

It seems inexcusable to me to destroy by disturbance some of our rarer animals and plants for the sake of a day or two's pleasure or a little extra convenience, things quickly forgotten, but the living creatures are gone for ever.

Curious anomalies also occur from time to time which show the illogical thought or ignorance of some. No doubt many of you read in the "Eastern Daily Press" about the Rabbit Clearance Society which was boasting of killing over a hundred foxes and the letter to the Editor which suggested they should be re-named the Rabbit Protection Society. Not all these foxes were rogues but all suffered for the actions of one or two. This kind of attitude is far too common and I think is to be deplored.

The threats to our wild life are many and varied but so many are needless. Search for more virulent and longer lasting insecticides and herbicides would surely be better channelled into search for more selective ones, so that fewer of our beneficial or innocent species are destroyed. I am afraid to say some naturalists and photographers are guilty of excessive collecting or of so-called 'gardening' for photography. The Botanical Society and the Royal Photographic Society produce Codes of Conduct which I hope all members will read before undertaking such activities.

Many people have interests in the countryside for their livelihoods and leisure activities and their interests are sometimes conflicting or seem to be so. It is essential that there is give and take on all sides. Let us try to get together with other societies and bodies and negotiate for the welfare of our wild life. This will take time, and time seems to be running out. In the meantime let us do all we can to preserve what we have until such time as more people realise what is being lost.

We can support as many bodies as possible which are seeking to set up reserves and trusts for breeding our endangered species so that when we have caused things to improve the stock is there to re-populate suitable habitats.

A great deal can be done to make all our gardens wild life sanctuaries. Perhaps we should be a little less tidy-minded and more tolerant so that there would be homes for the animals. What about the dead tree, the rough corner, the martins under the eaves etc. What about a garden pond for the toads and frogs? Why not grow some plants for the butterflies for nectar and food plants? Leave some seeds for the birds—antirrhinums and forget-me-nots so beloved of the finches. We are so anxious to tidy everything away we remove a desirable food supply.

The film which follows is intended to show that while the case is not yet desperate, yet there is cause for concern. It is mainly of Norfolk wild life and was filmed in 1976 and 1977 all in the field (except the otters). It shows both sides of the coin namely, how rich the county is in its fauna and flora but also that while some species are relatively safe others are threatened, e.g. cowslips, sundews etc. by loss of habitat, many interesting arable weeds such as shepherd's needle (*Spandix pecten-veneris*) by changing agricultural practice, dragonflies and otters by pollution. It shows too the importance of roadside hedges and verges as nature reserves for bird, plant and insect life, and of the managed reserves of the County Trusts and others. Gone are the days when we could take the wild life for granted. If posterity is to enjoy the engaging habits of the wild creatures and the delicate beauty of the wild flowers we must realise that their future is our responsibility and do all we can to ensure their welfare.

THE CHANGING STATUS OF AQUATIC MACROPHYTES IN THE NORFOLK BROADS:

A survey of twenty broads in the summer of 1977 and a review of existing records

M. J. Jackson

Introduction

This survey was carried out to assess the status of aquatic macrophytes in twenty of the Norfolk Broads during the summer of 1977. The main purpose was to provide a comparison with existing data, namely the surveys undertaken by Mason and Bryant (1975) and George (1970), but also with the many other records available from past years. It is hoped that the techniques incorporated in the survey will provide a firm basis upon which future work may be organised and results directly compared.

Twenty broads were selected for sampling to include a variety of different situations. Two of the largest broads, Barton and Hickling, were not sampled, partly on account of their size but partly because of the intensive research already in progress on these sites. The broads of the Waveney valley were also excluded from the study in order to permit more thorough coverage of the other areas.

Method

Samples of the submerged vegetation were taken using a double-headed rake 0.3m wide and covered with a layer of coarse wire mesh. This was tied to a length of rope and towed behind a small dinghy. The length of the rope and the speed of the boat were regulated to ensure the rake was always close to the bottom.

A number of straight transects were chosen. To simplify repeating the same transect in future surveys these were designed to run between prominent features on the edge of the broad. The length of the transects ranged from 14m to 446m with a mean value of 175m (N=189). This variation is accounted for in the analysis of the results.

Along each trawl a number of stops were made in proportion to the length of the transect. At each stopping point the rake was hauled in and the species noted with a visual estimate of the abundance of each plant. The latter was determined subjectively using a 'trace 1,2,3,4' frequency scale. All vascular plants were identified and three types of algae, namely, Charophytes, filamentous algae and *Enteromorpha* sp. were recorded. Distribution maps were drawn of *Nymphaea alba* and *Nuphar lutea*.

Results

The results of the survey are presented in Table 1. Species records are given as the approximate percentage area occupied by each plant in the combined transects at any site. These values were calculated as follows:

1. Firstly, a mean figure was derived from all the 'visually-estimated' frequencies of a species (X) collected from all the stopping points along a transect. This gives an average frequency (F) of a species X for the complete transect.

TABLE I. The distribution of aquatic macrophytes in twenty Norfolk Broads during the Summer of 1977. Estimates of the sampling efficiency at each site and the dates of site visits are also shown. (See text for explanation of key).

BROAD	DATE VISITED	OPEN WATER TRAVERSED (%)	SUBMERGENT													FLOATING			ALGAE			
			Callitriche sp.	Ceratophyllum demersum	Elodea canadensis	Hippuris vulgaris*	Myriophyllum spicatum	Myriophyllum verticillatum	Najas marina	Potamogeton berchtoldii	Potamogeton crispus	Potamogeton pectinatus	Potamogeton pusillus	Utricularia vulgaris agg.	Zannichellia palustris	Nuphar lutea	Nymphaea alba	Polygonum amphibium	Chara sp.	Enteromorpha sp.	Filamentous algae	Total number of vascular plants
ALDERFEN	30th Aug.	0.68	.	1	.	.	.	.	.	.	.	.	.	.	.	.	t	.	.	.	.	2
BELAUGH	8th Aug.	0.34	.	.	.	.	.	.	.	.	.	.	.	.	.	t	.	.	.	.	4	1
BLACKFLEET	14th Sept.	0.50	.	.	.	.	1	.	4	.	.	4	2	.	.	.	.	.	1	.	1	4
BURNTFEN	16th Aug.	0.55	.	.	.	.	.	.	.	.	p	.	.	.	.	2	t	.	.	.	.	3
CROMES	23rd Aug.	0.75	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	2
DECOY	26th July	0.54	.	2	.	.	.	.	.	.	1	.	.	.	.	t	.	.	.	.	.	3
FILBY	21st Sept.	0.22	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	t	.	1
HOVETON GREAT	21st July	0.28	.	.	.	.	.	.	.	.	1	t	.	.	.	1	t	.	.	.	t	4
HOVETON LITTLE	2nd Aug.	0.33	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
HUDSONS BAY	29th Sept.	0.10	.	.	.	.	.	.	.	.	.	.	.	.	.	4	1	.	.	1	.	2
LILY	27th Sept.	0.39	t	t	1	.	.	.	.	.	.	.	.	.	.	t	t	.	.	3	3	5
MALTHOUSE	8th Sept.	0.26	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
MARTHAM STH	5th Sept.	0.23	t	.	.	1	1	p	4	.	.	3	.	t	.	t	t	.	1	.	.	9
ORMESBY	2nd Sept.	0.29	t	1	1	.	t	.	1	t	1	.	.	.	2	t	.	t	t	1	1	10
ORMESBY LITTLE	23rd Sept.	0.27	.	.	t	.	.	.	.	.	.	.	t	.	.	t	t	.	.	.	.	4
RANWORTH	9th Sept.	0.45	.	1	.	.	.	.	.	.	1	t	.	.	.	.	.	.	.	.	.	3
ROCKLAND	28th July	0.15	.	1	1	.	.	.	.	.	1	1	.	.	p	2	.	.	.	2	2	6
ROLLESBY	5th Oct.	0.28	t	.	1	.	.	.	.	.	.	.	1	.	t	t	.	.	.	2	2	5
SNAPES WATER	29th Sept.	0.34	.	.	.	.	.	.	.	.	.	.	.	.	.	1	t	.	.	.	1	2
UPTON	3rd Oct.	0.45	.	.	.	.	.	.	3	.	.	.	.	.	1	.	t	.	1	2	2	3

*Strictly an emergent species

N.B. The lilies are recorded as percent cover of open water

Key:

t = or less than 5
1 = 5-25
2 = 25-50
3 = 50-75
4 = 75-100

% cover in the combined transect area of each site.

p= Present but not recorded from transect.

2. Assuming that F was proportional to the area occupied by X in the area of a transect, the cover of each species in a transect was calculated. These values were then summed and converted to a percentage of the combined transect area for each broad.
3. In order to simplify presentation the actual percentages are not given, but instead the species are grouped into the 'percentage-limits' shown in the key.

The degree of error in such calculations is, undoubtedly, considerable. This procedure, however, does provide a directly comparable methodology for future work. As a comparative measure of sampling efficiency the proportion of open water covered by the transects is given for each locality. Dates of site visits are also shown in Table 1.

Of the twenty broads surveyed, only one was found to be completely devoid of macrophytes, namely Malthouse Broad. Eleven sites had between one and three species and a further six between four and six vascular macrophytes. The two remaining localities, Martham South and Ormesby, had much the richest aquatic flora with nine and ten species recorded respectively.

The commonest macrophytes found were the two species of lily, *Nuphar lutea* and *Nymphaea alba* (recorded at twelve and ten sites respectively) and *Ceratophyllum demersum* which was found in eight of the broads visited. *Hippuris vulgaris*, *Myriophyllum verticillatum* and *Utricularia vulgaris* agg. were found only in Martham South while *Potamogeton berchtoldii* and *Polygonum amphibium* were found only in Ormesby Broad. The remaining species were recorded on a number of occasions. Of the algal groups fiilamentous algae were most frequently encountered, being present at almost half of the sites. *Enteromorpha* sp. was found at seven localities and *Chara* spp. in the same four broads as *Najas marina*.

In terms of productivity, the two brackish water broads, Martham South and Blackfleet, contained the greatest quantities of plant material. Ormesby, although exhibiting the most diverse assemblage of macrophytes, had none in any substantial quantity apart from *Zannichellia palustris* which dominated the eastern wing of the broad. The submerged species were poorly surveyed in Rockland Broad and Hudson's Bay because of extensive stands of water lilies which prevented the use of the sampling-rake.

In general terms the results show that the broads of the Ant and Bure valleys have the poorest macrophyte communities of the sites visited. Rockland and the Muckfleet Broads, on the other hand, were found to be more diverse and the two brackish waters of the Thurne catchment showed both high diversity and abundance of aquatic plants.

Discussion

For some time now there has been increasing anxiety over the rapidly diminishing diversity of both the flora and fauna of the Norfolk Broads. In particular, much concern has been centred on the disappearance of aquatic macrophytes from many hitherto thriving sites. The recent survey by Mason and Bryant (1975) and the earlier work of George (1970) both sought to quantify this problem. The ensuing discussion is aimed at comparing and contrasting these studies and other existing records in the light of this most recent information. Each of the river valleys and their associated broads will be considered in turn.

The Ant Broads

Nicholson (1906) undertook a comprehensive study of the aquatic flora of the Ant district, particularly of Sutton Broad and its surrounds, between 1902 and 1905. He recorded over thirty different species from this area, although it is difficult to distinguish which species were found in the surrounding dyke systems and which were found in the actual broads. Both Nicholson and Gurney (1904) emphasised the luxuriance of Charophytes in Barton Broad at this time including extensive growths of *Chara fragilis*, *Chara aspera* and *Chara vulgaris*. A few years later Pallis (1911) described *Stratiotes aloides* as dominant in the Ant region and listed nearly twenty other aquatics most of which were described as components of an "open reedswamp and rooted floating-leaf" association.

In 1933, Ellis identified ten species of macrophyte from dredgings of Barton Broad (In litt NCC) six of which had been recorded by Pallis. At this site Tubbs (1975) recalls that by the late thirties "*Stratiotes* and other plants were becoming a memory and by 1939 much open water had been cut outside the marked navigation channels". At the same time Geldhart recorded the presence of *Stratiotes* in Crome's Broad with *Myriophyllum verticillatum* and *Hottonia palustris* (Boardman 1939). Ellis (1965) observed that *Stratiotes* was abundant at Barton after the war. This species had, however, disappeared by 1968 (George 1970) and has not been found at either of these sites since.

Alderfen Broad has a well documented recent history which shows a dramatic change in its aquatic vegetation in the last fifteen to twenty years. An aerial photograph taken in July 1946 shows considerably more vegetation in the open water than is present today (Plate 1). Much of this may well be islands of hover (Gurney 1919) although it is likely that free-floating species are also a major component. In the late fifties Jermy (1959) found an abundance of *Ceratophyllum demersum* in the open water, together with *Nitella* sp., *Lemna triscula* and *Potamogeton pectinatus*. He also recorded *Hydrocharis morsus-ranae*, *Myriophyllum verticillatum* and *Utricularia vulgaris* agg. as common elements of the primary reedswamp. Again in 1963 Alderfen was so choked with *C. demersum* that a proposal to clear the weed mechanically was given serious consideration (George 1970). However by 1968 only a few depauperate plants of this species could be found and there was no trace of any of the other species recorded by Jermy. Only small amounts of *C. demersum* have been recorded since, although Mason & Bryant (1975) noted the presence of viable seeds from 1970-73, and more recently some has been introduced for experimental purposes by workers at the University of East Anglia (Phillips pers. comm.) Almost coinciding with this disappearance of submerged plants the white water lily has shown a marked decrease in abundance. Jermy described this species as predominating in the deeper areas of the broad in 1959 and it was recorded as frequent by George (1970) in 1968. By 1971, however, *Nymphaea alba* was reduced to one small patch along the eastern edge of the broad (Dollman—In litt NCC). In 1977 only scattered patches were found. Similar declines in the extent of both *Nymphaea alba* and the yellow water lily, *Nuphar lutea*, have been observed at the other three sites in the Ant region.

The 1977 survey revealed a similar situation at Alderfen and Crome's Broad to Mason and Bryant's survey in 1972, although *Ceratophyllum demersum* was found at Crome's and no *Nuphar* was found in Alderfen. Barton and Sutton

Broads were not surveyed but it is well known that, at present, neither of these sites contain macrophytes in any quantity (Hayes pers. comm., Wright pers. comm.).

One may conclude from these observations that much of the aquatic vegetation of these broads has clearly been lost and that this decline has occurred mainly in post-war times. The reduction in water lilies seems a somewhat more recent occurrence, about the late sixties, as does the particular case of *Ceratophyllum demersum* at Alderfen Broad.

The Bure Broads

In the past few of these sites have been shown to exhibit extensive stands of macrophytes. In the early part of the century both Gurney (1904) and Pallis (1911) remarked on the comparative lack of water plants in the area and Pallis suggested this was due to the broads being either too deep or too stagnant. Some years later Gurney (1929) commented on them being highly favourable to a rich growth of phytoplankton. Thus, insufficient light penetration may have been an important influence on the exclusion of submerged species at this time.

For most of the Bure Broads there is insufficient data to build up a comprehensive account of the changes that have occurred in their aquatic flora over the years. However two sites, namely Hoveton Great and Upton Broad, are well represented in this respect.

Hoveton Great Broad has undergone a remarkable transformation in the last thirty years. Aerial photographs in 1949 and 1951 show considerable encroachment of marginal reedswamp and many islets of floating macrophytes are evident. By 1961 not only has the marginal reedswamp receded but there is also a marked shrinkage in the distribution of the floating aquatics. Now there is virtually no remaining reedswamp (Boorman, Sheail and Fuller 1977) and only a few patches of lilies on the surface.

The earliest photographs referred to above coincide with the survey work of Lambert and Jennings (1951) and a transect line taken across the broad may be superimposed on these prints. This confirms the presence of substantial stands of Water Soldier and other floating macrophytes. In the transect *Stratiotes* and *Ceratophyllum demersum* were described as dominant with *Nuphur*, *Nymphaea*, *Lemna minor*, *Lemna trisulca*, *Azolla filiculoides* and *Myriophyllum verticillatum* as associates, but mainly at the edge of the open water in the shelter of *Typha angustifolia.*

Lambert (1965) has since described *Stratiotes* as having been dominant in 1947, but completely absent in 1953. There are no further records of *Stratiotes* from this site. In 1968, however, George did find an abundance of *Ceratophyllum demersum* and *Nymphaea.* All the records of the water lilies show *Nuphar* as being more abundant than *Nymphaea* and, as in the Ant Valley, there has been a gradual decrease in both these species at this site. In 1977 *Potamogeton pectinatus* was found in small quantities and *Potamogeton crispus* was also recorded apparently for the first time in this broad. Neither of these species were found by Mason and Bryant in 1973.

Thus there is reasonable evidence to suggest that, at Hoveton Great Broad, concurrent with the loss of marginal reedswamp there has been a gradual decrease in both macrophyte productivity and diversity. This has resulted in the complete loss of two formerly abundant species, firstly *Stratiotes* in the early fifties and more recently *C. demersum* sometime during the late sixties. It has also led to the disappearance of *Myriophyllum verticillatum* and *Lemna* spp. and to a substantial reduction in the distribution of water lilies.

Upton Broad is unique among the Bure broads, partly on account of its exceptionally clear water, but also because of its unusual sediments which are largely composed of invertebrate faecal pellets in which algal cells are preserved free from decay. Unlike Hoveton Great, Upton is completely cut-off from the main river.

Again the loss of aquatic vegetation is quite apparent from aerial photographs and, as at Hoveton Great Broad, many islets of vegetation have completely disappeared since the 1940's (Plate 000).

No records could be found for this site prior to 1938 when *Myriophyllum veticillatum* and *Ceratophyllum submersum* were recorded (Petch and Swann 1968). A survey by Lambert and Jennings (1951) in July 1949 revealed extensive, though scattered, patches of *Myriophyllum verticillatum* with *Hydrocharis*, *Utricularia vulgaris* agg., *Lemna minor* and *Lemna triscula** all in small quantities and generally confined to the reedswamp. *Nyphaea alba* and *Potamogeton pectinatus** were also recorded from the open water. In this same year Lambert first noted the presence of *Najas marina* (In litt NCC) and by July 1952 this species is described as abundant in both the open water and the reedswamp (Barry and Jermy 1953). Other species recorded at this time include *Myriophyllum verticillatum* and *Nymphaea alba* as abundant and very common respectively, *Chara vulgaris* in water over one metre deep and occasional plants of floating *Fontinalis antipyretica. Utricularia* sp. and *Hydrocharis* were again recorded from the reedswamp and later in the year *Lemna triscula*, *L. minor*, *Potamogeton pectinatus* and *Potamogeton obtusifolius* were also found by Jermy (In litt NCC). Hence between 1949 and 1952 the only significant change was the rapid increase in abundance of *Najas marina.*

In 1968 George again found an abundance of *Najas marina* (as indicated by all records from this site since 1952 although Phillips (1976) noted a decline in 1974) but this time with *Potamogeton pectinatus*, *Zannichellia palustris*, *Nymphaea*, *Nuphar* and *Sagittaria sagittifolia.*

In the following year Morgan (1972) recorded the same species excepting *Potamogeton pectinatus* and *Sagittaria*, but in addition he refound *Utricularia* sp. and *Chara* sp. and a new species for this site, *Potamogeton friesii.* Hence since the early fifties there appears to have been a substantial alteration of the species composition coupled with a slight decrease of diversity. *Myriophyllum verticillatum*, *Hydrocharis*, *Fontinalis*, *Lemna* spp and *Potamogeton obtusifolius* have been lost and *Zannichellia*, *Potamogeton friesii* and *Sagittaria* have been gained.

Since 1972 *Najas* has remained dominant although the less common species appear to have fluctuated about a low level. These include *Chara* sp., *Potamogeton pectinatus*, and *Zannichellia palustris.* In 1974 Mason (In litt NCC) recorded the apparent disappearance of both *Zannichellia* and *Chara* sp. although both these

*These species are recorded only in the original notes held at the NCC and were not published in Lambert and Jennings (1951).

species were recorded in 1977. Also in 1976 Driscoll, Lambley and Moore (In litt NCC) noted the presence of *Chara vulgaris* var. *longidracteata* and *Potamogeton pectinatus*. The latter was not found in 1977.

Upton Broad has thus been subject to a gradual decrease in diversity between the late forties and the mid-seventies which has been accompanied by a switch in species composition sometime between 1952 and 1967. In the last few years although *Najas marina* has remained dominant the other species which make up the macrophyte community have shown signs of instability through fluctuations in appearance from one year to the next.

To conclude, the Bure Broads, although having been regarded as poor in macrophytes for many years, do show similar signs of regression to the Ant valley Broads and this is particularly the case with Hoveton Great Broad. It is of interest to note the common features of these changes, in particular the loss of the marginal reedswamp association and gradual loss of diversity and productivity.

The Muckfleet Broads

Over the years there have been surprisingly few records of aquatic macrophytes from these broads and in general they have been considered too deep to support any extensive aquatic growth. Gurney (1965) refers to the "comparatively weedless" broads of the Ormesby Group and Lambert in the same year states that: "Many of the deep broads, such as Rollesby and Filby, have a very poor aquatic flora and such water plants as are present are limited to a few shallow marginal areas."

Nevertheless there are a number of early records from Filby Broad. These include an apparent abundance of *Nitellopsis obtusa* between 1880 and 1881 (Bennett 1910), *Chara hispida* and *Potamogeton friesii* in 1902 (Salmon and Bennett 1902) and again an abundance of *Nitellopsis obtusa* in the following year (Bennett and Salmon 1903).

The only apparent records from Rollesby Broad are of *Chara contraria* in 1902 (Salmon and Bennett 1902) and *Hippuris vulgaris* found by Long a year later (Herbarium, Norwich Castle Museum).

Apart from the Charophytes recorded by George (1970) from Filby in 1968 and those from Ormesby Broad in this survey none of the species mentioned above has since been found. In 1968 Morgan (In litt NCC) noted *Nymphaea alba* and *Nuphur lutea* from Ormesby Broad and the latter from Ormesby Little Broad, however, in 1977 the reverse situation was the case. Mason and Bryant (1975) found neither of these species in 1973 but recorded two new species for Ormesby Broad, namely *Stratiotes aloides* and *Fontinalis antipyretica*. Neither of these species were located in 1977. Similarly at Filby Broad, George (1970) recorded *Chara* sp., *Potamogeton pectinatus* and *Nuphur lutea* although Mason and Bryant found no macrophytes in 1973. In the latest survey *Potamogeton pusillus* was recorded in small quantities over virtually the whole area of this broad.

Assuming these records form an accurate reflection of the situation it is difficult to understand why the 1977 survey revealed such a comparatively rich diversity of species, particularly in Ormesby Broad. At this site, of the ten vascular macophytes found nine had not been previously recorded and in addition, of the five previous records only one was confirmed. It did seem, however, that

Filby, Ormesby Little and Rollesby were too deep to support highly productive macrophyte communities and in the central areas of these broads *Potamogeton pusillus* was practically the only species found. It should be noted that Mason and Bryant's work of 1973 was carried out during the winter months and this may account for the noticeable discrepancies between the two surveys. It is likely, therefore, that there has not been such a sudden expansion of the aquatic flora as might be inferred from the 1977 results. A more likely explanation is that many of the species found in 1977 have been overlooked in the past, either through insufficient searching or through sampling at the wrong time of the year. This interpretation is supported by the fact that aerial photographs taken in the late 1940's show considerable areas of open reedswamp around the margins of these Broads. Comparison with other sites suggest that these areas would have been rich in floating macrophyte species.

The Yare Broads

The Yare Valley Broads are known to have had rich macrophyte communities in the early part of the century. In 1911 Pallis identified *Potamogeton pectinatus* and *Zannichellia palustris* as the dominant submergents of the area with *Myriophyllum verticillatum*, *Ceratophyllum demersum* and *Enteromorpha* sp. as abundant components. Also among the submerged species *Stratiotes* was classified as occasional and the various Characeae as rare. Of the 'free floating-leaved' association at this time four species of duckweed were dominant with associated *Nuphur lutea*, *Hydrocharis morsus-ranae*, *Potamogeton lucens*, *P. perfoliatus* and rare plants of *Nymphaea alba*. By 1929, however, Gurney found *Myriophyllum* sp. and *Ceratophyllum* sp. to be the dominant species of the Yare Broads.

Before considering Rockland and Wheatfen Broads, which have the most comprehensive histories of this region, there are a few valuable records from the other broads. At Buckenham, for example, Ellis recorded seven species of macrophyte in 1933 (In litt NCC) yet both George (1970) and Mason and Bryant (1975) found only *Nymphaea* and *Nuphar* here in 1968 and 1973 respectively. Similarly, at Hassingham Broad the owner recalls that *Stratiotes* was abundant until 1939 (In litt NCC) and Lambert (1965) comments on the scarcity of submerged aquatics from the main basin of the broad despite their abundance in the surrounding dykes. Again George (1970) found only water lilies at this site in 1968. At Strumpshaw, *Ceratophyllum demersum* was at one time abundant (Lambert 1965) but no species have been recorded here since (George 1970, Wright pers comm.). The Bargate and Surlingham complex is also known to have supported large amounts of *C. demersum* between 1939 and 1945 (Morgan 1972) and Lambert (1946) illustrated the dense drifting masses of this plant here with its associated *Lemna* spp. in 1946. A photograph in 'The Times' in 1952 also shows large mats of floating vegetation around the edges of Surlingham Broad. Both George (1970) in 1968 and Mason and Bryant (1975) in 1973 found no macrophytes here and only *Nuphar lutea* was found in 1977 (Hayes, pers comm.).

The past events in Rockland are somewhat more complicated than the other Yare Broads. As early as 1866 *Potamogeton praelongus* was recorded (Morgan 1972) and in the following year Bennet (1910) found *Nitellopsis obtusa*. Nicholson's flora (1914) notes *Potamogeton zosterifolius*, *P. pectinatus* and *Lemna polyrhiza* from this site. By 1934 Ellis found abundant *Stratiotes* in the broad but in 1939 describes *Ceratophyllum demersum* as the dominant plant. Nearly ten years later both Hurrel (1942) and Rudd (1943) referred to the rank growth of water soldier in Rockland Broad although Ellis (1955) claimed that the species had vanished before the 1940's. As at Surlingham, Lambert (1965) refers to the past dominance of hornwort but comments that when it was dredged out some years previously "the water was immediately filled the same season by great masses of *Elodea canadensis* normally excluded by the dense floating hornwort matts". However by 1966 *C. demersum* had regained its former abundance and *Lemna minor*, *L. triscula*, *Elodea* and *Sagittaria* were noted as its associates (Bye 1966). Two years later Morgan estimated *Nuphur lutea* to have a 30% cover and once again recorded only small amounts of *C. demersum* with *Elodea canadensis*, *Potamogeton* spp. and *Chara* spp.. In 1970 George (In litt NCC) found even less *C. demersum* than in 1968 but *Elodea canadensis* was still present. By 1973 Mason and Bryant record only an abundance of *Nuphar lutea* which was still prolific in 1977. Small amounts of *C. demersum*, *E. canadensis*, *Potamogeton crispus*, *P. pectinatus* and *Zannichellia palustris* were also identified in 1977 although these were mostly distributed in sheltered areas of the broad, away from the main navigation channels and behind the *Nuphar* beds.

The Wheatfen channels have been closely monitored over the years through the detailed observations of Dr. E. A. Ellis. In 1934 he recorded twenty-three aquatics from this area of which *Ceratophyllum submersum* and the two duck-weeds, *Lemna minor* and *Lemna polyrhiza*, were classified as the dominant species. *Potamogeton pectinatus*, *P. compressus*, *Lemna gibba*, and *L. triscula* were also found in abundance. In 1939 Ellis added a number of new species to this list including *C. demersum* which by 1941 A. E. Ellis records as the dominant plant of the submerged community. By 1950 substantial changes had begun to occur and Ellis (1958b) commented on the scarcity of *C. demersum* and the duckweeds which were previously so abundant in the region. In 1958 Ellis (1958a) listed a number of species that had vanished from the Wheatfen area since 1933. These include *Nymphaea alba*, *Hippuris vulgaris*, *Hottonia palustris*, *Stratiotes aloides* and *Sagittaria sagittifolia*.

Thus there has been a severe decline in the diversity of the aquatic plants at Wheatfen similar to that demonstrated from all the Yare sites with the possible exception of Rockland Broad. The latter site seems to have retained a reasonable diversity although the majority of species occur only at low frequencies. Extreme variations also occur in the abundance of different species from one year to the next and this is particularly evident in the two members of the hornwort family. Finally it is worth mentioning the considerable development of the macrophyte flora of Brundall Inner Broad since it was mud-pumped and sealed off from the River Yare in 1975. This site has been closely monitored by research workers at the University of East Anglia. In 1977 fourteen species of macrophyte were identified (R. Leah pers comm.) although there were no species present prior to mud-pumping. These included an abundance of *Potamogeton pectinatus*, *Zannichellia palustris*, *Lemna minor*, *Lemna polyrhiza* and *Enteromorpha/Monostroma* sp., *Potamogeton crispus* and *Callitriche* sp. were also recorded as common.

The Thurne Broads

The Thurne region and in particular the Hickling/Horsey area has been a popular hunting-ground of botanists for many years, particularly since the discovery of *Najas marina* at Hickling in 1883 (Bennett 1883). In the last seven or eight years, however, there have been signs of widespread reductions in both diversity and biomass of macrophytes in some of the broads, namely Hickling, Heigham Sounds and Horsey Mere. Much of this area has recently come under the close scrutiny of researchers from the University of East Anglia in an attempt to discover the exact causes of this serious deterioration in the aquatic community. Pallis (1911) found the waters of the Thurne area to be the most productive of the Norfolk Broads and recorded a submerged flora dominated almost exclusively by various species of algae. These included *Chara aspera*, *C. hispida*, *C. polycantha*, *Cladophora* sp. and various filamentous types. *Potamogeton pectinatus* was the only dominant vascular plant found. The luxuriance of the Characeae in these broads during the early part of the century is also described by Gurney both in 1904 and 1929.

At Hickling Broad Bennett recorded a dominance of *C. aspera* with *C. hispida*, *C. polycantha* and *Nitellopsis obtusa* in the same year as his discovery of *Najas marina. Nitellopsis obtusa* was still abundant in 1903 (Bennett and Salmon) and again in 1906 (Nicholson). *Potamogeton pectinatus* and *P. praelongus* were also both recorded on a number of occasions around the turn of the century (Morgan 1972) and *P. lucens* was recovered from Hickling in 1892 (Herbarium, Norwich Castle Museum). In 1934 Ellis identified twelve species of vascular macrophytes from the weed-cutting operations in the broad (In litt NCC). These were *Myriophyllum spicatum*, *M. verticillatum*, *Elodea canadensis*, *Hippuris vulgaris*, *Utricularia vulgaris* agg., *Ranunculus circinatus*, *R. trichophyllus* and five different *Potamogeton* spp.. After the floods of 1938, however, Ellis made a detailed list of the casualties, brought about by this vast incursion of saltwater, which includes no less than twenty-six aquatic macrophytes which he believed to have succumbed to the floods in the Hickling area. Unfortunately he makes no distinction, however, between species recorded from the dykes and species found in the broads themselves. The only aquatics which appeared to have survived the floods were *Cladophora* sp. and a little *Enteromorpha* sp. As Ellis suggested at the time, however, many of the Charophytes that had apparently been lost were, in fact, found to have survived the flood. Thus in 1954 Lambert (In litt NCC) recorded an abundance of *Chara hispida* and *Cladophora* sp. with *Fontinalis antipyretica* and *Utricularia vulgaris*. Occasional specimens of *Chara globularis* and rare plants of *Myriophyllum spicatum* and *Lemna minor* were also found. Six years later Phillips (1963) recorded six Charophytes including *Nitellopsis obtusa*, *Chara hispida*, *C. contraria*, *C. aculeolata*, *C. aspera* and *C. contraria x hispida.*

There are very few records of vascular macrophytes specifically from Hickling Broad between 1954 and 1968, although Bye did record *Myriophyllum verticillatum*, *Utricularia* spp., *Ceratophyllum demersum* and *Callitriche* from Whiteslea Dyke in 1966. In 1968, Morgan (1972) found an abundance of *Zannichellia palustris* (apparently a new species for Hickling Broad), *Utricularia* sp., *Fontinalis*, *Myriophyllum* sp., *Cladophora* and *Chara* spp.. Associated species at this time were *Potamogeton pectinatus*, *C. demersum*, *Najas marina*, *Hottonia palustris*, *Hippuris vulgaris* and *Nitella sp.*. George (1970) also found an abundance of *Potamogeton friesii in 1968*. During 1972 two extensive searches were made of this broad and a total of eight vascular species were identified (Mason and Bryant 1975, Hornby—In litt NCC). In both cases *Potamogeton pectinatus* was recorded as abundant although Hornby also found an abundance of *Myriophyllum spicatum* which Mason and Bryant found only in scattered patches. *Najas marina*, *Fontinalis* *antipyretica*, *Zannichellia palustris*, *C. demersum* and *Chara* sp. were all recorded only in small quantities by Mason and Bryant although Hornby found more *Fontinalis* and noted *Hippuris vulgaris* as common.

Phillips surveyed both Hickling Broad and Heigham Corner in 1975 and 1976 (In prep -NCC report). In the main broad during the first survey he found an abundance of Characeae, *Myriophyllum spicatum* and *Najas marina.* In 1976, although *M. spicatum* was equally abundant, *Potamogeton pectinatus* dominated the broad and very few stoneworts were recorded. *Najas marina* was also found in lesser amounts than in 1975. The only other species recorded from the main broad were *Fontinalis antipyretica*, which was recorded in small quantities only in 1975, and small amounts of *Hippuris vulgaris* encountered in both years. In Heigham Corner *Myriophyllum spicatum* and *Ceratophyllum demersum* were the most abundant aquatic macrophytes in 1975, although in the following year *Najas marina* was the dominant species. *Potamogeton pectinatus* and *Myriophyllum spicatum* were also common in 1976 at this site. Neither Hickling Broad nor Heigham Corner were visited in 1977.

In Heigham Sounds, like Hickling, there is evidence to suggest an abundance of Stoneworts in the early 1900's (Salmon and Bennett 1902) but more recent records show little similarity between the two areas. For example, a survey undertaken by Lambert in 1954 found nine aquatic species but only four of these were recorded from the main broad (In litt NCC). Similarly, in 1972 Mason and Bryant found only an abundance of *Hippuris vulgaris* and *Cladophora* neither of which were recorded by them from Hickling on the same date. Phillips also surveyed this area in 1975 and 1976 and on both occasions recorded *Myriophyllum spicatum* as the dominant species with *Ceratophyllum demersum*, *Hippuris vulgaris* and *Potamogeton* spp. as the most common associates. It is of interest to note that Nicholson also recorded *Myriophyllum spicatum* as abundant in Heigham Sounds in 1906.

Horsey Mere was closely monitored for several years after the 1938 floods. Ellis (1938) recalls *Sagittaria sagittifolia* as previously common in the Mere with *Fontinalis antipyretica.* The year after the flood, however, *Potamogeton pectinatus* was dominant with an abundance of *Cladophora* and occasional plants of *Myriophyllum spicatum.* By 1940 *P. pectinatus* appeared to have lost its former dominance and *M. spicatum* and *P. zosterifolius* had become abundant (Buxton 1940). In 1941 there were clear signs of recovery and Ellis (Buxton 1941) identified *M. verticillatum*, *Chara hispida*, *C. aspera*, *P. perfoliatus*, *P. praelongus* and *Hydrocharis morsus-ranae* from the Mere. By 1968 Morgan (1972) recorded a wealth of aquatic plant life, including an abundance of *P. pectinatus*, *Hippuris vulgaris*, *Myriophyllum* spp. and *Cladophora.* Some stoneworts were also noted on this occasion. Far fewer species were found, however, by Mason and Bryant in 1972 and *Myriophyllum spicatum* and *P. pectinatus* were the only species found in any quantity. Again it must be noted, however, that Mason and Bryant visited all the broads of the Hickling area in the winter months. In 1975 George (In litt NCC) found *Myriophyllum* sp. and *Hippuris vulgaris* with a small amount of *Najas marina.* Horsey Mere was not surveyed in 1977 but *Hippuris vulgaris* and *Myriophyllum spicatum* were noted on a casual visit to this site in August.

Blackfeet Broad lies midway between Heigham Sounds and Horsey Mere on the south-eastern side of Meadow Dyke. A thick belt of reedswamp effectively isolates this body of water from the main dyke thus it is seldom subject to human disturbance. There are only a few early records from this site although all suggest an abundance of Charophytes as demonstrated from Hickling, Heigham Sounds and Horsey Mere. Thus in 1902, Salmon and Bennett found *Chara fragilis*, *C. aspera*, *C. hispida* and *Nitellopsis obtusa* and in the following year Bennett and Salmon stated that *Chara polycantha* was to be found " . . . in great beds many yards across, and so dense in places as to prevent a boat from proceeding".

George (1970) visited Blackfleet in 1968 and found *Myriophyllum*, *Ceratophyllum* and *Utricularia* spp.. In 1977 this site was so choked with submerged vegetation that it was difficult to use the sampling-rake due to the anchoring effect of the weed. The major components of this submerged flora were *Najas marina* and *Potamogeton pectinatus*. *P. pusillus*, *M. spicatum*, *Chara* spp. and filamentous algae were also found in small quantities.

Martham Broad is made up of two portions separated by the river channel running between Martham Ferry and West Somerton. According to their position the two are respectively termed the North and South Broad. There are many records from both these sites during the seventies and most indicate both a diverse and a productive macrophyte community.

George (1970) visited Martham North in 1968 and found an abundance of *Utricularia vulgaris* agg. with *Myriophyllum verticillatum*, *Ceratophyllum demersum*, *Potamogeton pectinatus* and *Chara* sp. all occurring in reasonable quantity. *Najas marina*, *Hippuris vulgaris* and *Cladophora sauteri* were also recorded but only in small amounts. In 1971 Hornby (In litt NCC) found all the species that George identified in 1968 but found no Charophytes and in addition recorded *M. spicatum*. Unlike George, however, Hornby found *Cladophora* to be the most abundant species and *U. vulgaris* and *H. vulgaris* were both found in lesser amounts than in 1968. In November 1972 Mason and Bryant (1975) found only an abundance of *Hippuris vulgaris* and *Cladophora* sp.. Almost on the same date, however, Hornby recorded *Utricularia vulgaris* agg., *Potamogeton pectinatus* and *Chara* sp. as common components of the submerged flora. By 1973 *Cladophora* had apparently vanished and *Utricularia vulgaris* agg. and *Hippuris vulgaris* had become the most abundant species (Britton - In litt NCC).

Phillips made detailed surveys of Martham North in June and September 1975 and again during the summers of 1976 and 1977 (In prep. NCC report). On all these occasions he found *Utricularia vulgaris* agg. to be the most productive species and all the surveys revealed a rich diversity of aquatics. The most abundant associates of the bladderwort were *Myriophyllum spicatum* in June 1975, *Najas marina* in September 1975, *Zannichellia palustris* in 1976 and *Ceratophyllum demersum* in 1977. There are no signs of any macrophyte decline during this period. Indeed, there is little evidence of any major loss of aquatic plants from Martham North over the past ten years.

The macrophyte community of the South Broad has shown little similarity to Martham North. One of the most interesting features of the former site is the quite vivid changes in abundance of both *Najas marina* and the various Charophytes from one year to the next. In 1971, for example, both Hornby and Cadbury (In litt NCC) encountered only *Najas marina* and *Utricularia* spp.. However, in the following year, although *Najas* was still abundant, the stone worts were the dominant species (Hornby - In litt NCC). *Cladophora sauteri* was also found in some quantity in 1972, but it was by no means as prolific as in the North Broad at this time. In 1973 Britton found *Chara hispida* to be the dominant

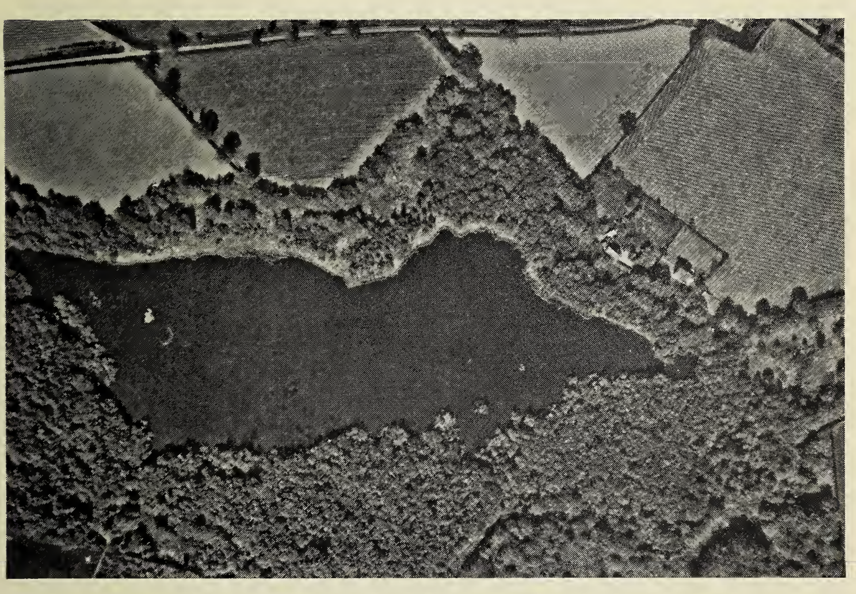

Plate 1. Aerial views of Alderfen Broad showing the almost complete loss of open-water vegetation between July 1946 (above) and June 1976 (below).

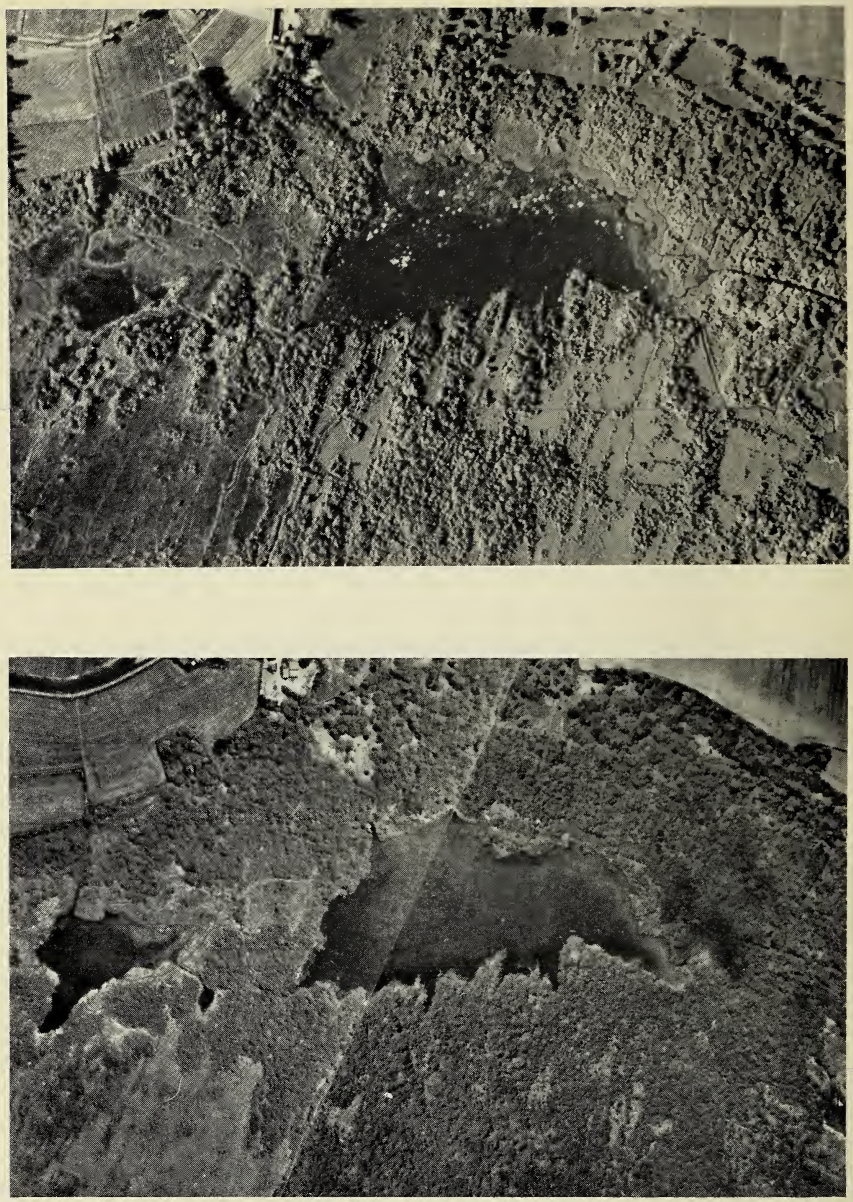

Plate 2. Aerial views of Upton Broad in July 1946 (above) and May 1977 (below). As at Alderfen notice the considerable loss of open-water vegetation.

species with associated *C. aspera*, *U. vulgaris* agg., *P. pectinatus*, *Hippuris vulgaris*, *Cladophora* sp. and *Najas marina*. (In litt NCC).

Phillips visited the South Broad in both 1975 and 1976 (In prep. NCC report). In 1975 a dominance of *Chara hispida* was still apparent and he recorded essentially the same species as Britton in 1973 but, in addition, found *Zannichellia palustris*. *Ceratophyllum demersum*, *Najas marina* and *Cladophora* sp. were not recorded in 1975. The following year, however, *Najas* was the dominant species although *Chara hispida* was still abundant. In the 1977 survey, *Najas* was again dominant and *Potamogeton pectinatus* was found in almost equal amounts but only a few Charophytes were noted.

In the Martham area there have thus been few signs of any recent deterioration in the aquatic community as demonstrated from some of the other Thurne Broads. There is evidence, however, to suggest wide fluctuations in the abundance of the various macrophytes from one year to the next and these are particularly noticeable in the records from the South Broad. It is possible, however, that these are partly seasonal variations. For example, *Najas marina* is known to be a species which appears late in the season and this is demonstrated by the two surveys undertaken by Phillips of Martham North in 1975.

The only other site in the Thurne region is Calthorpe Broad which is the most northerly of the Norfolk Broads and lies to the south-west of Sea Palling. This Broad has recently undergone two drastic changes in pH firstly in 1970 when a value of about 3.6 was recorded and again in 1977 when the pH fell even lower to about 3.2 (Dollman - In litt NCC). As a result of these highly acidic conditions many of the submerged species which previously abounded in the broad (Jermy 1956 and Tutin 1955 - In litt NCC) have now disappeared and water lilies are all that remain. The reasons for the changes in pH at this site are complex but are basically caused by the drying out of the broad and its adjacent fens during the summer months.

To conclude, in the Thurne region macrophyte losses have only occurred in the last seven or eight years and have been confined to Hickling Broad, Heigham Sounds and Horsey Mere. The major losses have been of the Charophyte species although other plants such as *Hydrocharis morsus-ranae*, *Myriophyllum verticillatum* and *Lemna minor* have also disappeared.

Summary

It is clear that in the majority of the Norfolk Broads there has been a serious, decline in both diversity and standing crop of aquatic macrophytes. Martham Blackfleet, Rockland and the Muckfleet Broads are the only possible exceptions to this general trend.

The Ant Broads have all shown a considerable deterioration in their aquatic vegetation since the war. There are strong similarities between the broads of this region and the Bure valley sites. For example, the disappearance of *Myriophyllum verticillatum* from both Upton and Hoveton Great coincides with its loss from Crome's and Alderfen Broads. The loss of *Stratiotes* from Hoveton Great and Barton also occurred at about the same time and in both cases was a comparatively rapid event. A particularly noticeable loss from both these areas is that of free-floating species such as *Hydrocharis morsus-ranae*, *Lemna* spp. and *Azolla filiculoides*. In the majority of the Ant and Bure Broads water lilies are the only aquatic plants remaining in any quantity and even these species have been progressively diminishing in abundance in recent years. The Muckfleet Broads show few signs of impoverishment other than would be expected on account of their greater depth.

In the Yare Valley, the broads have also lost many previously abundant aquatic species although these losses have not apparently coincided with those from the Bure and the Ant Broads. For example, *Stratiotes* disappeared about 1940 in both Strumpshaw and Rockland Broad, some ten years previous to its loss from Hoveton Great and Barton. The Yare Broads also show considerable fluctuations in abundance of species from one year to the next and this phenomenon is particularly attributable to both *Ceratophyllum demersum* and *C. submersum.*

The decline of macrophytes in the Thurne Broads has been a more recent occurrence than elsewhere in Broadland and has only been noticeable in Hickling Broad, Horsey Mere and Heigham Sounds. The major losses from the Hickling area are of the many Charophyte species which were once so luxuriant in this region. Blackfleet and the two Martham Broads have shown no signs of any such impoverishment. In the latter area there have been considerable variations in the abundance of the various aquatic species. This is particularly evident from the spasmodic appearances of *Najas marina* and the Characeae over the last few years, although this may be a largely seasonal phenomenon. It would indeed be a worthwhile exercise to study the seasonal variation in abundance of macrophytes in a number of broads over a period of several years. It is quite likely that prevailing climatic conditions, particularly early on in the season, have considerable bearing on the success of different aquatics from one year to the next. For example, the late springs experienced in the last few years have doubtless had an adverse effect on those species that appear early in the season.

A point of particular interest, revealed by the 1977 survey, is the apparent increase in the distribution of *Potamogeton crispus.* This species has, in the past, been recorded only on one or two occasions in the Norfolk Broads although in 1977 it was found at six sites.

No attempt has been made in this review to account for the loss of aquatic macrophytes from the different broads. The precise causes for the decline of macrophytes in the Norfolk Broads have been closely investigated by a number of research workers from the University of East Anglia (Phillips 1976, Eminson & Moss 1977 and Eminson & Phillips 1978).

This discussion has endeavoured to highlight some of the more important changes in the distribution and abundance of aquatic macrophytes in the Norfolk Broads. Nevertheless, it should be emphasised that due to limited space records have been omitted and, doubtless, there have been many important events that have passed-by unrecorded. It is hoped that this work will enable a closer watch to be kept on any further changes in the status of the aquatic communities in the Norfolk Broads.

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THE WETLAND PLANT COMMUNITIES OF THE RIVER ANT VALLEY, NORFOLK

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Introduction

The area of East Norfolk generally known as Broadland has long been recognised as a unique wetland complex of primary conservational importance in Britain (Ellis, 1965). Much of its scientific interest derives from the vegetation cover which contains a range of plant communities and species that occur rarely, if at all, elsewhere in Britain. This is particularly so for one of the smaller valleys of the region, that of the River Ant. Vegetationally this is, arguably, the most interesting, certainly the most diverse, of all the Broadland valleys. It supports the greatest number of different wetland plant communities (and probably species as well) including some absent or poorly developed in the other valleys; it presents the richest and most extensive developments of many of these; it retains large tracts of herbaceous fen (cf. the Bure valley) as considerable areas are still regularly mown for reed and sedge; and, partly related to this, it provides the only known remaining sites for several plant communities and species that were once more widespread in Broadland.

Despite the vegetational interest of the Ant marshes, there has been no comprehensive survey made of the plant communities. The present contribution attempts to remedy this deficiency. It may be noted that although attention is primarily focussed upon the Ant valley, many of the community descriptions are applicable to some of the other Broadland valleys as well.

Topography of the River Ant Valley

The River Ant, a tributary of the Bure, originates from a number of small streams arising at around 100 ft. O.D. in the vicinity of Antingham (from which it is named) and Southrepps. It quickly loses height and flows south-eastwards past North Walsham to Honing where it is joined by an important, though short, tributary stream flowing southwards from just behind the coast at Bacton to the neighbourhood of East Ruston.

Below Honing and East Ruston the broad valley floor is only a few feet above the level of the sea. It has a negligible gradient and is poorly drained. The sluggish river winds along for some 15 km before joining the Bure south of Ludham Bridge. On either side there are extensive tracts of peatland, stretching across to the gently rising slopes of the adjoining upland. It is this area, which for the present purposes is referred to as the Middle Ant valley, that contains the bulk of the Ant wetlands and provided the main survey area. Its extent and location are shown in Fig. 1. Attention has, however, also been directed to the contigous wetlands of the tributary valley leading north past East Ruston. These are just north of the map.

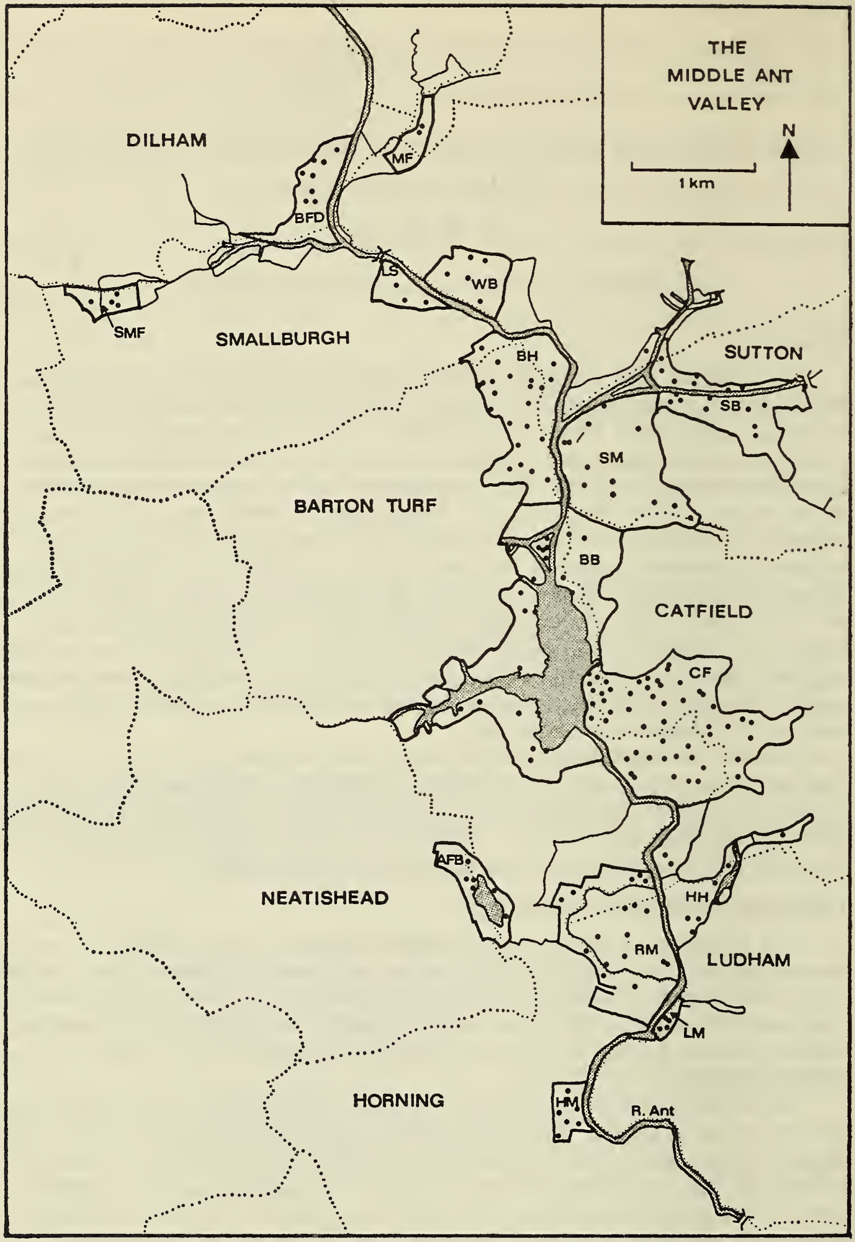


Fig. 1 Dots indicate the main sampling points. Areas outlined with heavy lines indicate the main areas examined. Each has been named and this is represented by initials: AFB: Alderfen Broad; BB: Barton Broad; BFD: Broad Fen, Dilham; BH: Berry Hall; CF: Catfield Fens; HH: How Hill; HM: Horning Marshes: LM: Ludham Marshes; LS: Low Street; MF: Marsh Farm, Brumstead; RM; Reedham Marshes; SB: Sutton Broad; SM: Sutton Marshes; SMF: Smallburgh Fen; WB: Wayford Bridge.

Throughout its course, the Ant flows over a bedrock of Norwich Crag. This is, however, exposed only in certain areas, particularly along the lower slopes of the valley. For the most part, the catchment area of the river is covered by Pleistocene drifts, particularly the decalcified clays of the Norwich brickearth and, especially in the higher parts, by glacial sands and gravels.

Two topographic types of mire can be distinguished within the Ant valley—valley mires and flood-plain mires. Valley mires, which occupy the slopes as well as the floors of valley systems, have their high water table maintained primarily by marginal springs and seepage. In contrast, flood-plain mires, which are developed on flat, waterlogged flood-plains alongside rivers, are irrigated predominantly by the river. The distinction is not absolute in that flood-plain mires may frequently have some degree of marginal seepage. But the relative contribution of water from this source is small. In the Ant valley the distinction is essentially geographic. The narrow, upper reaches of the valley, and particularly of the tributaries, have a high seepage component of water input and are essentially valley mires. The best examples are the fens along the valleys near Smallburgh and East Ruston. In contrast, the lower reaches are maintained in a waterlogged condition primarily by the influence of the river and support flood-plain mires. Most of the Ant marshes are of this type. This topographic distinction is important in that it has associated vegetational distinctions.

In the lower reaches of the valley a considerable depth (6-8m) of peat has accumulated. This is predominantly brushwood peat. Towards the seaward end it becomes compressed beneath a thickening deposit of estuarine clay. The detailed stratigraphy of these valley deposits has been given by Jennings (1952). In some parts of the valley, particularly in the lowest reaches, the marshes have been extensively drained and converted into grazing levels. But for the most part they still remain as vast tracts of undrained, embanked wetland. The amount of undrained flood plain mire is estimated at about 900 hectares.

There are, of course, two main components of the flood-plain mires—the mires proper and the broads and other peat cuts that have been excavated within them. The peat workings support a range of hydroseral communities and are themselves in various states of terrestrialisation. Their communities, which are all comparatively recent in origin, are quite different from those of the unworked peat surfaces in ontogeny, though not necessarily in floristic composition.

There are five broad basins within the Ant valley. The largest is Barton Broad. This is the only one that occurs actually within the main valley. The Ant actually flows through the broad, but this is the product of a diversion. Originally the river followed a winding course through the Catfield fens east of the broad, indicated now only by the line of the Barton Turf—Catfield parish boundary (Jennings, 1952). The other four broads are all side-valley broads—Alderfen Broad, Crome's Broad, Dilham Broad and Sutton Broad. Of these, only the first two retain any significant amount of open water. The Dilham Broad basin, located at the south-west corner of Dilham Broad Fen, has become completely overgrown. It originally straddled the Smallburgh-Dilham parish boundary and is marked as a small area of open water on the Tithe maps for the two parishes. It is not, however, on any of the subsequent Ordnance Survey editions. Nowadays a narrow channel is still maintained through the broad basin, but there is no surface evidence to indicate that it was once an area of open water. Likewise, Sutton Broad is marked on the 1841 Tithe map as occupying much of the arm of the Ant valley leading up to Sutton Staithe. In fact, the original broad basin was even more extensive (Lambert *et al.*, 1960). But by 1946 the broad basin, initially some 6 - 7 ft. deep, was completely overgrown, except for a central channel which was maintained in a navigable condition. This is still the case, though it seems as if the channel has become wider in recent years (Ellis, pers. comm.). Much of the basin has been filled by a raft of reedswamp peat overlying nekron mud (Lambert *et al.*, 1960) and in places the substratum retains a pronounced swinging character.

In addition to the broad basins proper, shallower, more recent peat cuts have also been made in several parts of the valley. Most notable perhaps are the extensive peat cuts that were made in the Catfield fens in the mid-nineteenth century. These have also become largely overgrown, with only a few remaining vestiges of open water.

The extent and location of the flood plain mires is, of course, determined by the topography of the valley. In places, particularly where there are side arms to the valley or large embayments cut into the adjoining upland, they can be very extensive. In some parts the margins of the mires are well over 1 km distant from the irrigating river. Although, for the most part, the dykes that extend through the marshes are in direct communication with the Ant, as Lambert (1965) has recognised the more distant areas are likely to be subject to very little water circulation and hence nutrient replenishment. This is a function not only of the distances involved but also of the weakly tidal character of the Ant and of the degree of dereliction and overgrowth of the dykes. Furthermore, parts of the Catfield fen complex have an internal dyke system, effectively separated from the main river by a sluice. The more remote areas are additionally little susceptible to periodic flooding, unless as part of a management regime. A consequence of this is that, although the water of the Ant itself has a high pH and a high nutrient loading, some parts of the adjoining fens are nutrient poor and in some places, where the rheotrophic influence is least, base poor as well. As a result there is in some areas the development of oligotrophic nuclei within the mesotrophic fens. It is this feature which is partly responsible for the vegetational diversity of the Ant valley.

Methods

The Ant valley fens were initially examined in 1972-1975 as part of a descriptive survey of rich fen vegetation throughout lowland England and Wales. Details of the methods used are given by Wheeler (1975). Essentially a subjective sampling procedure was adopted in which uniform and representative stands were selected for description. The area sampled in each case was variable but was usually $10m^2$. With the exception of samples from very species-poor stands, the stand data were processed using Information Analysis (Williams *et al.*, 1966) in conjunction with the so-called Zurich-Montpellier table method (see Westhoff & Van der Maarel, 1973) to generate a classification based upon the overall floristic composition of the stands.

Further attention was given to the area in 1976 and 1977 when most of the marshes were thoroughly explored and additional samples collected. These were used to expand and, to some small extent, modify the original classification.

Fig. 1 shows the main areas that were examined and the locations of the sampling points. It must, however, be recognised, as anyone who has examined the Broadland marshes will appreciate, that the purely physical problems presented by the tall and tangled vegetation, by the treacherous swamps and unbridged dykes have meant that it has not been possible to examine every part of the area.

The communities that occur in the valley are described below. For each a characterising species, or group of species, is given. In the latter case it is important to appreciate that no one species of the group is diagnostic for the community or need occur in every stand. It is only as a group that they have diagnostic value. Communities which are considered to be well circumscribed and defined floristically are regarded as named Associations (in the sense of the Zurich-Montpellier school). The concept of fidelity is not used in their definition. Other communities which have not been well examined in Britain are just left as *ad hoc* communities. Species-poor stands, defined only by their dominant species, are generally regarded as sociations.

The community-types recognised cannot be regarded as completely separate entities. Because of the nature of variation within vegetation, stands occur which are clearly transitional between two or more units. It cannot be expected that every stand of vegetation within the Ant marshes can be, or indeed should be, neatly allocated within the classification. But it is considered that this should be possible for most of them.

I. The Vegetation of the Flood-Plain Mires

Reedswamp Vegetation

The term swamp is used here to refer to areas of wetland in which the summer water table is constantly above the substratum. Its depth may range from a few centimetres to about 1 metre. The vegetation is composed primarily of tall immersive graminoids and as such presents a very distinct physiognomy.

In general, marginal reedswamp is not well developed in the Ant valley at present. This is in contrast to its more widespread occurrence earlier in this century when large areas of the Broadland basins that are now open water were being invaded by swamp as part of the normal process of terrestrialisation. This process has been reversed in many places by the regression or "dieback" of the reedbeds, although the factors that have led to this are not fully understood. They include grazing by coypus (*Myocastor coypus*) and the mechanical damage caused by the high intensity of boating traffic using the broadland waterways.

This has certainly been the case in the Ant valley. The large areas of swamp that, at the turn of the century, occupied much of Barton broad are now represented only by a few marginal fragments. The only broad to retain an extensive area which may be designated as swamp is Sutton. This had become overgrown by 1946 and the closed swamp vegetation which was established has not regressed. It is, however, not typical swamp vegetation.

In the shallower peat cuts of the Catfield fens, isolated from the Ant, certain areas of swamp still remain and these represent the best development of this type of vegetation within the valley.

Several types of swamp vegetation can be recognised. Some of them are represented only as isolated, monospecific stands characterised by the dominant species.

Schoenoplectus lacustris society

Open reedswamp dominated by *S. lacustris*. Rare and fragmentary. BB.

Typha angustifolia society

Open reedswamp dominated by *T. angustifolia*. More widespread and less fragmented than above, forming a narrow marginal fringe around some areas of open water. BB.

Acorus calamus society

A rare fragmented society represented only by a few clumps of *Acorus* growing around the edge of Barton Broad.

Phragmites communis swamp sociation

Closed reedswamp dominated by *Phragmites*. Persists as marginal fragments in Barton and Alderfen broads. More extensive areas are found colonising pools in the Catfield fens, but the stands are still very species poor, characteristically monotypic.

Cicuto-Phragmitetum ass. nov. prov.
Characterising species:

Phragmites communis (dominant)	*Rumex hydrolapathum*
Carex pseudocyperus	*Schoenoplectus lacustris*
Cicuta virosa	*Sium latifolium*
Ranunculus lingua	*Typha angustifolia*

In contrast to the above communities, this swamp vegetation is not just a dominance-type but is well defined floristically and this is recognised by its designation as an Association. It is, however, of very restricted occurrence being largely confined to the site of Sutton Broad where it occupies a large area on either side of the central channel and constitutes the main swamp vegetation. As the section of Lambert and Jennings (in Lambert *et al.* 1960) has shown this part of the broad basin consists of a raft of reedswamp peat overlying necron mud and this is well appreciated by the swinging character of the substratum.

Cladietum marisci Zobrist 1931 em. Pfeiffer 1961
Characterising species: Cladium mariscus (as dominant)
Description

Although in Broadland *Cladium mariscus* is often regarded as a species *par excellence* of the mowing marshes, nonetheless it is also sometimes found in wetter swamp situations. Here, around the margins of certain broads and in the shallow pools of old peat workings, the plant grows very vigorously, flowers prolifically and often forms dense sedge beds in which the growth of associated species tends to be suppressed. Indeed, this may represent the optimal habitat for the sedge.

Cladium swamp is not a frequent community in Broadland and when it does occur it is often only as patches of limited extent. In the Ant valley several examples are known, not in association with the margins of any of the broads, but in the shallow peat cuts of the Catfield fens. Here two rather different expressions of the community have been noted.

In one *Cladium* appears to be actively colonising open pools, forming robust tufts growing out from the margins or even occurring as isolated individuals within the pools. In this situation the plant may form a floating raft, rarely abutting directly onto open water, more often onto liquid muds. This raft, though often firmly held together by a network of interlacing rhizomes, may be highly mobile. In the spaces amongst the *Cladium* several associates are typically found, in particular *Phragmites communis*, *Typha angustifolia*, *Berula erecta*, *Carex pseudocyperus*, *Cicuta virosa*, *Lythrum salicaria* and *Potentilla palustris*.

Only a few such pools are known. They are of additional interest in supporting a quite rich growth of aquatic macrophytes. Several are choked with a dense growth of *Utricularia* spp., mainly *U. vulgaris*. *Nuphar lutea*, *Callitriche* spp. and *Hydrocharis morsus-ranae* have also been noted.

In the second variant of the community *Cladium* forms a more closed cover with fewer associates—often only *Phragmites*, sometimes with some aquatics—*Utricularia minor*, *U. vulgaris*, *Chara* spp. The pools are usually small and shallow with a firm substratum and typically they are found as wet hollows within areas of otherwise drier mowing marsh. There is one important exception to this where the community is found growing over several acres of shallow swamp which, despite the high summer water table, is regularly mown. Large areas of this are a *Cladium* monoculture.

Distribution: Infrequent. CF.

In general of restricted occurrence in England and Wales in wet topogenous hollows.

Herbaceous Fen Vegetation

This includes the bulk of the vegetation of the flood-plain mires, and a wide range of communities have been identified. The term fen is used to refer to areas where the summer water table is generally at or below the surface of the peat.

CARICETUM PANICULATAE Wangerin 1915

Characterising species: Carex paniculata (as dominant)

This Association contains sedge swamp communities dominated by *Carex paniculata*. The community is found occasionally throughout England and Wales but some of the richest and most extensive examples occur in Broadland. These belong to a distinct subassociation.

Subassociation: PEUCEDANETOSUM.

Characterisation: by the occurrence of "Broadland" species such as *Peucedanum palustre* and *Thelypteris palustris*.

Description

The community has already been described from Broadland as "tussock fen" (Lambert, 1951).

The physiognomy of the community is completely determined by the enormous upstanding tussocks of *Carex paniculata* which can attain heights in excess of 1m. These, according to the observations of Lambert, normally develop on a fairly firm, but floating, raft of *Phragmites* rhizomes which, as the tussocks increase in size, becomes depressed leading to the formation of secondary pools between the stools. In these intertussock spaces the main species are usually *Phragmites communis*, *Carex riparia*, *Typha angustifolia* and *Sparganium erectum*, together with floating fronds of *Lemna minor*. Sometimes, however, the pools may be devoid of plants.

The chief substratum for the associated species is provided by the sedge tussocks themselves. These support a rich epiphytic flora containing *Eupatorium* *cannabinum*, *Epilobium hirsutum*, *Galium palustre*, *Impatiens capensis*, *Lysimachia vulgaris*, *Lythrum salicaria*, *Peucedanum palustre*, *Rorippa islandica*, *Scutellaria galericulata*, *Solanum dulcamara*. *Thelypteris palustris* may form dense carpets on some tussocks. Mosses include *Acrocladium cuspidatum*, *Brachythecium rutabulum* and *Lophocolea bidentata*.

There is considerable variation in the composition of the stands and in the number of species which they contain. The richest examples are found on the west side of Barton Broad where extensive areas of the community occur. Additional species found here include *Carex pseudocyperus*, *Calamagrostis canescens*, *Cirsium palustre*, *Calystegia sepium*, *Filipendula ulmaria*, *Juncus subnodulosus* (rare), *Lycopus europaeus*, *Ranunculus lingua* and *Rumex hydrolapathum*.

An important feature of the tussocks is that they provide a suitable substratum for the establishment of saplings of *Alnus glutinosa* and *Salix cinerea* and in many stands several stages in the development of woody vegetation can be observed.

It is evident that many stands have a floristic composition similar to certain *Peucedano-Phragmitetum* communities.

Distribution: Broad margins. AFB; BB.

PEUCEDANO-PHRAGMITETUM ass. nov.

Characterising species:

A range of species form the "core" of this Association.

The following are constant:

Cladium mariscus	*Lysimachia vulgaris*
Eupatorium cannabinum	*Mentha aquatica*
Galium palustre	*Phragmites communis*
Juncus subnodulosus	*Peucedanum palustre*

The following are constant or frequent in many of the developments of the community-type:

Calamagrostis canescens	*Lythrum salicaria*
Carex elata	*Potentilla palustris*
Calystegia sepium	*Rumex hydrolapathum*
Filipendula ulmaria	*Scutellaria galericulata*
Hydrocotyle vulgaris	*Valeriana officinalis*
Iris pseudacorus	*Acrocladium cuspidatum*
Lycopus europaeus	*Campylium stellatum*

Description

This Association contains the major part of the herbaceous fen vegetation of the flood plain mires, not only of the Ant valley but also of all of Broadland. For this reason it will be considered in some detail here.

The vegetation is of characteristic appearance and structure. The predominant components are usually graminoid monocots particularly *Phragmites* and *Cladium* and, to a lesser degree, *Calamagrostis canescens*. These grow in varying densities to form stands which often cover the flat valley floor with large tracts of a superficially uniform vegetation.

There is a whole range of associated species. The most characteristic and constant are given in the list above; they are all abundantly developed in the Broadland marshes and include a number of species largely confined to this area within Britain. In addition a number of other species often occur. These include species and species-groups that are diagnostic for the different expressions of the Association as detailed below. They also include a number of species of lower constancy and diagnostic value.

Structurally, at least eight components may be recognised.

(i) shrubs—typically *Alnus*, *Betula pubescens*, *Myrica gale*, *Salix cinera* and, less frequently, *Frangula alnus*. Shrub development is variable. It is very limited in regularly mown marshes, except around the edges of the compartments, but with the abandonment of a periodic mowing regime it becomes much more prominent.

(ii) tall graminoid monocots—principally *Phragmites*, *Calamagrostis canescens* and *Cladium mariscus* and, in some communities, *Typha* spp.

(iii) tall herbaceous dicots—as well as those listed above *Angelica sylvestris* and *Cirsium palustre* occur sporadically across a range of community-types.

(iv) rushes and sedges of medium height (approx. 60-80 cms)—sometimes not developed in the more species-poor stands, but *Juncus subnodulosus* and *Carex elata* are characteristic. In some communities this component can be extensively developed both in terms of the biomass and diversity of the plants composing it, with species such as *Schoenus nigricans*, *Carex diandra*.

(v) small herbs—in some of the least species-rich stands this component is often very poorly developed. It reaches its fullest expression when the growth of taller species is for some reason reduced as for example in rather unproductive, regularly mown situations, often in some of the wetter areas. In these circumstances a whole range of additional species occur, many of them belonging to this structural component.

(vi) trailing plants—most characteristic is *Galium palustre;* the closely related *G. uliginosum* is rare in this Association being more characteristic of fen meadow communities. Others found include *Calystegia sepium* and, less frequently, *Stellaria palustris* and *Solanum dulcamara*.

(vii) bryophytes—characteristically poorly developed. The usual species are *Acrocladium cuspidatum* and *Campylium stellatum* and these are frequently only in small quantity. *Mnium affine*, *Mn. longirostum* and *Campylium elodes* are sometimes additionally found but a rich development of bryophytes is exceptional.

(viii) aquatics—only in the wettest communities.

Physiognomically this vegetation is quite variable as different species may dominate different areas, presenting a patchwork of stands. This has been well reflected in some earlier dominance-based classifications of this type of vegetation—*Phragmitetum*, *Juncetum* etc. This approach is at variance with the present one in which stands with different dominants have all been united into the one Association. The reasons for this different approach is that it is considered that, whereas a classification on the basis of dominance may have several merits, it does not provide the most meaningful way of expressing the full floristic variation of the fens. There are several reasons for this. First, as is well known, the pattern of dominance on the marshes has to a large extent been artificially determined by the management regime—*Cladium* sedge beds are favoured by summer cutting every three or so years, *Phragmites* reed beds by annual winter harvesting. Second, there is little evidence to suggest that the presence of a particular dominant, or management regime, exerts an over-riding influence upon the composition of the stands. This has been demonstrated by the application of Information Analysis to classify all of the samples of the Broadland fens. This procedure generates classes on the basis of the overall similarity between stands based upon their full floristic content, giving equal weighting to each species. In this instance it has produced classes which, for the most part, are well characterised floristically but contain stands with different dominant species. This is not to suggest that the floristic complement of the stands is completely independent of the dominant. It is possible that different dominants may well create minor, consistent differences between stands, especially of a quantitative kind—this is a matter that would repay closer examination. It does, however, suggest that, to some extent at least, the patchwork of dominance has been superimposed over the distributions of the associated species and that, in order to extract more exact vegetation units, attention has to be directed towards the less obvious features of the stands, namely the nature of these associates.

Distribution

The *Peucedano-Phragmitetum* is largely confined to Broadland, where it is abundant. Elsewhere it has been recorded only from Wicken Fen and Woodwalton Fen in East Anglia and from Catcott Heath on the Somerset peat moors.

Subassociation: TYPICUM

Characterisation: Negative only, by the absence of species differential for other groups.

Description

Composed of generally rather species-poor vegetation of mowing marshes and primary fen. The species complement consists of the basic core of *Peucedano-Phragmitetum* species (as outlined above) together with a few other species of sporadic occurrence. The degree to which the core is expressed is, in fact, rather variable. Some stands contain all of the species, in others several may be absent although, with the present data, no consistent pattern of absences can be detected—i.e. it is not possible to recognise sub-communities on the basis of the absence of groups of core species. It is evident that, as a result, this subassociation contains both species-rich and species-poor stands. As it is unlikely that this is just due to random floristic variation it has to be recognised that, floristically, and probably ecologically also, this subassociation is not as uniform as the others. In addition to this other consistent trends of floristic variation due to additional species permit the distinction of several varieties (below).

The dominant species are *Phragmites*, *Cladium* or *Calamgrostis canescens*. *Calamgrostis* is only normally dominant in rather dry areas and is often found as a band along the better-drained edges of fen compartments. Elsewhere in the mowing marshes it occurs in smaller quantity and is often quite absent from the wetter areas.

Although comparatively species-poor, many of the stands are not without some additional botanical interest. Species occurring occasionally include *Carex appropinquata*, *Menyanthes trifoliata*, *Schoenus nigricans*, *Stellaria palustris*, *Valeriana dioica* and, on drier sites, *Molinia caerulea*. Another plant of interesting occurrence in this subassociation—as indeed in others—is *Thelypteris palustris*. On the one hand there are many stands from which it is completely absent; on the other when it does occur it is often with considerable abundance,

forming a dense underlayer to the vegetation. It is not intuitively evident why this should be the case and it would be of interest to examine the matter further. It may, however, be noted that the plant is most characteristic of stands also supporting shrubs—*Betula pubescens*, and *Salix cinerea* mainly.
Variants. Several variants have been recognised:

(i) *typical var.* No differentials. Generally species-poor vegetation expressed as *Phragmites*, *Cladium* or *Calamagrostis* facies, depending upon the dominant. *Distribution:* Widespread: HM, LM, RM, HH, CF, BB, BH, SM, SB, LS, WB, BFD, East Ruston.

(ii) *Carex paniculata var.* Wet fen communities characterised by *Carex paniculata*, and *Epiblobium hirsutum* and, to a lesser degree, *Carex acutiformis*, and *Solanum dulcamara. Berula erecta* is also quite frequent. In the Ant valley, *Phragmites* is the usual dominant. Usually only small in extent, occupying wet depressions within mowing marsh, and around broad margins.
Distribution: Uncommon: LM, AFB, RM, BB.

(iii) *Phalaris var.* Similar to the *Carex paniculata* var., containing most of its characterising species but additionally with *Phalaris arundinacea* and *Urtica dioica.*
Distribution: Broad margins, rare: BB.

Subassociation: MYRICETOSUM.
Characterisation: Myrica gale, Thelypteris palustris together with a general prominence of shrubs.
Description: A species-poor and rather badly defined vegetation unit. *Myrica* is abundant, usually with *Thelypteris palustris*, *Betula pubescens*, *Salix cinerea* and *S. repens* and, to a lesser degree, *Alnus glutinosa.* It is usually expressed as *Cladium or Calamagrostis canescens* dominated facies. *Phragmites* is rarely dominant.
Distribution: Frequent: HM, CF, BB, BH, SM.

A community, often of small extent, alongside dykes and in isolated corners of mowing marshes. Larger stands on derelict mowing marshes sometimes occur.

Subassociation: CICUTETOSUM.
Characterising species: Cicuta virosa, Carex pseudocyperus, Berula erecta, Ranunculus lingua, Sium latifolium, Typha angustifolia.
Description:

A well defined, though variable, subassociation containing stands usually dominated by *Phragmites communis. Cladium* is generally infrequent and is absent from many stands. Nonetheless at some sites it is sufficiently plentiful to form quite thick sedge beds.

Most of the core species of the Association occur in the *cicutetosum* but there is a tendency for some of the species of drier fen to be absent, notably *Calamagrostis canescens*, *Filipendula ulmaria* and *Valeriana officinalis.* This, together with the list of characterising species, all of which have their optimal development in swamp situations, points towards one of the most evident features of this subassociation—that it is developed in rather wetter situations than most other *Peucedano-Phragmitetum* communities. The substratum is an oozing peat with the summer water table at, or just below, the surface. The community is typical of hollows within the fens, occupying depressions often, though not always, of small extent. In some cases the substratum has a markedly swinging character suggesting that the community is developed as a semi-floating, though firm, raft. In the few examples that have been investigated peat cores have confirmed this, revealing a fen mat usually at least 50 cms thick developed over a semi-fluid suspension of muds and peats. These would apparently represent closed-over peat cuts and in such situations the community is again usually only of small extent.

Distribution: CF, BB, SB.

The subassociation has been found in both the Ant and Bure valleys and also at Burgh Common. It appears to be by far the most widespread in the Ant marshes.

Variants

Two clear, though intergrading, variants may be recognised.

(i) *typical var.*

Dominated usually by *Phragmites*, sometimes *Cladium. Calamagrostis* occassionally present, but never in large quantity. Some stands are species rich and support small herbs such as *Cardamine pratensis*, *Epilobium palustre*, *Lychnis flos-cuculi*, *Lycopus europaeus*, *Myosotis caespitosa* and *Oenanthe fistulosa. Stellaria palustris* is often found in this type of vegetation.

(ii) *Carex lasiocarpa var.*

Characterising species:

Carex lasiocarpa, *C. diandra*, *Equisetum fluviatile*, *Pedicularis palustris*, *Carex appropinquata*, *Acrocladium giganteum.*

Description

A very distinct community-type. *Phragmites* is usually the most conspicuous species together with *Typha angustifolia.* Tall umbellifers are also important. Sedges are prominent, especially *Carex lasiocarpa*, often forming a dense underlayer. In some stands where the *Phragmites* cover is reduced it is this sedge, together with others of similar stature, such as *C. diandra*, which, in conjunction with *Juncus subnodulosus*, comprise the bulk of the vegetation cover. Beneath this layer there is often a rich development of smaller herbaceous species. *Menyanthes trifoliata* is often abundant and can sometimes form a closed carpet over quite large areas. *Potentilla palustris* also sometimes forms local societies. A range of other herbs occur, including those of the typical var. together with *Pedicularis palustris* and, occasionally, orchids such as *Dactylorhiza praetermissa* and *Epipactis palustris.* The moss layer is relatively well developed with *Acrocladium giganteum*, *Riccardia pinguis* and sometimes *Scorpidium scorpioides* in addition to the more usual species and on the oozing peat hydrophytes such as *Alisma plantago-aquatica*, *Baldellia ranunculoides* and *Nymphaea alba* occasionally occur.

This community is of considerable interest in supporting large populations of *Carex lasiocarpa* and *C. diandra* both of which are presently rather infrequent in Broadland as in East Anglia generally. It also provides the site for *Carex rostrata* which, frequent enough in much of N.W. Britain and indeed even in parts of East Anglia, is decidedly uncommon in the wetland complexes of Broadland. Further, an early record from Sutton Broad of the nationally rare species *Carex limosa* was also apparently from this community. However, despite considerable searching, this sedge was not re-found at this site during the present survey, and consequently this cannot be confirmed.

Subassociation: SCHOENETOSUM
Characterisation: Presence of *Schoenus nigricans*, *Carex panicea*, *Oenanthe lachenalii* (rare) together with the absence of differentials for the *caricetosum* subass.
Description

Mowing marsh communities dominated mainly by *Cladium* but sometimes by *Phragmites*. Sometimes extensive but often not very rich in species (c.20 spp./10m^2). *Calamagrostis canescens*, *Filipendula* and *Valeriana officinalis* are frequently absent. Slightly wetter areas support *Ranunculus flammula* and *Berula erecta*. Other species occasionally found include *Osmunda regalis*, *Molinia caerulea*, *Samolus valerandi* and *Salix repens*. *Scorpidium scorpioides* is also known.

In a number of sites slightly richer developments may occur. These are usually small in extent and occur as islands of lower growth within the more typical community. They may support occasional specimens of *Carex lepidocarpa*, *Pedicularis palustris* and *Valeriana dioica* and even isolated populations of *Epipactis palustris*. These are clearly very closely related to certain *caricetosum* communities.

Distribution: CF, LS, BFD, HM, LM, Mown Fen, (East Ruston).

A rather similar community, but with *Oenanthe lachenalii* more prominent is widespread in the Thurne valley fens.

Subassociation: CARICETOSUM
Characterising species: Carex diandra, C. lasiocarpa, C. appropinquata, Caltha palustris, Cirsium dissectum, Epipactis palustris, Pedicularis palustris, Valeriana dioica, Acrocladium giganteum, Bryum pseudotriquetrum, Riccardia pinguis.

The differentials of the *cicutetosum* are present in some variants, but they are not as frequently or as abundantly developed as in that subassociation.
Description

Into this subassociation are placed a number of stands, all characteristically rather species rich. Indeed this community is the richest of all of the *Peucedano-Phragmitetum* communities and is of particular importance in providing the sociological location for some of the rarest species of British rich fen.

Phragmites and Cladium both occur in variably quantity, usually the latter being the most prominent, the stands often being managed sedge beds. However, neither species is really well developed. The plants tend to be shorter (often not much in excess of 1m high) and more sparsely distributed than in most *Peucedano-Phragmitetum* communities and concomitantly there is a strong development of plants of lower growth. As is the case with the *cicutetosum Carex lasiocarpa* var. (to which, incidentally, the present subassociation is very closely related) much of the vegetation cover is created by sedges and rushes of medium height, notably *Juncus subnodulosus*, *Carex elata*, *C. diandra*, *C. appropinquata*, *C. lasiocarpa* and *Schoenus nigricans*.

Although this subassociation represents a fairly well defined floristic unit it must be emphasised that it is a variable one and that it is difficult to find a single species that characterises it well. None of the characterising species listed above occur in every stand; it is only as a group that they have diagnostic value. However, one of the features of the vegetation is the prominence of cyperaceous species. In addition to the species already mentioned smaller plants such as *Carex lepidocarpa*, *C. nigra*, *C. panicea* and, more rarely, *Eriophorum angustifolium* are found. Hence the general designation *caricetosum*.

Small herbs are often richly represented; the moss layer is relatively well developed, and in some communities so are aquatics. However, the species involved vary and details are best given in consideration of the several variants that have been recognised.

Menyanthes var.

Characterising species: Menyanthes trifioliata, Eriophorum angustifolium, Equisetum fluviatile, Dactylorhiza incarnata, D. praetermissa, Liparis loeselii

The samples brought together by this set of species are rather variable and it is possible to recognise two sub-variants:

(i) *Ranunculus lingua sub-var.*

Characterising species: Ranunculus lingua, Acrocladium cordifolium. With lower frequency *Cicuta virosa, Carex pseudocyperus.*

Description

This sub-variety represents the wettest expression of the subassociation. Found at only two sites, at both it has clear spatial and floristic connections to the *cicutetosum* subassociation *Carex lasiocarpa* var.

At one of the sites the community occurs as part of a well-defined zone located at the very edge of the fen system flanking a band of alder carr which backs onto the adjoining upland.

Here the community has a species complement more or less as described, except for the rarity of *Schoenus nigricans.* Otherwise all of the diagnostic species are present. The bryophyte cover is well developed with *Acrocadium cuspidatum*, *A. cordifolium*, *A. giganteum*, *Campylium stellatum*, *Fissidens adianthoides*, *Pellia endiviifolia*, *Riccardia pinguis.* Of special note is a small population of *Liparis loeselii*. The stands are species-rich: c50 spp/10m^2.

At the second site the community is more extensive and more interesting, developed over 2-3 acres of wet mowing marsh. Here *Cladium mariscus* is more strongly dominant than in the first, though the other sedge species still remain as important components, including a large amount of *Schoenus nigricans* and also some *Carex rostrata* and *C. pseudocyperus.* The typical taller *Peucedano-Phragmitetum* species are present as in addition are scattered plants of *Osmunda regalis. Cicuta virosa* is frequent and *Sium latifolium* also occurs. These two species together with *Carex pseudocyperus* and *Ranunculus lingua* again point towards the similarity with the *cicuteosum Carex lasiocarps* var. which in fact can be found occupying wetter depressions within this community.

However, as is generally true with the *caricetosum* communities, particular interest attaches to the species of the lower layers of the vegetation and in this case this is due to the occurrence of a number of plants found in few other sites in Broadland. There are scattered plants of *Parnassia palustris* and *Pyrola rotundifolia* together with large quantities of the fen orchid, *Liparis loeselii.* Also some *Dactylorhiza traunsteineri* and *Drosera anglica*. Mosses are abundant and, in addition to those mentioned above, are *Campylium elodes*, *Drepanocladus revolvens* var. *intermedius*, *D. vernicosus*, *Mnium pseudopunctatum*, *Mn. seligeri*, *Scorpidium scorpioides* and *Cinclidium stygium.* With them are the trailing shoots of *Anagallis tenella* and a few patches of *Hypericum elodes*. Small fen pools contain *Baldellia ranunculoides*, *Hottonia palustris*, *Potamogeton coloratus*, *Utricularia vulgaris*, *U.* cf. *intermedia* and *U. minor* with various Charophytes of which *Chara vulgaris* and *C. hispida* have been positively identified, though there may also be others. Also in association with these wetter depressions is a small amount of the mud sedge, *Carex limosa*. The resultant stands are very rich in species with up to 60/10m^2.

Distribution: SB, CF. Rare, but locally estensive. Known from nowhere else in Britain, though some communities of topogenous calcereous fens in the N and W of Britain are closely related. These, however, belong to a different Association, the *Acroladio-Caricetum diandrae* (see Wheeler 1975; and in press).

(ii) *Molinia sub-var.*

Differential spp. to Ranunculus sub-var.: Molinia caerulea, Cirsium dissectum, Succisa pratensis, Potentilla erecta.

Description

A drier version of the *Menyanthes* var. demonstrated by two small stands of sedge fen, both in the same general area. *Phragmites* and *Cladium* are both relatively sparse and the sedges of the lower layers contribute most to the vegetation cover. The wet fen species of the *Ranunculus* sub-var. are absent and in the drier conditions *Molinia caerulea* becomes more important with *Cirsium dissectum*, *Succisa'pratensis* and a small amount of *Potentilla erecta*. Nonetheless, the herbs are still well developed and an important feature is the occurrence of a small amount of *Platanthera bifolia* and a large population of *Liparis loeselii*. Fen pools are not generally well developed, but *Utricularia minor* occurs in one place.

When this community was visited in 1972, the substratum was dry and the bryophytes desiccated—though the bryophyte mat was still quite rich with *Campylium elodes* and *Scorpidium scorpioides*. In the summer of 1977 it was much wetter. Nonetheless, the species complement points to the generally dry character of this site, a view re-inforced by the increasingly dense development of young plants of *Betula pubescens*.

Distribution: SB. Rare. Known from nowhere else in Britain.

Typical var.

Characterisation: Absence of differential species.

Description

A relatively species-poor variant of the *caricetosum* with often only 30-40 spp./10m^2. The characterising species of the subassociation are more sporadically developed and often only a few of them can be found. In consequence some stands appear to be transitional between the *caricetosum* and *schoenteosum* communities. However, it is usually evident which community a particular stand belongs to.

Cladium and/or *Phragmites* are often quite prominent and there is then a corresponding reduction in the importance of the middle sedge layer. This usually contains *Schoenus nigricans* but of the three characterising sedges *Carex appropinquata*, *C. diandra* and *C. lasiocarpa*, often only one occurs and then in rather small quantity. Nonetheless, within this variety there are stands in which these sedges are prominent and which have the characteristic physiognomy.

A few other herbs may occur in addition to the characterising species. *Carex lepidocarpa*, *Anagallis tenella*, *Cardamine pratensis*, *Dactylorhiza trauns-*

teineri, *Lychnis flos-cuculi* have been recorded, Bryophytes are fairly well developed including *Bryum pseudotriquetrum*, *Fissidens adianthoides*, *Mniums eligeri* and *Riccardia pinguis*. *Acrocladium giganteum* is known only from a few stands.

One expression of this community, possibly a sub-varietal form, is distinguished by the occurrence of *Lotus uliginosus*, *Agrostis stolonifera*, *Stellaria palustris* and, to a lesser extent, *Vicia cracca*. This has been recorded only from Broad Fen, Dilham and one example of it is particularly notable. This is an area mown annually during the summer which consequently supports little *Cladium* or *Phragmites*. Instead the dominant is *Carex appropinquata* with a lot of *Juncus subnodulosus*. The stand is species-rich—with a lot of *Epipactis palustris*, for example—and floristically clearly belongs to the present community rather than to some putative "Caricetum appropinquatae".

Distribution: CF, SB, BFD, Mown Fen, East Ruston. Infrequent. Also in the Bure valley in small amount.

SPECIES-POOR PHRAGMITES COMMUNITIES

In contrast to the relatively species-rich character of many of the mowing marshes, areas of much more impoverished herbaceous fen vegetation also exist. These include small belts and patches where tall vegetation has grown up alongside dykes or in the corners of fen compartments. They also include much larger areas, actively managed reedbeds in which *Phragmites* is very much the predominant plant, often forming a near-monoculture. Completely pure stands are, however, of limited extent—usually there is at least a scattering of associates. Indeed, if a sufficiently large area of the reed beds is examined, individuals of most of the characteristic *Peucedano-Phragmitetum* species can usually eventually be found. But in a sample of 10m^2 only a few occur. In some sites the floristic monotony is somewhat relieved by slightly elevated strips crossing the compartments—these often support a much richer flora.

The floristic composition of these communities is variable—in terms of both the nature and number of associates. Some consists of little more than a *Phragmites* monoculture; others may support a variety of associates. The following communities have been tentatively recognised.

Phragmites—Sium latifolium Community

Characterising species: Phragmites (as dominant), *Typha angustifolia*, *Sium latifolium*.

Some stands have no more species than the three above. Others may have in addition *Potentilla palustris* or *Cicuta virosa*. This community occurs in wetter areas—a few sites have standing water in the summer. Equally, however, others have a dry substratum. A feature of such areas is often a fairly dense growth of *Agrostis stolonifera*.

Distribution: HM, LM, RM, HH, CF, BB, BH.

Phragmites—Agrostis stolonifera Community

Characterising species: Phragmites (as dominant), *Agrostis stolonifera*. Absence of *Sium* and *Typha angustifolia*.

This represents a generally drier type of vegetation. A characteristic feature is the development of a thick carpet of *Agrostis stolonifera*. In both this and the above community, the growth of the reed sometimes appears to be lacking vigour —the shoots are only about 1m tall and not growing densely. In some places (e.g. Little Fen, Catfield) the reed beds appear to be in a degenerate condition with patches dominated by *Agrostis* in which *Phragmites* is developed very feebly. In the comparatively open conditions ruderals such as *Chenopodium rubrum* and *Sonchus arvensis* are sometimes to be found, in places with *Carex disticha*, *Cirsium arvense* and *Urtica dioica*.

Distribution: LM, RM, HH, CF, BB.

Although both of the above communities are generally species-poor they are not without botanical interest. A feature of some of the most southern marshes of the valley is the occasional occurrence of *Lathyrus palustris* in these communities. In such sites the plant is most abundant in the more species rich areas even on narrow ridges that subdivided the compartments—but nonetheless it still occurs in these more impoverished fens.

Phragmites—Thelypteris Community

Characterising species: Phragmites communis and *Thelypteris palustris* (as dominants).

Phragmites forms dense stands with few associates except for *Thelypteris palustris* which forms a thick carpet. Other associates are typical *Peucedano-Phragmitetum* species—*Peucedanum*, *Galium palustre*, *Potentilla palustris*, *Calamagrostis canescens* etc.

Distribution: Rare and usually of small extent. BH, LS.

Phragmites Sociation

Characterising species: Phragmites communis (as dominant).

A heterogenous syntaxon containing stands dominated by *Phragmites* with very few associates. These are variable, but may include various *Peucedano-Phragmitetum* species—*Peucedanum*, *Lysimachia vulgaris*, *Juncus subnodulosus* etc.

Distribution: Frequent but usually of small extent. Often particularly characteristic of wetter areas alongside dykes etc. HM, LM, AFB, RM, HH, CF, BB, SM, BH, LS, MF, MF, BFD, SMF, East Ruston.

SPECIES-POOR CLADIUM COMMUNITIES

As with *Phragmites*, certain areas of tall, dense *Cladium* fen are also characteristically species-poor, including some quite extensive, thick sedge beds of mowing marshes.

Cladium—Carex elata Community

Characterising species: Cladium mariscus (as dominant), *Carex elata*.

A community of mowing marshes consisting basically of *Cladium* together with a good representation of *C. elata*. Sometimes no other species are found, but there are usually a few such as *Peucedanum palustre* and *Lysimachia vulgaris*.

Distribution: Infrequent, but can form quite large stands. BH, SM.

Cladium—Thelypteris Community

Characterising species: Cladium mariscus (as dominant), *Thelypteris palustris*.

As the *Phragmites—Thelypteris* community, but with *Cladium* dominance. At least a few plants of Phragmites usually occur.

Distribution: Rare. CF, BH, SM.

Cladium—Myrica Community

Characterising species: Cladium mariscus (dominant), *Myrica gale.*

Tall stands of *Cladium* and *Myrica* in scrubbing up fen corners etc. Usually several associates—*Peucedanum, Filipendula, Phragmites, Lysimachia vulgaris. Thelypteris* may be abundant.

Distribution: Occasional. HM, CF, BH, SM.

Cladium mariscus Sociation

Characterising species: Cladium mariscus (as dominant).

A heterogenous syntaxon of stands dominated by *Cladium.* A variable range of associates may occur. *Phragmites* is often present.

Distribution: Occasional. CF, SM.

Scrub and Carr Vegetation

MYRICETUM GALE (Gadeceau 1909) Jonas 1935 PEUCEDANETOSUM Fischer 1967.

Characterising species: Myrica gale (as dominant).

Description

The predominant plant of this community is *Myrica gale* which forms a dense stand of straggling bushes which may be as much as 2m tall. Associates are generally few and variable. *Phragmites* is usually found in some quantity, growing up amongst the bushes, and *Cladium mariscus* also frequently occurs. Various herbs may be present, all of them, with the exception of *Thelypteris palustris* which sometimes forms a sparse understorey to the vegetation, normally being tall fen species, characteristically *Calamagrostis canescens, Eupatorium cannabinum, Lysimachia vulgaris* and *Peucedanim palustre.* Other shrubs include *Salix cinerea, Betula pubescens* and *Alnus glutinosa.* Mosses tend to be absent.

This Association is related to the *Myrica*-rich stands of the *Peucedano-Phragmitetum*, especially to the *myricetosum* subassociation from which it may have developed in some places. Pockets of more species rich, more herbaceous vegetation often persist within the *Myrica* stands as relicts of the earlier communities. The presence of small plants of *Alnus* and *Betula* suggest that mire forest dominated by these species will ultimately develop if the stands are left unmanaged.

Distribution: CF, SM, BB, BH.

A seral community that is locally widespread. In actively managed areas it is restricted to the edges and corners of the fen compartments where the vegetation has been allowed to grow up, but in abandoned mowing marshes it can be much more extensive, covering large areas with a scrub difficult of penetration.

The Association has been noted also in the Bure valley and may well occur in the others. *Myrica* stands are also known elsewhere in Britain, especially acidophilic communities of the *Myricetum gale ericetosum* Fischer 1967, but the *peucedanetosum* subassociation is confined to Broadland.

BETULO-DRYOPTERIDETUM CRISTATAE. Wheeler 1975.

Characterising species-group: Dryopteris cristata, D. carthusiana, Betula pubescens, Sphagnum fimbriatum, S. palustre, S. plumulosum, S. recurvum, S. rubellum,

S. squarrosum. Together with a range of herbs of open fen.
Description

A scrub community associated with areas of fen that are able to sustain an acidophilic vegetation.

Typically it consists of an immature birch scrub. In the younger, more open forms, the bushes are often only about 1 - 1.5m tall and rather sparsely distributed. In the more mature forms the tree canopy may be in excess of 4m and much more closed. Growing up with the birch there is usually a range of other shrubs, mainly *Myrica gale*, *Salix aurita*, *S. cinera* and *S. repens*. *Alnus glutinosa*, *Frangula alnus* and oak saplings are occasional.

Bryophytes are well developed and the floor of the community characteristically supports large, inflated plosters of *Sphagna*, in some places forming an extensive and continuous cover. The species are those listed above. Other bryophytes include *Calypogeia muellerana*, *Campylopus pyriformis*, *Dicranella heteromalla*, *Mnium hornum*, *Leucobryum glaucum*, *Plagiothecium undulatum* and *Polytrichum commune*.

Herbs are sparse to abundant. They include a range of open fen species—*Phragmites*, *Calamagrostis canescens*, *Carex appropinquata*, *C. elata*, *Eupatorium*, *Juncus subnodulosus*, *Lysimachia vulgaris*, *Lythrum salicaria*, *Peucedanum palustre*, *Potentilla palustris* and *Cladium mariscus*. However, a particularly noticeable feature of this community is the range of ferns that occur—*Athyrium filix-femina*, *Dryopteris cristata*, *D. carthusiana*, *D. dilatata*, *D. filix-mas*, *D. x uliginosa*, *Ophioglossum vulgatum* (rare), *Osmunda regalis* and *Thelypteris palustris*. *Dryopteris cristata* is the most notable of these. It is a regular component of this community: only a few stands are known where it has not been located. Often only a few fronds may be found, especially in the more closed communities, but careful searching will usually reveal it. As well as the crested buckler fern, other species of particular interest that are sometimes present are *Pyrola rotundifolia* and *Drosera rotundifolia*. Less notable are *Dactylorhiza praetermissa*, *Eriophorum angustifolium* and *Viola palustris*.

The *Betulo-Dryopteridetum cristatae* is found in several situations. Perhaps most characteristically it is found in association with small "islands" of birch scrub. These islands—which may be very small, sometimes only 1-2m across—are dotted sporadically around the Ant marshes and are found within stands of herbaceous fen, often in fact within wet tall fen communities with *Phragmites* and *Typha angustifolia*. The origin of these areas is not at all clear and would repay further study. They are not always just composed of birch. In a few instances part of the island is dominated by alder, supporting a fairly typical *Osmundo-Alnetum* flora. But in such cases the *Betulo-Dryopteridetum* is found only on the parts with birch. With the smaller "islands" and with the less mature stands the whole area effectively belongs to the present Association. But with the larger, more mature "islands" the community is only found in the more open, boundary situations, around the periphery or around the margins of glades. The drier, more shaded internal areas usually belong to a *Betula-Myrica* community (below).

Dryopteris cristata appears to be very much a plant of boundary situations, occupying the transition between the birch communities and more open fen. Sometimes the bright green fronds effectively serve to pick out the edge of glades etc. It only occasionally occurs in the more mature communities and very rarely in open fen. It is known from a few open fen communities where it seems invariably to be associated with *Sphagnum*. The community is otherwise a rather impoverished *Peucedano-Phragmitetum* type, i.e. rather similar to the present Association but without the woody species. In one case at least it appears very likely that such a stand of *D. cristata* occupies the site of a cleared birch copse.

The most extensive stands of the *Betulo-Dryopteridetum* are found in association with a sparse birch cover. Again it is not at all clear just how these stands have developed. Preliminary observations and peat cores have indicated that in one place such a community is developed on a slightly elevated area of peat, which is probably situated above the main influence of the minerotrophic ground water. In other examples it has developed on a firm but floating peat raft. Good examples of this are found on the island at the north end of Barton Broad. Here there is a fen raft, composed mainly of *Phragmites* rhizomes underlain at least in places by *Typha*, floating over fluid muds. This is about 50cms thick and supports an extensive development of the *Betulo-Dryopteridetum*. The community forms a mosaic with treacherous areas of wetter fen, often tussock fen dominated by *Carex paniculata*, and with more consolidated areas supporting mature copses of birch. It thus appears that the *Betula-Dryopteridetum* has developed from a floating *Phragmites* fen community. The reason why this sere should have occurred, as opposed to the *Carex paniculata* sere (Lambert, 1951) which is more typical of the margins of Barton Broad, is not entirely clear. It is possibly related to the floating character of the substratum which may prevent regular flooding of the mire surface by nutrient rich water. In any case, the interior of the island where the communities occur may be comparatively stagnant and not much influenced by the water of the broad. This remains to be clarified. It may be noted that, at this site, tussocks of *C. paniculata* forming the *Carietum paniculatae* also often support *D. cristata*.

Distribution. See Fig.2. HM, LF, RM, BB, CF, SM, SB.

Widespread in the Ant valley, but rarely extensive, usually occurring as small islands within mowing marsh. Fig.2 indicates the known distribution of sites noted in this survey, but it is likely that there are more, particularly in the Reedham Marshes.

Similar communities occur in the Hickling Broad area—again usually as islands. They have not been observed outside of Broadland.

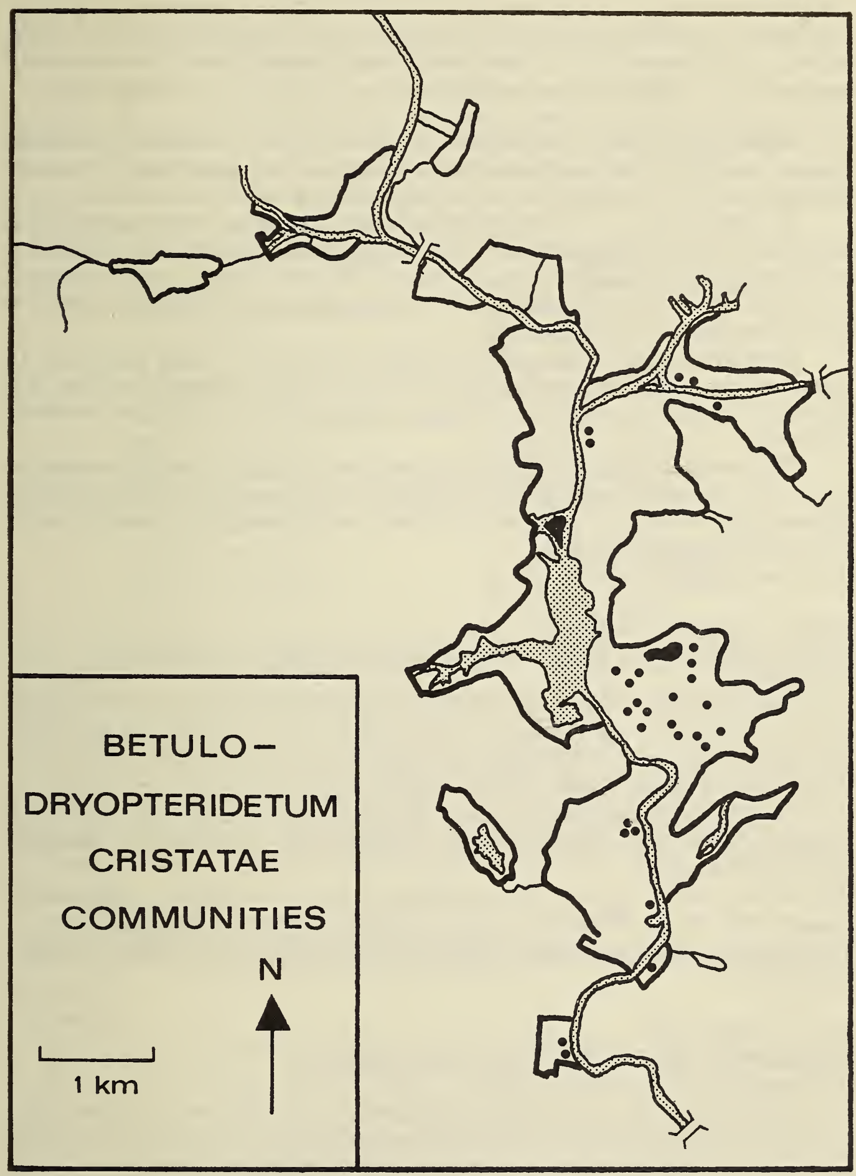
BETULA-MYRICA COMMUNITY

Characterising species: Betula pubescens, Myrica gale, Rubus idaeus, Dryopteris carthusiana, Lonicera periclymenum.

Description

Usually occurs as dense thickets of *Betula pubescens* accompanied by much *Myrica gale* and, less frequently, *Frangula alnus*, *Salix aurita*, *S. cinerea* and *S. repens*. There is often much *Rubus idaeus* and *R. fruticosus*, typically with oak saplings. Three varietal forms have been distinguished:

(i) *Typical var.:* Immature stands in particular may contain a range of open fen species—*Cladium*, *Phragmites*, *Lysimachia vulgaris*, *Peucedanum palustre.*


BETULO–
DRYOPTERIDETUM
CRISTATAE
COMMUNITIES
N
1 km

Ferns may be quite prominent and typically include *Athyrium filix-femina*, *Dryopteris carthusiana*, *D. dilatata*, *Osmunda* and *Thelypteris palustris*. Older, drier stands typically have a sparse field layer, including relict populations of herbaceous fen species. *Dryopteris filix-mas* and (rarely) *D. borreri* may occur.

The bryophyte layer may be poor or well developed, containing woodland species such as *Amblystegium serpens*, *Eurhynchium praelongum*, *Hypnum cupressiforme*, *Lophocolea bidentata*, *Mnium hornum* and *Mn. undulatum*.

(ii) *Sphagnum var.:* As the typical var. but with species of Sphagnum being important, often in addition to the typical bryophytes. Cushions—even carpets—of Sphagna occur—*S. fimbriatum*, *S. palustre*, *S. squarrosum*—which in summer are frequently dry and bleached. *Leucobryum glaucum* and *Calluna vulgaris* are rare components of this vegetation.

(iii) *Pteridium var.:* Composed of older, more mature birch trees with an open canopy. The field layer is typically dominated by *Rubus fruticosus* and *Pteridium aquilinum*. Open fen species are sparse though a few can normally be found.

This community is not extensively developed. It often forms the vegetation occupying the central core of birch "islands" that support a peripheral *Betulo-Dryopteridetum cristatae* community. It also locally forms more extensive stands in areas of scrubbing-up fen.

Distribution: BB, CF, SM.

BETULA—QUERCUS COMMUNITY

Characteristic species: Betula pubescens, *Quercus robur* (as dominants).

Description

Closely related to the *Betula-Myrica* community, growing on fairly dry peat. *Betula pubescens* is the dominant with *Quercus robur* making an important contribution. Other shrubs include *Frangula alnus*, *Myrica*, *Salix cinerea* and *S. repens* and *Rubus idaeus* and *R. fruticosus*.

The field layer contains a variety of open fen species. In some stands the canopy is quite open and *Phragmites communis* and *Calamagrostis canescens* are well developed.

Distribution: Rare in areas of scrubbing-up fen. BB. Similar communities, though without the Broadland species, are found on fairly dry, acidic peat in mire basins elsewhere in Britain, though usually with much *Molinia* in the field vegetation.

SALIX CINEREA CARR

Characterising species: Salix cinerea (as dominant)

Description

In general, willow carr is a rather variable and poorly developed community in the Ant fens and it has not been examined in detail in this survey. It develops consequent upon the cessation of active marsh management by the rapid growth and coalescence of *Salix cinerea* bushes. The community may thus appear in several forms, from young willow bushes growing together intermixed with patches of species-poor herbaceous fen, to more uniform stands with a more continuous canopy. Only a few such uniform stands have been located, at least of any extent.

Salix cinerea is the predominant shrub, sometimes with *Alnus glutinosa*. *Salix repens* and *Myrica gale* are sometimes also found, but usually at the extending margins of the carr rather than in the interior.

The stands are typically some 2-4m high, often rather difficult of penetration. The ground vegetation is quite variable. Under small *Salix* bushes at the scrub margin there is a very poor associated flora—though species such as *Phragmites* may be growing up between the bushes. Under the taller, more open, canopy of older carr a number of species may be found, mainly herbaceous fen species in a sterile condition. Typical species are:

Cardamine amara (rare)	*Mentha aquatica*
C. pratensis	*Menyanthes trifoliata* (occ)
Carex appropinquata (occ)	*Myosotis caespitosa*
C. acutiformis	*Poa trivialis*
C. elata	*Potentilla palustris*
Cladium mariscus	*Peucedanum palustre*
Dactylhoriza praetermissa (occ)	*Phragmites communis*
Equisetum palustre	*Thelypteris palustris*
Filipendula ulmaria	*Valeriana dioica*
Impatiens capensis	*V. officinalis*
Iris pseudacorus	
Lycopus europaeus	*Acrocladium cuspidatum*
Lysimachia vulgaris	*Brachythecium rutabulum*
Lythrum salicaria	*Mnium punctatum*

Pyrola rotundifolia has been found in this community at one site. The precise species composition is variable and may well be related to the composition of the herbaceous fen from which the carr developed. This requires further investigation.

Distribution: Narrow strips of willow carr are frequent around the edges of fen compartments, alongise dykes etc. In the Catfield fens, much of the course of the Catfield-Barton Turf parish boundary (the old course of the R. Ant) is traced by a narrow band of willow carr. More extensive areas, developed over old mowing marshes, are much less frequent and have been noted mainly in CF, BH and SM.

ALNUS GLUTINOSA-CAREX PANICULATA COMMUNITY

Characterisation: Alnus glutinosa and/or *Salix cinerea* as dominants. *Carex paniculata.*

Description

This community is well defined physiognomically, but poorly so floristically. It is essentially immature alder carr and it is closely related to *Osmundo-Alnetum* communities, from which it may be distinguished (often with difficulty) by the absence of the species of more mature alder woodland—shrubs such as *Frangula*, *Ilex*, *Prunus padus*, *Ribes* etc.

The community consists of large tussocks of *Carex paniculata* supporting a low woody canopy composed mainly of *Alnus glutinosa*, but sometimes with large amounts of *Salix cinerea*. Herbaceous associates, like the trees, are largely confined to the tussock tops, and are essentially the species of the *Caricetum paniculatae* tussock fen, usually somewhat reduced in abundance.

This community is a seral stage in the development of swamp carr from open tussock fen and it has strong floristic affiliations with both of these vegetations. However, its physiognomic distinction make it appropriate to recognise it as an independent community.

Distribution: BB. Similar communities are known from elsewhere in Britain.

OSMUNDO-ALNETUM Klötzli 1970
Characterisation: Alnus glutinosa (as dominant)

A range of species from the "core" of this Association. The following are fairly constant:

Alnus glutinosa (usually dominant)	*Galium palustre*
Salix atrocinerea	*Iris pseudacorus*
Carex acutiformis	*Solanum dulcamara*
C. paniculata	*Valeriana officinalis*
Cirsium palustre	
Dryopteris dilatata	*Acrocladium cuspidatum*
Eupatorium cannabinum	*Brachythecium rutabulum*
Filipendula ulmaria	*Eurhynchium praelongum*

The following are also characteristic, but with lower constancy:

Angelica sylvestris	*Phragmites communis*
Cardamine pratensis	*Poa trivialis*
Caltha palustris	*Mentha aquatica*
Equisetum palustre	*Urtica dioica*
	Mnium undulatum

The *Osmundo-Alnetum* contains relatively mature alderwood vegetation developed on nutrient rich peats throughout Britain, and the above characterisation is a general one for the communities as they are developed throughout the country. This Association was first described by Klötzli (1970) in a brief survey of British alderwoods and the work of Wheeler (1975) has largely confirmed its value as a syntaxonomic unit. Klötzli regarded the Association as a vicariant of the closely related continental *Caricetum elongatae-Alnetum.* The use of the name *Osmundo-Alnetum* does not imply that *Osmunda regalis* is a frequent and characteristic component of British alderwood, because it is not. Its occasional occurrence does, however, serve to distinguish nutrient-rich British alderwoods from the continental counterparts in which *Osmunda* is not found. On the continent, *Osmunda* is much more restricted to acidophilous, nutrient-poor communities.

A number of subassociations have been recognised. The Broadland carrs are all contained within one of these, the *lycopetosum* subassociation.

Subassociation LYCOPETOSUM Klötzli 1970.
Characterising species: Lycopus europaeus, Carex elata, C. remota, Lysimachia vulgaris, Lythrum salicaria, Peucedanum palustre, Thelypteris palustris.
Description

The exact character of these woods depends upon their state of maturity· However it must be noted that very young, developing alder forest with a rather different species-composition to that listed above is not included within this Association.

The dominant tree is *Alnus* and in well developed stands this can form a canopy reaching over 40ft. Growing up with it there may be *Betula pubescens* and, generally in drier situations, *Fraxinus excelsior* and occasionally *Quercus robur*. The willow *Salix cinerea* is a constant component of the vegetation. In mature alder forest it may be only in small amounts, forming a layer beneath the *Alnus* canopy. But often it is more important, even codominant.

Smaller trees also occur—including *Crataegus monogyna*, *Frangula alnus*, *Ilex aquifolium*, *Prunus padus*, *Rhamnus catharticus* and *Viburnum opulus*. In the Ant valley *Frangula* is quite frequent (as for example at Alderfen Broad) whilst *Rhamnus catharticus* has been noted only occasionally. Low-growing shrubs include *Rubus caesius*, *R. fruticosus*, *Rosa canina*, *Ribes nigrum* and *R. sylvestre*.

The extent to which these various woody species are developed is variable· Some stands may contain just *Alnus* and *Salix cinerea*, though in fact *Betula pubescens* is also a common tree of the Ant carrs. Others may have some or all of them. The best example of alder wood is Heron's Carr at the south end of Barton Broad where the more mature areas, which are close to the land margin of the fen, contain all of the above species. Superficial impressions suggest that the richness of trees and shrubs may be at least partly related to the size and maturity of the stands. Certainly as a general rule, recent alder carr often contains little other than *Alnus* and *Salix*.

Scrambling species occur to some degree. *Solanum dulcamara* is characteristic of most stands where it can be abundant, forming a tangled undergrowth. But additional species—*Bryonia dioica*, *Humulus lupulina* and *Lonicera periclymenum* can also occur, especially in the more mature stands.

The field layer is typically tall and luxuriant. *Phragmites* is sometimes found, particularly beneath clearings, but normally its cover is rather limited. *Phalaris arundinacea*, which can be important in some alderwood communities, is not generally so in the Ant fens. *Calamagrostis canescens* and *Cladium* occur occasionally but not in quantity. Instead the dominants are usually *Carex acutiformis* and *C. paniculata* and sometimes *C. elata*. Other herbs include those listed as characterising species. Most of these are tall growing species typical of herbaceous fen. Some of them, such as *Filipendula ulmaria* and *Iris pseudacorus*, flower rarely in the shaded conditions of carr. One of them—*Urtica dioica*—is not at all common in some of the Ant carrs.

The floor of a typical carr often presents a mosaic of habitats. Elevated areas are associated with the bases of trees and may support typical woodland plants—*Stachys sylvatica* and *Circaea lutetiana*. Between the trees are areas of peat, in some cases with a well-developed vegetation cover which serves to consolidate them, in others, often associated with dense shading, with an open, treacherous surface. Such areas seem to be largely associated with degeneration of the vegetation cover in response to deep shade. There may also be pools, though not containing aquatics other than occasional fronds of *Lemna minor*. In general the wetter places contain species such as *Carex pseudocyperus*, *Sparganium erectum* and *Potentilla palustris*. *Carex rostrata* and *Menyanthes* are much less common.

Other herbs frequently found include *Cardamine amara*, *C. flexuosa*, *Myosotis caespitosa* and *Valeriana dioica*.

Ferns are also well represented—especially *Thelypteris palustris* which sometimes carpets the ground, but also *Dryopteris dilatata*, sometimes with *D. filix-mas* and *Athyrium filix-femina.* But perhaps the most notable species is the royal fern, *Osmunda regalis.* This is widespread in the Ant carrs and can be abundant. In one place, near to Sutton High Fen, it forms the dominant component of the field layer, covering much of the ground with its huge fronds.

The most common bryophytes are *Acrocladium cuspidatum*, *Brachythecium rutabulum*, *Eurhynchium praelongum* and *Mnium hornum*, but *Amblystegium serpens*, *Hypnum cupressiforme* and *Mnium undulatum* are also frequent. In some places *Sphagna* occur.

A structural variant of this community is swamp carr (see Lambert, 1951) which originates through the colonisation of the semi-floating *Caricetum paniculatae* (q.v.) by *Alnus* and *Salix cinerea.* Very young stands of this belong to the *Alnus-Carex paniculata* community, but more mature stands are referable to the present Association.

Variants

Several variants may be recognised:

(i) *typical var.* as described above.

(ii) *Sphagnum var.* Characterised by the occurrence of *Sphagnum* cushions, usually not very extensive. Species are typically *S. fimbriatum*, *S. palustre*, *S. recurvum* and *S. squarrosum. Viola palustris* is often found in these more acidic situations.

(iii) *Rubus fruticosus var.* Characterised by greater amounts of *Rubus fruticosus* and a reduction in the number of more typically wetland species. This is a variant of drier situations, often developed close to the fen margins and often supports *Fraxinus* and sometimes *Quercus robur.* Well developed examples of this on dry peat are very distinct and have a large amount of *Rubus* in the field layer and sometimes much *Urtica.* Others are harder to distinguish from the *typical var.* but in general there is a reduction or absence of fen species—such as *Potentilla palustris* and *Carex pseudocyperus*—and an increase in the importance of more general woodland species such as *Lonicera periclymenum* and *Geranium robertianum* and others such as *Holcus lanatus. Dryopteris filix-mas* and *D. borreri* occur.

Distribution: Frequent. HM, AFB, HH, RM, BB, CF, BH, SF, SB, WB, LS, MF, DBF, SF, East Ruston.

II. Marginal Vegetation of the Flood Plain Mires

Contributing to the vegetational diversity of the Ant valley are the communities developed along the edge of the fens where they back onto the valley slopes of the adjoining upland. Sometimes the mire/slope transition is very clearly defined by a boundary dike, in which case the wetland communities extend up to the edge of the peat and there is an abrupt transition to drier vegetation. In other situations, however, the wet-dry gradient is uninterrupted and a distinct zone of marginal vegetation occurs. Frequently this consists of a narrow strip of woodland, alder carr in the wetter places, gradually grading into a drier woodland upslope. This woodland often has oak as an important component (e.g. Heron's Carr, Berry Hall) and although probably in no way natural, it has considerably more similarity to the presumed natural vegetation of the lower crag slopes than do the woodlands planted with exotics which occupy the same transition in some other parts of the valley.

In a number of places, however, the edge of the marshes is marked by herbaceous vegetation, grading up from the *Peucedano-Phragmitetum* communities of the fens into a type of dry grassland. In this situation, developed towards the base of the usually gentle valley slopes and irrigated by some degree of water seepage from the adjoining upland, there is often a wetland community of very different character from that of the marshes proper.

CIRSIO-MOLINIETUM Sissingh et De Vries 1942.
Characterising species: Cirsium dissectum, Molinia caerulea, Potentilla erecta, Succisa pratensis, Viola palustris, Juncus conglomeratus, Luzula multiflora.
Description

Essentially a wet grassland community with *Molinia* often, but not necessarily dominant. The other characterising species are also constant. Other species found, though with lower constancy, are *Carex nigra* (sometimes dominant), *Eriophorum angustifolium*, *Juncus acutiflorus* and *J. articulatus.* More rare are *Carex echinata, C. lasiocarpa, C. panicea* and *C. pulicaris. Calluna vulgaris* and *Erica tetralix* sometimes also occur.

In addition there are typical species of wet grassland—*Anthoxanthum odoratum, Holcus lanatus, Lotus uliginosus, Leontodon autumnalis, Rhinanthus minor* and *Rumex acetosa.* There are also various taller *Peucedano-Phragmitetum* species, usually only sparsely developed and decreasing in abundance away from the edge of the valley bottom mires. Typical examples include *Calamagrostis canescens, Juncus subnodulosus, Lysimachia vulgaris, Peucedanum palustre, Phragmites communis* and *Valeriana officinalis.*

In general shrubs are not frequent in this community. Small bushes of *Alnus, Betula pubescens, Frangula alnus, Myrica, Salix cinerea* and *Ulex europeaus* can sometimes be found. Bryophytes include *Acrocladium cuspidatum, Brachythecium rutabulum, Campylium stellatum, Hypnum cupressiforme, Pseudoscleropodium purum* and *Sphagnum plumulosum.*

There is some floristic variation between the stands. The small number actually found and examined (6) demands that any floristic subdivision is necessarily tentative. The following, however, is suggested:

(i) PEUCEDANETOSUMS
Characterisation: presence of *Peucedano-Phragmitetum* species: *Phragmites communis, Calamagrostis canescens* (sometimes dominant) *Juncus subnodulosus, Lysimachia vulgaris, Peucedanum palustre, Valeriana officinalis.*

(ii) NARDETOSUM
Characterisation: Nardus stricta, Seiglingia decumbens, Festuca ovina. Mesotrophic fen species much less well developed.

This community is usually found further up slope. Both *Nardus* and *Sieglingia* are uncommon species in Broadland.

It is thus evident that these *Cirsio-Molinietum* communities contain an interesting mixture of species, including those typical of moist, nutrient-poor grassland, wet heath and mesotrophic fen. The stands can be rich in species (45spp/10m^2)and provide the sites for a number of plants that are otherwise rare in Broadland.

At their lower end, the *Cirsio-Molinietum* communities usually grade into one of the *Peucedano-Phragmitetum* stands. The upper limit may be determined by a boundary hedge of agricultural land or, in some instances, a rather narrow band of rather dry *Quercus robur* woodland. At one site, the community leads up into a small area of heath (see below).
Distribution: Rare. HH, CF, BH.

CALLUNA-MOLINIA COMMUNITY
Characterisation: Predominance of *Calluna, Ulex europaeus, Molinia, Erica tetralix.*
Description

A small area of fairly dry heath. It has fairly strong floristic similarities with the *Cirsio-Molinietum.* The following species list was made:

Betula pubescens	*Cirsium dissectum*
Calluna vulgaris	*Juncus articulatus*
Ulex europaeus	*J. conglomeratus*
Molinia caerulea	*Luzula multiflora*
Erica tetralix	*Nardus stricta*
Agrostis canina	*Phragmites communis*
Anthoxanthum odoratum	
Carex pilulifera	*Sphagnum plumulosum*
Calamagrostis canescens	

Distribution: One known site. BH.

OAK WOODLAND

The dry strips of oak forest at the fen margins have not been examined in detail. As well as oak, some birch trees may also occur. The woodland floor supports species such as:

Agrostis stolonifera	*Molinia caerulea*
Crataegus monogyna	*Potentilla erecta*
Epilobium angustifolium	*Pteridium aquilinum*
Holcus mollis	*Rubus fruticosus*
Lonicera periclymenum	*R. idaeus*

III. The Vegetation of the Valley Mires

Two main valley mire systems occur in the survey area—at Smallburgh and East Ruston. These are of rather different character. Some of the vegetation of both sites (e.g. alder carr) may be referred to flood-plain mire communities, and will not be discussed again. Other communities, however, are quite different.

SCHOENO-JUNCETUM SUBNODULOSI Allorge 1922.
Characterising species:

Schoenus nigricans, Juncus subnodulosus, Anagallis tenella, Carex flacca, C. hostiana, C. lepidocarpa, Dactylorhiza praetermissa, Epipactis palustris, Eriophorum latifolium, Parnassia palustris, Pedicularis palustris, Pinguicula vulgaris, Bryum pseudotriquetrum, Drepanocladus revolvens, Fissidens adianthoides, Riccardia pinguis etc.

Description

Stands of herbaceous vegetation in which relatively low-growing graminoid monocots are the predominant components—especially sedges (*Schoenus* *nigricans* and smaller carices), rushes (*Juncus subnodulosus*) and grasses (*Molinia caerulea*). *Phragmites* and *Cladium* may form a sparse upper layer to the vegetation and bushes of *Alnus*, *Betula pubescens* and *Salix cinerea* may also occur, but these are of small cover compared with the lower-growing plants. Physiognomically this Association is distinct from most flood-plain mire communities, though there are strong resemblances to some of the *Peucedano-Phragmitetum caricetosum* stands. Characteristic of this Association, and this certainly applies to the examples in the Ant valley, is a high diversity of herbs and a well developed bryophyte layer, composed in the main of hypnoid mosses.

This Association is typically one of valley mires, occuring in moist to wet habitats which are irrigated by highly calcareous water, with a pH often in excess of 7.5

It occurs at one site in the middle Ant valley, Smallburgh Fen. This is a most important site as it represents one of the richest examples of *Schoeno-Juncetum* vegetation in Britain. This was recognised by Goode (1977) in awarding the site Grade 1 status in his evaluation of British peatlands.

The richest areas contain the following species:

Anagallis tenella
Angelica sylvestris
Berula erecta
Caltha palustris
Cardamine pratensis
Carex diandra
C. dioica
C. elata
C. lepidocarpa
C. nigra
C. panicea
C. pulicaris
C. rostrata
Cirsium palustre
Dactylorhiza fuchsii
D. praetermissa
D. traunsteineri
Drosera anglica
Eleocharis quinqueflora
Epilobium palustre
Epipactis palustris
Equisetum fluviatile
E. palustre
Eriophorum angustifolium
E. latifolium
Eupatorium cannabinum
Galium palustre
G. uliginosum
Hydrocotyle vulgaris
Juncus articulatus
J. subnodulosus
Lychnis flos-cuculi
Mentha aquatica
Menyanthes trifoliata
Parnassia palustris
Pedicularis palustris
Phragmites communis
Ranunculus flammula
Salix repens
Schoenus nigricans
Valeriana dioica

Acrocladium cuspidatum
A. giganteum
Aulacomnium palustre
Bryum pseudotriquetrum
Campylium stellatum
C. elodes
Cratoneuron commutatum
C. filicinum
Drepanocladus revolvens
Fissidens adianthoides
Lophocolea bidentata
Mnium pseudopunctatum
Mnium punctatum
Mn. seligeri
Pellia endiviifolia
Philonotis calcarea
Riccardia pinguis
Scorpidium scorpioides
Sphagnum palustre
S. plumulosum
S. squarrosum

The above community, of rather wet species-rich *Schoenus* fen belongs to the *caricetosum rostratae* subassociation. Much of the vegetation at Smallburgh is not as species-rich, however. Much of the fen is covered by a taller sward of *Juncus subnodulosus*, and many of the smaller associates are excluded from this, largely on account of the thick "mattresses" of *Juncus* litter. In this community *Schoenus* is also rare. It does, however, contain *Thelypteris palustris* which is absent from the more diverse communities.

Although outside of the middle Ant valley, mention may also be made of Southrepps Common, located at the head of one of the tributaries that feed the Ant. This again is a calcareous valley fen, much of which is covered by dense beds of *Phragmites*. However, in a central sump area there is some development of a *Schoeno-Juncetum*. Much of the area is dominated by *Juncus subnodulosus*. Particularly notable is the presence of large populations of *Epipactis palustris* and, to a lesser extent, *Gymnadenia densiflora*. The presence of this latter species, together with *Centaurea nigra*, *Festuca ovina*, *Luzula multiflora* and *Leontodon* place much of the site into the *leontedonetosum* subassociation. In the very centre of the site there are wet flushes with *Anagallis tenella*, *Carex lepidocarpa*, *Eleocharis quinqueflora*, *Pedicularis palustris*, *Euphrasia nemorosa* and *Menyanthes trifoliata*. These also support a greater range of bryophytes including *Drepanocladus revolvens*, *Bryum pseudotriquetrum* and *Philonotis calcarea*. There is also a very small amount of *Carex dioica*.

CAREX CURTA—CAREX ROSTRATA COMMUNITY

Characterising species: Carex curta, C. rostrata, C. nigra, Potentilla palustris, Menyanthes trifoliata.

A poor fen community developed at East Ruston Common where a tributary of the Ant has cut back into nutrient poor, decalcified Norwich brickearth. It is found below a seepage zone at the valley margin.

The vegetation is quite different from any other in the Ant valley. The dominant sedge is *Carex rostrata* with smaller amounts of *Carex curta* and *C. nigra*. The species complement includes:

Agrostis canina	*Menyanthes trifoliata*
Betula pubescens	*Molinia caerulea*
Carex lasiocarpa	*Potentilla palustris*
Eriophorum angustifolium	*Salix cinerea*
Equisetum fluviatile	*Aulacomnium palustre*
Holcus lanatus	*Polytrichum commune*
Juncus articulatus	*Sphagnum squarrosum*
J. effusus	

The above list was made in 1972. Currently the vegetation appears to have been subject to some degree of desiccation and, particularly, burning. However, the basic community seems to have been retained.

Distribution: Rare: East Ruston Common. A similar community occurs in a valley fen leading down to Hickling Broad. *Carex curta* has also been recorded from the margin of Sutton Broad, but it has not been seen there in this survey.

Discussion

It is unfortunate that there is but little documentation of the former character of the Ant valley fens. The main sources from which information can be obtained are Pallis (1911) who, in addition to her general account of the swamp and fen vegetation of Broadland, has also provided a detailed transect across part of Barton Broad, and from Nicholson (1909) who gave some account of the Ant valley in the Sutton Broad area. Some comments concerning the East Ruston area are made by Bird (1909).

It is evident from these accounts that, during the present century, some changes have occurred in the character of the vegetation, at least in some areas. Generalising, these have been:

(i) reed die-back and the loss of reedswamp, especially open reedswamp.

(ii) overgrowth of the mowing marshes resulting from the reduction of active management and from changes in the character of the management—such as virtual cessation of annual summer mowing for litter. This has led to the disappearance of a number of the lower-growing herbs from their former sites.

(iii) the on-going terrestrialisation of old peat workings. This has been important, not only in the broads that have closed over, but also in smaller diggings. It has resulted in considerable changes in the character of the substratum. For example, Clarke (1915) writes that " . . . parts of East Ruston . . . consist of a mass of vegetation floating on an unknown depth of water and mud. The floating carpet yields at every step . . . " No parts of the fens at East Ruston appear to have this character now. Nor do they continue to support their former populations of *Liparis loeselii.*

The Broadland plants that are of particular interest fall into two basic categories. First, those which are abundant in this region but absent or rare elsewhere in Britain. Examples are *Calamagrostis canescens*, *Peucedanum palustre* and *Thelypteris palustris.* Second, those which are rare within Broadland. These are not necessarily generally rare within Britain. It is this latter category of rarities which have tended to become increasingly less common in Broadland during the last fifty or so years. They include:

Anagallis tenella	*Hypericum elodes*
Carex limosa	*Lathyrus palustris*
Dactylorhiza traunsteineri	*Liparis loeselii*
Drosera anglica	*Parnassia palustris*
D. rotundifolia	*Pyrola rotundifolia*
Dryopteris cristata	ssp. *rotundifolia*

Many of these have their main remaining localities within the Ant valley. An important exception is *Lathyrus palustris* which is largely absent, growing only in a few areas towards the southern end. Its Broadland distribution is curious. The main strongholds are several sites in the Yare valley and Upton Broad. It is not restricted to, or characteristic of, any one community and is absent from large areas of vegetation that superficially appear suitable.

A feature of the other species in the list is that they tend to be specific to a particular community. On the (unsupported) assumption that they previously occupied the same sort of community as they do now, it is reasonable to suggest that changes in their abundance may reflect changes in the character of the vegetation.

The species fall into two basic groups—those typical of the *Betulo-Dryopteridetum cristatae* and those of the *Peucedano-Phragmitetum caricetosum.*

Species of the *Betulo-Dryopteridetum* are *Dryopteris cristata, Drosera rotundifolia* and *Pyrola rotundifolia. D. cristata* is of particular interest. Previously more widespread (Bennett, 1904) it is now mainly restricted to Norfolk where it is given as "rare and decreasing" by Petch & Swann (1968). In fact, the present survey has shown it to be tolerably abundant in the Ant fens. It lends no support to the suggestion that it is disappearing through hybridisation with *D. carthusiana.* Notwithstanding the sterility of the spores of *D.* x *uliginosa,* hybrid plants have also been found much less frequently than pure *D. cristata.* Unfortunately, it is difficult to know to what extent the new records for the plant in the Ant valley represent genuinely new sites and to what extent they are unreported old localities. It is possible that the plant is expanding its range within the valley.

Pyrola rotundifolia ssp *rotundifolia* is known from several scattered localities, where it is characteristic of the immature edge of birch or willow carr. Although not specific to the *Betulo-Dryopteridetum*, it is found most often in this community. Elsewhere it also tends to be associated with *Sphagnum* suggesting a preference for more acidic conditions. Sutton is the only Ant locality given for the plant by Petch & Swann (1968). It is currently known also from other areas, again suggesting that there may have been little, if any, contraction of its range.

Drosera rotundifolia has long been known as an acidophilic species of the Ant marshes. Nicholson (1909) cites it as a characteristic though not abundant plant; Pallis (1911) shows it as an inhabitant of a mossy "island" near Barton Broad; Ellis (1965) reports an early observation of F. W. Oliver of large numbers of white butterflies captured by the plant. All of these records seem to have referred to the Barton Broad area, where currently at least 4 populations are known, all in *Betulo-Dryopteridetum* communities. This apparent fidelity is probably because nearly all of the *Sphagnum* areas on which the plant grows support the *Betulo-Dryopteridetum.* This has probably not always been the case. The plant at present is able to persist in immature carr, but it is best developed in more open areas. The largest population, where it grows with many young fronds of *D. cristata*, is on a regularly mown path.

Another species which could conceivably occur within the *Betulo-Dryopteridetum* is *Vaccinium oxycoccos*, which has an early record from Horning (referring to the Ant valley?), but careful searching has failed to locate it.

Much more needs to be known about the *Betulo-Dryopteridetum*, particularly with reference to its ontogenesis. It is at least possible that it represents an expanding community within the Ant valley.

In contrast, the most species-rich form of herbaceous fen of the valley, the *Peucedano-Phragmitetum caricetosum*, is almost certainly a community declining in extent. The other rare species listed are almost exclusively restricted to this community and all show diminishing distributions.

The most notable is *Liparis loeselii.* This still occurs in some abundance in parts of the Ant valley, possibly the only remaining populations of the fenland form of the orchid within Britain. At least 6 populations are known, some extensive, though apparently subject to considerable flux. In 1973, one site supported at least 150 plants. In subsequent years it appears to have been much reduced. The orchid grows on mossy cushions and slightly elevated areas which are free from summer flooding. In sites which are regularly mown, the plants are subject to trampling damage although the populations continue to thrive.

The plant was formerly more widespread in the Ant valley, as indeed in Broadland generally. An early record is from East Ruston (Bird, 1909) and a more recent one from Dilham Broad Fen, where apparently it was present in some quantity. Obviously, it is not possible, in the absence of records, to know the precise character of the communities in which it occurred. However, at Dilham, the main area in which it grew is now occupied by a *Peucedano-Phragmitetum caricetosum typical* var. community—a more species-poor, more overgrown and (possibly) drier version of the closely related *Menyanthes* var. from which all the current records of *Liparis* have been made. It is at least possible that the *Menyanthes* var. once occupied the marginal band of the fen, having been subsequently lost upon overgrowth of the vegetation and drying out of the substratum. Similarly another former *Liparis* site in Sutton High Fen, which from records of Ellis (unpublished) almost certainly belonged to the *caricetosum Menyanthes* var., has become overgrown and impoverished.

Of the other species *Anagallis tenella*, *Drosera anglica* and *Parnassia palustris* are all less abundant than formerly (Ellis, 1965, Nicholson 1909 and flora records). *Hypericum elodes* was given by Pallis (1911) as an occasional component of the fen association in all the Broadland river valleys. It is certainly not so now. In the present survey it has been found in two places in Broadland, one of them (near Barton Broad) in the *Peucedano-Phragmitetum caricetosum*. (The other is from an acidic valley fen in the Thurne valley). No comment can be made on *Dactylorhiza traunsteineri* as this species was only recognised in 1953.

Carex limosa, phytogeographically a northern species, has never been abundant in Broadland (at least in recent times). It is characteristically a species of wet "mud-bottom" communities and this is applicable to the two current sites. Interestingly, in one of these it is associated with the northern moss *Cinclidium stygium*.

As yet there is little information available concerning the factors that are instrumental in determining the species composition and richness of the *Peucedano-Phragmitetum caricetosum* stands. Preliminary investigations suggest that it is partly related to the absence of a strong dominant species and the development of a lower-growing, more mixed fen vegetation. This appears to be a result of the relatively low nutrient status of the substratum and its inability to sustain a vigorously growing fen community, reinforced by the periodic removal of biomass by the management regime. Evidence for this is provided by the location of the community. In most of its sites—with one important exception—the *caricetosum* is situated as a narrow band along the fen margins, near to the upland and well away from the irrigating river, from which it is separated by more vigorous, less species-rich communities. It is thus situated where the influence of the nutrient rich river water is least, possibly to some extent protected from it by the "screen" of separating vegetation. Evidence supporting this suggestion has been provided by productivity and nutrient availability studies which have demonstrated a declining gradient of productivity and nutrients (mainly N and P) across the fen towards the landward margin. This work is only in its initial stages and the results will be published elsewhere later.

Related to this is the extent to which an increase in the nutrient status of the River Ant, which has probably been an important factor in the decline of the macrophytes of the waterways (Mason & Bryant, 1975), has affected the composition of the fen vegetation. It is likely that the areas of rather species-poor, tall and vigorous fen which are found near to the Ant in places may have developed in response to higher nutrient loadings associated with the proximity of the river. But as yet there is little reason to suggest that eutrophication *per se* has had a significant affect upon the composition of large areas of fen vegetation.

Indeed, there is some evidence to suggest that the opposite process of oligotrophication may operate in some areas, notably the Catfield complex. This is a large fen area (approximately 130 hectares) and the central areas in particular are well removed from the R. Ant and from any marginal input of agricultural runoff. Although there are dykes, in some parts at least these are separated from the Ant by a sluice. As much of the area is mowing marsh, it seems possible that nutrient depletion could occur. Such a hypothesis could provide an explanation for some of the areas of impoverished fen in which *Phragmites* is only feebly developed on the basis that the nutrient loadings (especially N and P) are insufficient to sustain a regularly mown reed bed. Nutrient deficiency might also account, in part at least, for the small amount of macrophytic vegetation found in some of the internal pools and dykes of the system. Preliminary measurements indicate that these have low N and P loadings.

Related to this is the possibility that some of this area is subject to the process of ombrotrophication (i.e. the development of acid bog peat on top of fen peat). This seems to represent the natural ontogenesis of mires (Weber, 1908)—at least in suitable climatic regions (Bellamy, 1972), but the extent to which it is likely to occur in the Broadland fens is uncertain. The hydroseral scheme of Tansley (1939) for sub-oceanic climates, which has been widely accepted, was towards the development of alder forest and then, possibly, the establishment of mixed deciduous woodland. Yet it is known (Godwin & Clifford, 1938) that ombrotrophic mires formed in the nearby area of the Fens and there seems little reason to suppose that the same would not be possible in those areas of the Broadland valleys not subject to periodic inundation. Certainly, ombrotrophic nuclei of *Sphagna* occur. The question is whether these are localised features of particular habitat situations or the basis for more extensive acidophilic mire development. Certainly, the acidophilic nuclei in the Catfield fens, the areas dominated by *Sphagnum* and *Betula* peripheral to the rich fen, have every suggestion of incipient ombrotrophic mire, possibly raised bog or, at the very least, acidophilous *Sphagnum*-birch forest. Indeed it is not impossible that certain of the areas (those on slightly raised peat) could represent vestiges of a former, more extensive cover of acidic peat which was largely removed by the peat digging of the nineteenth century (or earlier).

In conclusion, it is evident that much more information is required concerning the factors and processes determining the composition of the vegetation within the middle Ant valley, certainly from the viewpoint of devising appropriate management strategies for the wetland communities of primary conservational interest. It is hoped that the classification presented here provides some basis upon which this can be done, as well as emphasising its importance.

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ELODEA CANADENSIS AND ELODEA NUTTALLII

By E. L. Swann

Introduction

Search of the literature has shown innumerable examples of the influx of aliens into the British flora but references to aquatic macrophytes are relatively few in number. The present paper traces the history and distribution of *Elodea canadensis* Michx., Canadian Pondweed, and *E. nuttallii* (Planch.) St. John, an American Pondweed. Evidence is given that *E. canadensis*, at one time both widespread and abundant, is diminishing in both frequency and vigour and, on a long-term view, is likely to be superseded by the closely-allied *E. nuttallii.* Some biological and ecological data are given and certain taxonomic misconceptions receive comment.

Elodea canadensis Michx.

The history of this species in Britain is well-documented and records go back for one hundred and forty years. In her pioneer work Ann Arbor (1920) writes "Exactly when and how it was introduced from America remains a mystery. Its first appearance is in Ireland in 1836". This provides a clue as we now know that birds fly across from America and Canada and their first landfall would be in Ireland. In America this species is fertile and in an account of their work V. W. Proctor and V. L. De Vlaming (1967) found that "viable seeds of many aquatic plants are carried in the digestive tracts of killdeer (quail) and mallard ducks for up to 48 hours, and in a few cases after more than 100 hours". L. van der Pijl (1972) quotes the work of Fredikson who found that snow buntings "of the non-Icelandic race were caught on the new volcanic island of Sturtsey off Iceland. Their gizzards contained viable seeds picked up in the British Islands." There would therefore appear to be exceptions to the long-held view of ornithologists that migrating birds empty the digestive tract before departing.

Norfolk provides further evidence of bird-carriage in *Alisma gramineum* subsp. *gramineum*, the Grass-leaved Water-plaintain, found by R. P. Libbey in Langmere in 1972. It is considered that migrating wild fowl from Denmark and the Baltic States where this taxon is native carry the seeds in their digestive tracts and the hard-coated pericarps resist digestive action thereby ensuring their ultimate germination despite the long flight of some 600/700 miles.

It is more puzzling to explain why this species, fertile in America, should only have female flowers in Britain apart from a very rare record of male flowers near Edinburgh in 1879. Since British plants are unable to set seed they must all have reproduced vegetatively from the earliest introductions; like other aquatic macrophytes *Elodea* exhibits excessive vegetative activity which may act as a deterrent to sexual reproduction.

Biology and Ecology

Because its leaves are only two cells thick it is a very brittle plant and any piece broken off quickly roots. It is this adaptability and the small serratures along the leaf margins providing further adherence which account for its wide distribution when carried by wild fowl about their bodies. Clement Reid (1894) studied the flora of isolated ponds and found *Elodea* in three dewponds on the Sussex Downs concluding that "it has probably been transported twisted round the leg of a bird". In winter it produces cauline branches which have crowded leaves, fresh green in colour, and incipient roots which break off and ensure further reproduction.

This species occurs in the fresh water of lakes, ponds, shallow rivers, and dykes, favouring habitats poor in nutritive salts. This is possibly the reason for its decline since many of its habitats have become highly eutrophic and polluted because of seepage and drainage from arable land heavily fertilised with chemicals, but although this has most likely accelerated its decline it was becoming less frequent before the widespread use of chemical fertilisers. It is tempting to suggest that in the course of its one hundred and forty years it has passed through the natural sequence of being a pioneer, building up to maturity and so to senescence but there is no evidence for this.

Vegetative reproductions by ramets and winter buds ensure plants that are genetically identical with one another so that little variation can be expected. However, during the long hot summer of 1976 plants in a static water tank in Reffley Wood, near King's Lynn, were kept under observation. This outdoors laboratory enabled comparisons to be made between the rooting and submerged plants with those free-floating on the surface. In the short space of 50 days the length of the rooted plants reached 48cm., as against 12cm. of the floating ones; leaf lengths also showed a remarkable increase of 25% over the normal so that the whole plant with leaves as long as 12.5mm. the resemblance to *E. nuttallii* was striking; the leaves of the floating plant did not exceed 7.5mm. With consistently high temperatures by night and day ranging from 22.2°C to 30°C the heat together with the excess of carbon dioxide account for the abnormal growth.

Distribution

The *Atlas of the British Flora* (1962) shows it to be widespread throughout the British Isles but thinning out northwards. All evidence points to it being abundant towards the end of last century when it reached its climax and became a considerable nuisance to "navigation, drainage, boating, swimmers and anglers" (Marshall, 1852). There is now no doubt that is is declining and a survey of regional Floras bears testimony thus:

Flora of Bristol	First record	1856	Diminished	1912
Flora of Cambridgeshire	,,	1847	,,	1964
Flora of Gloucestershire	,,	1836	,,	1948
Flora of Surrey	,,	1852	,,	1976
Flora of Norfolk	,,	1866	,,	1976

Elodea nuttallii (Planch.) St. John

The first British record appears to be in 1972 when specimens were sent from Oxford; in 1974 J. H. Chandler carried out intensive work in Huntingdonshire, the Soke of Peterborough, S. Lincolnshire and Cambridgeshire. Recently it has taken on an explosive increase both in north-west Europe and has been recorded in other English counties but so far has not been found in Norfolk.

Mr. Chandler finds it occurring in shallow water on muddy bottoms in slow-flowing drains. This suggests that, unlike the commoner species, it favours or can tolerate eutrophic conditions and is, therefore, likely to take the place of *E. canadensis* in the long run. Already in Belgium it is tending to supplant *E. canadensis*. It has been suggested that it owes its introduction to aquarists throwing out superfluous plants. Like *E. canadensis* it is equally well adapted for bird-carriage, probably better as the uppermost leaves adhere together when taken from the water; it may also be spread by man when machines are used for dredging by water authorities.

Taxonomy

There have been some misconceptions in the reference books creating difficulties in naming and recording. Tutin (1952) states "Flowers not recorded in Britain" but flowering plants have been seen in Cambridgeshire, Oxfordshire and Sussex. Although leaf-length is given as "about 10mm." (1.c.) it may reach as long as 17mm. It should not be equated with *Hydrilla* spp., and this is repeated in Stella Ross-Craig (1971) where plate 2 is given as *E. nuttallii* and called the Esthwaite Water Pondweed. In his monograph St. John (1962) placed *E. nuttallii* as the only member of the *Section Natator* with "Staminate flowers sessile, at anthesis liberated, floating to and expanding on the surface of the water". So far male flowers have not been seen in Britain but the peculiar habit of breaking loose at maturity may well have escaped notice.

To help clarify the confusion the following key gives the salient characters based mainly on field-work:

Leaves more or less rigid, usually 3 in a whorl, 5-12 (-15)mm. long, 1.5 - 2.5 (-3.2)mm wide, generally obtuse at the apex, margins serrulate for about two-thirds from apex; flowers (female) floating on long axes, 5mm. diam . . . *E. canadensis.*

Leaves flaccid, loosely divergent, uppermost clustered together when taken from the water, 3-4 in a whorl, 8-17mm. long, 1.0 - 2.5mm. wide, linear-lanceolate or acuminate, margins similarly serrulate; flowers (female) floating on long axes, c. 3.0mm. diam. . . . *E. nuttallii.*

Material used

E. canadensis.

A. Reffley Wood, King's Lynn, static water tank, 12.7.1976. Grid 53/657.221.
B. Same station. 31.8.1976.
C. Wormegay Fen. Deep water form. 25.8.1977. Grid 53/674.116.
D. Black Drain, Shouldham Warren. 20.7.1976. Grid 53/673114.
E. Pentney Drove, Pentney. Shallow Dyke. 3.11.1976. Grid 53/692.113.
F. Forty Foot Drain, Manea, Cambs. Shallow counter drain. 10.8.1976.

E. nuttallii

G. Thorney, River Thorney, Cambs. 31.7.1976. 53/275.997.
H. Same locality. 31.7.1976. 53/275.995.
J. As above. 31.7.1976. 53/275.995.
K. Peakirk, Northants. Sent by Mr. Chandler. 53/173066.

	LEAF LENGTH	LEAF WIDTH	MEAN
A.	5.0 - 7.5mm	2.0 - 2.5mm	6.4 x 2.2mm
B.	7.0 - 12.5	2.0 - 2.3	10.5 x 2.1
C.	11.0 - 15.0	2.0 - 3.0	13.0 x 2.7
D.	6.0 - 7.5	1.5 - 2.0	6.8 x 1.7
E.	7.5 - 9.0	2.3 - 2.8	8.4 x 2.5
F.	5.5 - 10.0	2.0 - 3.2	8.3 x 2.6
G.	10.0 - 14.0	2.0 - 2.5	11.7 x 2.21
H.	8.0 - 13.0	1.5 - 2.0	11.0 x 1.71
J.	9.0 - 17.0	1.5 - 2.0	12.1 x 1.75
K.	10.0 - 13.0	1.2 - 2.6	11.2 x 1.45

Biometrial analyses

LEAF LENGTH				LEAF WIDTH			
E. canadensis		*E. nuttallii*		*E. canadensis*		*E. nuttallii*	
1 at	5.0mm	—		— at	1.2mm	1 at	1.2mm
2	5.5	—		—	1.2	2	1.3
1	5.7	—		2	1.5	12	1.5
4	6.0	—		3	1.6	4	1.6
5	6.5	—		1	1.7	3	1.9
6	7.0	—		2	1.8	3	1.8
7	7.5	—		—	1.9	4	1.9
1	7.8	—		12	2.0	4	2.0
1	7.9	—		7	2.2	2	2.2
2	8.0	2 at	8.0mm	3	2.3	—	
1	8.3	—		5	2.4	4	2.4
2	8.5	—		8	2.5	—	
1	8.3	—		2	2.7	—	
2	8.5	—		4	2.8	—	
7	9.0	3	9.0	3	2.9	1	2.9
4	10.0	8	10.0	5	3.0		
1	11.0	2	11.0	1	3.2		
1	11.5	1	11.5				
6	12.0	14	12.0				
2	12.5	—					
3	13.0	8	13.0				
1	14.0	—					
2	15.0	1	15.0				
—	17.0	1	17.0				

This shows there is considerable overlap in both length and width.

	E. canadensis	*E. nuttallii*
The present work shows a range	5-15 x 1.2-3.5mm	8-17 x 1.5-3.2mm
According to Gray (1950)	6-13 x 1-5	7-17 x 0.3-1.5
According to St. John (1965)	7-17 x 1-4	6-13 x 0.3-1.5
According to Tutin (1952)	c. 10 x 3-4	c. 10 x 2

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WEATHER 1976/77

By T. B. Norgate

1977

January. The only redeeming feature was that sunshine was nearly 25% above normal—Mean Temperature was marginally the lowest for January in Norfolk, since 1964. North America had its coldest January with the most snow this century. Rainfall was excessive in Norfolk, especially north of the county where over 125mm was recorded.

February. This month was even wetter here with some rain to measure in many parts of the county on 23 days—(double the average) and a total over 150mm at Rougham. Though it was the dullest February for 9 years, the mean temperature has only been exceeded once in the last 10 years (1974). The reduction in frosts was contributed by the additional cloud cover.

March. Though rainfall was slightly above average, it was the driest month since last July when the drought was ending. While on the warm side, the month had almost its share of frosts. It turned cold during the last 10 days with a change of wind to N.E. bringing showers of sleet and snow. Until them there had been only one sunless day.

April. Mean temperature was only marginally warmer than March but more ground frosts, down to —9°C (10th). Rainfall was mostly a bit below average, especially towards the south of the county. This included snow showers early on which lay for 3-4 days, but did not delay arrival dates of cuckoos and swallows.

May. Despite being slightly on the cool side it was the sunniest month of the year—only 2 days having none to measure, and best May since 1971. A drought was experienced in the last half of the month, but the total was nearly up to average and included a little snow locally.

June. Thundery showers caused a very uneven pattern of rainfall, from over 83mm at Sandringham down to 10mm at Starston. The month began with the coldest day since April 19th, down to 2.5°C in the air and —.9°C on the ground and had only one day (13th) reaching 24°C (75°F) compared with 15 such days in June 1976. Sunshine was only 70% or normal though there were only 5 completely sunless days.

July. The mean temperature was not far short of the average, but there were only 6 days above 24°C, almost all in the first week (21 days in 1976). Occasional thunderstorms in the north of the county boosted totals to nearly 24mm rainfall —otherwise it would have been the driest July in Norfolk since 1955.

August. Beccles was the wettest place in the county with over 150mm., thunderstorms affecting both north and south of the county (8th and 18th). Mean temperatures were below normal for the fifth consecutive month and ended with a mean below 15 °C—though there were only 4 sunless days, total sunshine was about 80% of average.

September. Rainfall was down to 25 or 30% of normal, nowhere recording more than 26.4mm—in fact the average for 119 places in the county was only 19mm. The month's total was the lowest for the year in central Norfolk. Sunshine was only 70% of the usual amount, but with only 5 sunless days.

October. Despite 4 ground frosts, slightly fewer than usual, the month was on the warm side and sunshine hours were more than last month nearly 40% up on average. There were several early-morning fogs but only one day without some sunshine.

November. This is normally our wettest month but this year it was February, followed by Jan., Aug. and Dec. in that order. Sunshine was again nearly as high, relatively, as October. The first air frosts were recorded for the autumn but none were severe, the mean temperature being almost exactly normal.

December. Sunshine was on the high side for the third month in succession, a 33% excess over this period. The mean temperature was also noticeably high, particularly around Christmas. Kew Gardens recorded the warmest day for over 100 years on Dec. 23rd.

THE YEAR 1977

Treating the period on a seasonal basis (as previously), winter and summer were both cooler than average, 3.0 °C and 3.8° and 14.5° and 15.4° respectively, whereas the autumn was slightly warmer, 10.7° and 10.4°. The winter figures do not strictly tally with those shown for the full year, since the winter season includes the cold Dec. of 1976 but excludes the warm Dec. 1977.

Both air and ground frosts were 20% more frequent than usual in winter and about 30% fewer than average in the autumn.

So far as rainfall is concerned winter was wetter than normal by 50% and the wettest since 1966 in central Norfolk. Spring was about average, and both summer and autumn were distinctly on the dry side, about 33% below normal in summer and 50% in autumn which was the driest since 1947. It is not surprising, therefore, that the water-table in most parts of the county was low at the end of the year. Rainfall has been deceptive since there were more "rain-days" that usual, but amounts were mostly on the small side.

1977 will be remembered as having had a poor summer, especially compared with 1976. We had hardly any hot spells, only 10 days reaching 24 °C (75 °F). 6 of which were in July. In 1976 the figure was 51 such days, the average since 1968 being 17 days that can be called a warm summer's day.

	MEAN TEMPERATURE		NO. OF AIR AND GROUND FROSTS		SUNSHINE HOUR	
	°C	°C				
	1977	10yr. Avg.	1977	10yr. Avg.	1977	10yr. Avg.
Jan.	2.3	4.0	12/22	8.1/15.3	48.9	40.2
Feb.	4.8	3.5	5/14	10.0/18.7	44.6	64.7
March	6.7	5.2	5/13	7.0/17.4	108.1	108.5
April	6.8	7.4	4/18	3.2/12.9	163.2	154.6
May	10.2	11.0	0/6	.5/5.3	224.0	189.2
June	12.3	14.0	1/1	.1/.8	147.4	213.7
July	15.5	16.0	—	—	185.8	193.8
Aug.	15.6	16.2	—	—	148.7	182.5
Sept.	13.7	13.6	—	0/.6	130.2	147.5
Oct.	11.8	10.7	0/4	.1/5.6	137.3	100.0
Nov.	6.7	6.8	4/9	5.8/12.2	87.1	68.1
Dec.	6.0	4.1	0/9	6.3/15.2	62.5	47.0
Year	9.4	9.4	31/96	43.0/105.3	1489.2	1508.1

	RAINFALL MM'S		DAYS WITH HAIL/SNOW		DAYS WITH THUNDER	
	1977	10yr.Avg.	1977	10yr.Avg.	1977	10yr.Avg.
Jan.	90.0	58.7	2/11	.6/3.3	—	.1
Feb.	93.9	45.0	1/1	.9/4.3	—	.2
March	43.6	39.6	5/2	1.2/3.7	1	.3
April	43.4	40.1	5/3	2.2/1.9	2	1.3
May	39.4	45,5	—	.3/.0	1	2.7
June	14.9	34.5	—	.4/.1	1	2.4
July	14.2	56.9	—	—	—	2.6
Aug.	69.1	54.1	—	—	2	2.8
Sept.	12.6	56.6	—	.2/0	—	2.2
Oct.	24.4	51.6	1/0	1.5/0	1	.8
Nov.	50.7	80.8	3/2	4.2/3.7	—	.6
Dec.	63.7	51.8	0/1	3.3/4.4	—	.1
Year	559.9	615.4	17/20	27.6/23.9	8	16.1

THE RIVER WENSUM (1)

By Roy Baker, Robert J. Driscoll, Peter Lambley

It is surprising to discover that Norfolk, a county renowned for its many distinguished naturalists both past and present, lacks detailed surveys of most of its river systems. The present study was undertaken to follow the River Wensum from its source to its confluence with the River Yare at Norwich and to survey both the flora and fauna of the waterways and river valley. This paper describes the river from above Fakenham downstream as far as Lyng and it is hoped to complete the survey of the lower reaches to Norwich in 1978. In addition to the study of the natural history of the river the paper attempts to examine both past and present management and to identify any habitats of high conservation value.

Previous work on the Wensum and its tributaries includes the entomological studies of E. T. Daniels (1958) and K. C. Durrant (1958). The Anglian Water Authority has monitored water chemistry at selected sites for several years and has recently started to sample the aquatic invertebrate fauna. The A.W.A. data are not included in this paper.

Name

The Wensum derives its name from the Old English adjective 'Waendum' meaning wending or winding. The form of the word has undergone many changes over the centuries from Wensom (1096), Wensun (1250), Wenson (1461), Wensome (1556), Wantsume (1557), Wentsum (1586), Windser (1793) to Wensum of present day usage. Rudd (1943) in his Presidential address to the Norfolk and Norwich Naturalists' Society argued that above Norwich the larger Wensum should not be considered as a tributary of the smaller Yare, and that the whole river should be renamed as far as Breydon. In support of this Rudd quoted from a Charter of Edward IV of 1461 as naming the river from Norwich as the 'Wenson'.

Origin

The location of the source of any river is invariably a contentious problem and the Wensum is no exception. The earliest maps of Norfolk by Saxton (1574), Speed (1611), Jansson (1630) and Blaeu (1645) all show a single river rising from land to the east of Tattersett and it is not until Bowen (1720) published his map that all three head-streams were included. The 1-inch O.S. map of 1824 fails to name any of these head-streams, but the map produced by Bryant (1826) clearly indicates the source of the Wensum as Wick End Pond in the Coxford Heath-Syderstone Common complex. White (1836) in his History, Gazetter and Directory of Norfolk describes a small brook running through West Rudham as the source and Tatterford as a hamlet in the valley of the Wensum near its source and confluence with two smaller streams. The 1838 1-inch O.S. map shows the source as a number of springs in land adjoining Hall Farm, West Rudham and later O.S. maps record the source as a pond in the corner of a small meadow in the same village. Water from these springs flows through a series of ditches and land drainage pipes before it joins the other stream from Syderstone Common. This latter stream is named the Tat, a name derived from a 16th C. backformation from Tattersett, and it is by far the larger of the two head-streams. The combined streams flow through Tatterford Common and it is questionable why they should be shown as the Wensum on the 1-inch and $2\frac{1}{2}$-inch O.S. maps when the Tat would seem to be the more logical name to use in conjunction with Tatterford Common.

The more probable source of the Wensum is to be found at an altitude of 75m above sea level on land known as Colkirk Heath (Nat.Grid Ref. TF 942 246). An arable field, bounded on the west by the Dereham-Fakenham road (B1146) and on the south by a cart track known as Goss Drift, contains an active spring which feeds water into a series of ditches passing through the northern parts of Horningtoft and Whissonsett. Twenty years ago this spring was known to bubble continuously even in times of drought, but to improve farming it has since been piped by land drains into a ditch on the other side of the road. This spring is accepted locally as the source of the Wensum. In 1884 H. B. Woodward, of the Geological Survey, wrote that, 'The Wensum originates from streams rising in the parishes of Colkirk and Horningtoft' but even though requests for corrections to the O.S. maps were made, it is only on the recently published 1:50,000 (1974) edition that the Wensum is shown as originating from this area.

There are numerous other springs on Colkirk Heath and those on the eastern side drain through another ditch system in an E.N.E. direction to join the Wensum near Sennowe Park.

In order to avoid confusion about names the Internal Drainage Board staff refer to the Colkirk Heath branch of the head-streams as the Raynham Brook. The head-stream originating from Colkirk Heath should, from a geographical viewpoint, be named the Wensum and the other head-streams named the Tat.

Geology

The solid geology of the whole area drained by the Wensum included in this survey is Senonian (Upper) Chalk. This, however, only occasionally outcrops in the river or valley sides as it is generally covered with boulder clay or plateau and river gravels. Exposures of chalk are found on the river bed at South Mill Farm, Dunton and south of Bintree Mill and they probably occur elsewhere. Most of the springs that feed the Wensum rise from chalk, although in some cases the water, which is under pressure in most of the area, has to force its way through capping gravels and boulder clay. The regional geological sheet memoir mentions iron stained waters issuing from springs, e.g. N.E. of Guist Bridge, but these were not observed during the present survey. There may also be local sources issuing from gravels and not connected to the chalk, but these are likely to be more seasonal in nature. In some places the Wensum has cut into the water table of the chalk and where this occurs springs are especially active. Such an area is found north of Dereham on the Whitewater.

A feature of the Wensum valley is the thick deposits of gravels which in some cases are deposited 6-7m above the present level of the river. These gravels have been extracted in the past on a small scale but during the last thirty or so years there has been a marked increase in their commercial exploitation. The main areas of extraction are east of Fakenham, Swanton Morley, Beetley and Lyng. During these excavations interglacial deposits of Ipswichian age have been found

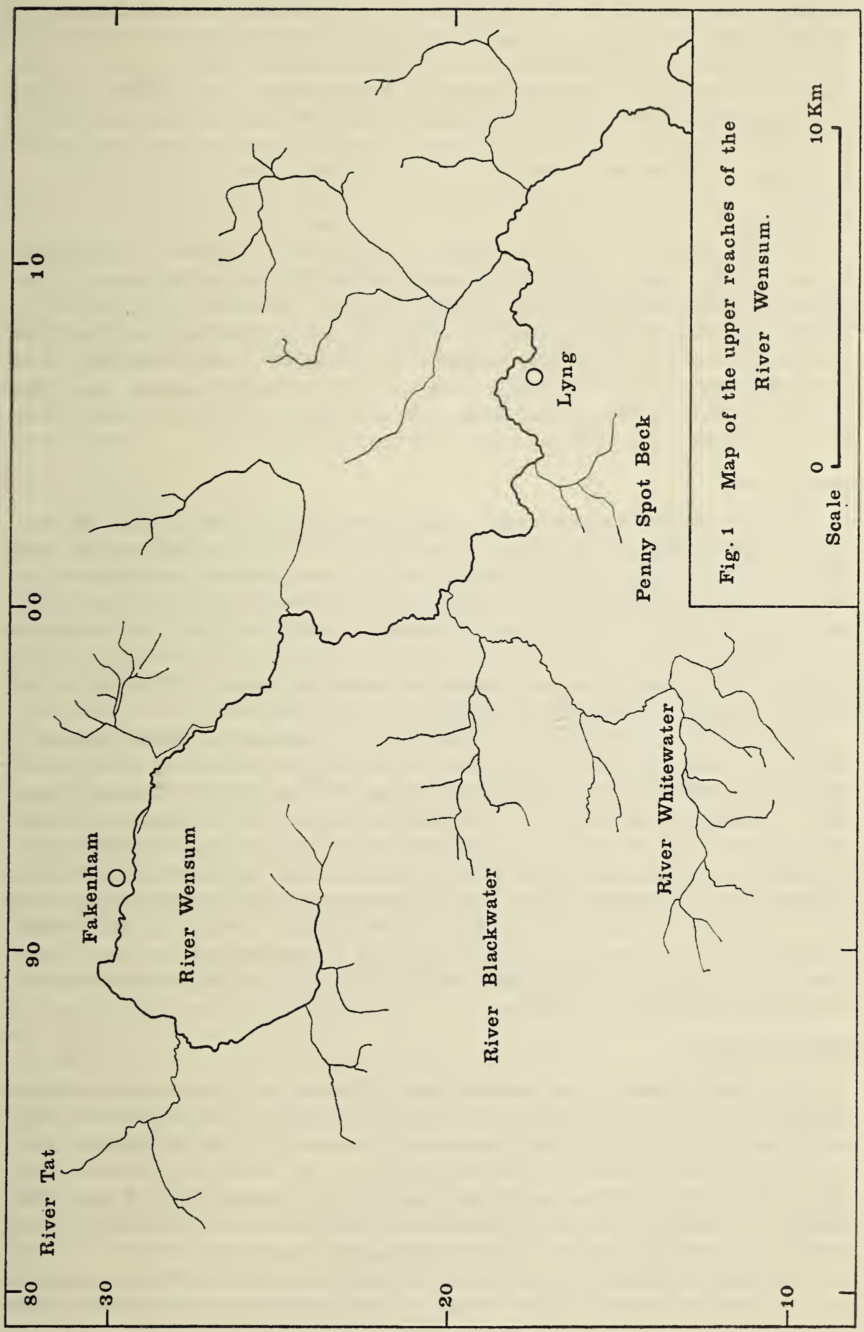


Fig. 1 Map of the upper reaches of the River Wensum.

at Beetley and Swanton Morley and these have yielded vertebrate remains of *Hippopotamus amphibius* L., *Bos primigenius* Boj., and the elephant *Palaeoloxodon antiquus* (Falc. & Caut.). The site at Swanton Morley yielded the fruit of the southern maple, *Acer monspessulanum* L.. Interesting records from Beetley include needles of *Picea abies* (L.) and seeds of an extinct taxon *Erica scoparia* var. *macrospermum* L.. At Lyng the gravels have included late-glacial remains of mammoth, reindeer and aurochs.

Land Use

The present major land use in the river valley is as pasture or meadow cut as hay and this shows little change since the Land Utilization Surveys of Great Britain in 1931-32 and 1960-61, although since the latter date some conversion to arable use has taken place near the upper reaches of the river near Pear Tree Corner. Gravel workings have radically altered some of the river valley and these represent a major change in land use. Small areas of natural vegetation occur at Sculthorpe Moor, Sculthorpe Fen, Ryburgh Common and Guist Common and these are probably maintained for shooting.

Management

The present form of the river is largely the result of the activities of man. Several water mills were built along the river in the past and these mills with their associated weirs and mill ponds superimpose a series of steps on the natural gradient. Immediately downstream from the weirs the river is relatively narrow, shallower and fast flowing, whereas upstream from the mills, where the weirs hold back the water, the river is wider, deeper and slow flowing. These physical differences above and below the weirs give rise to differences in the aquatic vegetation and to a lesser extent the aquatic fauna.

The river and its tributaries are managed by the Anglian Water Authority. The present management involves little more than periodic weed cutting. This causes an immediate reduction in the amount of macrophytes (higher plants) and an increase in the amount of filamentous algae. The changes are usually temporary and do not result in any obviously lasting change in the species composition of the flora. Indeed as all, or at least most, of the river is subjected to weed cutting the present flora should perhaps be considered to be the result of the management regime rather than as persisting in spite of it. The current management scheme seems, on the basis of the present survey, to have a beneficial affect on both the aquatic flora and fauna by maintaining optimal conditions for a wide range of species.

Survey Methods

The River Wensum was surveyed for a distance of 43km upstream from Lyng Bridge during the summers of 1976 and 1977. Some of the major tributaries and dykes associated with the river were also surveyed. A total of 49 sites were examined: River Wensum 32 sites, River Tat 3 sites, River Blackwater 2 sites, River Whitewater 4 sites, Penny Spot Beck 2 sites, drainage dykes 6 sites. The location of sampling sites was determined partly by ease of road access and partly by the need to achieve an even coverage of the river system.

Although sampling was usually carried out from the river bank a rowing boat was used to survey a 3.4km stretch of river between Swanton Morley and

Elsing. In general sampling involved the examination and recording of the aquatic, marginal and bank floras. The submerged vegetation was collected using hand nets and weed grapples. The aquatic fauna was sampled by sweeping with hand nets and by hand collecting from the submerged parts of plants. Due to lack of time it was not possible to record the aquatic fauna and the bank flora fully from all the sites.

Species lists were compiled for each site, using a subjective scale of assessment of abundance for each species. These species lists were also used to prepare distribution maps for each species recorded in the survey. Figure 2 includes a selection of these distribution maps. Appendix 1 contains a complete list of the animals and plants recorded during the present survey.

Copies of the field notes, species lists, distribution maps and a map showing the location of the sample sites have been deposited in the Norfolk Biological Data Bank at the Castle Museum, Norwich, where they are available for inspection.

Survey Data

River Wensum

The waters from the springs at Colkirk Heath flow into a series of shallow farm ditches which become steeply banked west of Horningtoft. These ditches have summer water levels in the 5-10cm range and a minimal water flow, except during and following heavy rainfall. A number of springs have been noted in the stream bed near Pear Tree Corner. Management of these ditches is largely undertaken by the adjacent farms and in consequence the vegetation may vary dramatically from season to season dependent upon the dates of clearance. Watercress (*Rorippa nasturtium-aquaticum* agg.), starworts (*Callitriche* spp.) and pink water speedwell (*Veronica catenata* Pennell) often form dense closed patches of vegetation in the running waters. The marginal species include brooklime (*Veronica beccabunga* L.), fool's watercress (*Apium nodiflorum* (L.) Lag.) and water forget-me-not (*Myosotis scorpioides* L.). A feature of this section of the river is the number of Dytiscid beetles present, particularly *Ilybius ater* (Degeer) and *Agabus bipustulatus* (L.). The latter species is widely distributed, although rather uncommon, in Broadland dykes, whether freshwater or brackish (Driscoll 1976).

There is a marked change in the river from its entry into Norman's Burrow Wood and its emergence at South Raynham Bridge. The flow is greatly increased by run-off, springs and drainage ditches to give a fairly fast flowing reach over beds of stones, gravel and sand. The dense tree canopy of alder, poplar, beech and ash combined with the increased current favours few aquatic plants. Starwort forms occasional patches, but this section is characterised by the growth of willow moss (*Fontinalis antipyretica* Hedw.) and the liverwort *Pellia endiviifolia* Dicks. on many of the larger stones. These stones also provide micro-habitats for a number of animals. The river sponge *Ephydatia fluviatilis* (L.) colonizes many stones as a yellow encrusting layer. Simuliidae larvae and pupae are abundant, as are the larvae of the mayflies *Baetis rhodani* (Pictet) and *Ephemerella ignita* (Poda). The riffle beetle *Elmis aenea* (Muller, P. W. J.) lives under the stones and amongst the submerged mosses. Stone loach (*Noemacheilus barbatulus* (L).) are occasional in this stretch of the river.

The straightened river between Norman's Burrow Wood and Raynham Park is an intensely managed section where the flow is slow, the depth greater than 20cm and the bed formed of a hard sandy layer. There are few plants in this part of the river other than the occasional patches of common reed (*Phragmites australis* Cav. Trin. ex Steud., which was formerly known as *Phragmites communis* Trin.). The extremely poor vegetation cover provides a habitat that is favourable for only a few animal species. Chironomid larvae are abundant, but only occasional freshwater shrimps (*Gammarus pulex* (L.)) and alderfly larvae (*Sialis lutaria* (L.)) are to be found. The management of this section is probably the major cause of the low species abundance since the ditches draining directly into the river from West Raynham are biologically rich. In one ditch dominated by starwort, pink water speedwell and water forget-me-not, the lesser water boatman *Sigara distincta* (Fieb.) and the water snails *Anisus vortex* (L.), *Bathyomphalus contortus* (L.) and *Lymnaea peregra* (Mull.) are abundant. *Sigara distincta* is a rare species in Norfolk and it was collected on only a few occasions by one of the authors (R.J.D.) in a Broadland dyke survey.

The river leaving Raynham Park flows through grazed pastures at Helhoughton and Tatterford Commons. The depth remains in the 20-30cm range but there is a widening of the river to between seven and eight metres. The flow is fast and exposes a hard chalk bed with flints and some sand banks. The vegetation cover varies from 30 to 40 per cent with starwort, horned pondweed (*Zannichellia palustris* L.) and blanket alga (*Cladophora* sp. Kutz.) being frequent. The semi-floating *Lemna triscula* L. and the submerged spiked water milfoil (*Myriophyllum spicatum* L.) occur along this section of the Wensum. The marginal vegetation is dominated by reed-grass (*Glyceria maxima* (Hartm.) Holmberg). There is a marked increase both in the numbers and species diversity of mollusca and this section must be considered to be very favourable to the group. The white ramshorn (*Gyraulus albus* (Mull.)), the whirlpool ramshorn (*Anisus vortex*). the keeled ramshorn (*Planorbis carinatus* Mull.), the ramshorn (*Planorbis planorbis* (L.)), the nautilus ramshorn (*Armiger crista* (L.)), Jenkin's spire shell (*Potamopyrgus jenkinsi* (Smith)), the valve shell (*Valvata piscinalis* (Mull.), the wandering snail (*Lymnaea peregra*), the river limpet (*Ancylus fluviatilis* (Mull.)) and the bivalves *Sphaerium corneum* (L.) and *Pisidium nitidum* Jenyns are all common in this section. Jenkin's spire shells recorded from the Wensum and its tributaries during this survey are all of the form 'A' described by Warwick (1969). This is the form usually found in inland waterways.

The River Tat joins the Wensum at the eastern corner of Tatterford Common. The Tat is a small, slow flowing stream with a sandy, gravelly bed which is joined south of the village of Coxford by the stream from West Rudham. At Tatterford Common the vegetation forms a fairly closed community consisting mainly of starwort (possibly *Callitriche platycarpa* Kutz.), *Veronica catenata*, *Veronica beccabunga* and *Zannichellia palustris*. Trout (*Salmo* sp.) and miller's thumb (*Cottus gobio* L.) are found along this reach, as is the fish leech *Piscicola geometra* (L.). This is also one of only two sites, the other being at Hempton, where the water beetle *Haliplus wehnckei* Gerhardt was recorded during the present survey. The only other known recent records for this species in Norfolk are from drainage dykes in Broadland where it is widely distributed, although uncommon (Driscoll 1976).

At Doughton Bridge near Shereford Common there is an increase in the depth of the river to 1m and a change in the bed to a silty-mud. Starworts (probably *Callitriche stagnalis* Scop.), and fennel pondweed (*Potamogeton pectinatus* L.) are dominant, but there are occasional stands of the broad-leaved pondweed (*Potamogeton natans* L.) and the curled pondweed (*Potamogeton crispus* L.). This is the only record of *P.natans* from the present survey. Also of interest is a small growth of the opposite-leaved pondweed (*Groenlandia densa* (L.) Fourr.) which is recorded from the Wensum only upstream from Fakenham. The unbranched bur-reed (*Sparganium emersum* Rehm.) is first noted at Doughton Bridge and it forms a major part of the submerged vegetation at some of the sample sites further downstream. Over short distances the river near Shereford varies from a silty bed to one of chalk and flints. Many of these changes may be associated with the first major man-made barrier across the river in the form of a disused working mill and weir at Sculthorpe.

The influence of man upon the river is seen as it approaches the outskirts of Fakenham. At Hempton a straightening programme has been combined with a rigorous cutting of the weeds to produce a sparce flora, the muddy bottom being virtually covered with algae (*Cladophora* sp. and *Enteromorpha* sp. Link in Nees). Other aquatics include Canadian pondweed (*Elodea canadensis* Michx.), fool's watercress (*Apium nodiflorum*), *Zannichellia palustris* and *Groenlandia densa*, but these show an uneven distribution. The marginal vegetation provides an important habitat for the Dytiscid beetle *Ilybius fuliginosus* (Fab.) and the Haliplid beetles *Haliplus fluviatilis* Aube, *Haliplus wehnckei* and *Haliplus laminatus* (Schaller). The water-measurer *Hydrometra stagnorum* (L.) and the riffle beetle *Oulimnius tuberculatus* (Muller, P. W. J.) are found in small numbers in the same sheltered habitat. The riffle beetle normally prefers large rivers with unstable stony beds so its presence in this slow flowing and muddy reach of the Wensum is surprising. The flour mill at Fakenham affords a barrier which controls both water levels and flow in the immediate vicinity. Above the mill the depth increases to 1.5 to 2.0m and the water flow is effectively slowed down. The macrophytes include the yellow water lily (*Nuphar lutea* (L.)) which is a characteristic plant of the deeper waters of the Wensum, especially near the mills and weirs.

The section of the river from Fakenham to Great Ryburgh is bounded for most of its length by railway embankments and common land. The river valley is fed by numerous springs and ditches to form, especially near Fakenham and Great Ryburgh, a highly managed system of water meadows and land drains, some of which are at a lower level than the river itself. A similar situation is found in Broadland, where pumps are used to raise water from the dykes draining the low-lying marshes before emptying it into the higher level river system. In the Wensum valley, however, pumps are not used. Instead water from the smaller field drains is fed into a system of larger dykes, the main drains, which run sub-parallel to the river and follow its course downstream until a weir is reached. The main drains enter the river downstream of the weirs where the river is at a lower level than the water in the dykes. In this way gravity flow can be used to drain the land without the use of pumps and sluices. At Great Ryburgh a main drain carrying effluents from a maltings on the west side of the Wensum flows under the river to join the main drain on the east side at Little Ryburgh. The organically enriched water from the maltings supports a significantly lower diversity of flora than that found in adjacent dykes.

The Wensum, except near the mill at Great Ryburgh, is comparatively shallow (less than 1m), moderately fast flowing and with a mixed bed of sand, gravel, stones, silt and mud. The flora is generally rich and varied, although it is limited in the muddier places where *Cladophora* sp., *Enteromorpha* sp. and *Potamogeton pectinatus* are often co-dominants. The rooted aquatics include *Potamogeton crispus*, *Veronica catenata*, *Elodea canadensis*, *Potamogeton perfoliatus* L., *Potamogeton pusillus* L., *Sparganium emersum*, *Myriophyllum spicatum* and *Callitriche* sp. Floating aquatics at the more sheltered margins include the duckweeds *Lemna minor* L. and *Lemna polyrhiza* L. The swifter flowing reaches near the railway bridge crossings often have small colonies of the frog's spawn alga *Batrachospermum boryanum* (Ag. ?) Sirodot attached to the stones and rubble. Pike, dace, roach, trout, eels and minnows are found in the river. Examination of gut contents of trout caught by fishermen in this stretch of the Wensum in 1975 revealed the remains of mayfly larvae, alderfly larvae, the crustaceans *Asellus aquaticus* (L.), *Asellus meridianus* Racovitza and *Gammarus pulex*. Occasional leeches (*Erpobdella octoculata* (L.)) in the trout guts suggest that the encysted stage of a fluke noted in the leech may use the fish as a second host. Other common leeches noted at Great Ryburgh include the waterfowl leech *Theromyzon tessulatum* (Mull.) and the freshwater molluscan leech *Glossiphonia complanata* (L.). The latter species is a major predator of freshwater snails, especially *Physa fontinalis* (L.) which is a common snail in the Wensum. Of special interest is the observation of the cnidarian *Hydra oligactis* (Pallas) with the commensal rotifer *Pleurotrocha petromyzon* Ehrenberg on its surface.

The river adjacent to Sennowe Park is fairly fast flowing over sand, though occasional chalky stones occur. It is fringed on the north by alder-willow carr and on the south by water meadows or mixed *Filipendula ulmaria* (L.) Maxim. and *Epilobium hirsutum* L. fen. The vegetation cover within the river is over 50 per cent with *Potamogeton pectinatus* the most abundant species and *Sparganium emersum* and *Elodea canadensis* locally abundant. The presence of the introduced species *Elodea nuttallii* (Planch) was noted neither in the Wensum nor its tributaries during the present survey, although the related species *Elodea canadensis* is common everywhere. Swann (1978) considers that in time the latter species will be superseded by the closely related *E. nuttallii*. The bank vegetation is largely dominated by nettles (*Urtica dioica* L.) and the marginals *Iris pseudacorus* L. and *Myosotis scorpioides*. Bivalve molluscs are frequent in this stretch of the river and include *Sphaerium corneum*, *Pisidium nitidum* and *Pisidium milium* Hedw.. *Pisidium milium* is generally distributed throughout the British Isles and occurs in similar habitats to *Pisidium nitidum*.

The river by Guist Bridge is similar to that at Sennowe Park, although on its northern bank it is fringed by an extensive area of *Glyceria maxima* at Guist Common. To the south-east of the bridge there is a specimen of black poplar (*Populus nigra* L.) which proved to be the only one noted in this survey.

The importance of mills and their associated weirs in affecting the character of the river is well illustrated at Bintree Mill. Above the mill the waters are comparatively still and deep. The river bed is sandy with mud. The vegetation includes *Elodea canadensis*, *Nuphar lutea*, *Potamogeton crispus*, *Potamogeton perfoliatus*, *Zannichellia palustris* and *Sparganium emersum*. Patches of the green alga *Enteromorpha* sp. occur and in the sheltered parts there are surface mats of *Spirogyra sp.* Link and the blue-green alga *Oscillatoria* sp. Vauch.. The giant

River Tat at Tatterford Common

Fakenham Mill, River Wensum

Swanton Morley, River Wensum

pond snail (*Lymnaea stagnalis* (L.)) and Lister's river snail (*Viviparus contectus* Millet) are frequent in these deeper waters. Below the mill race the river cuts a deep valley into the chalk where it exposes a bed of chalky stones and flints. The rapid flow is favourable only to the blanket alga which forms dense mats on the stones and flints. About 100m below the mill the flow slackens and the river meanders across water meadows. The bed changes to a sandy, chalky form and the blanket alga is progressively replaced by aquatic macrophytes, mainly *Potamogeton perfoliatus*, *Potamogeton crispus*, *Callitriche* sp. and *Myriophyllum spicatum*. At North Elmham the river is still fairly fast flowing over a sandy-silty bottom. The water meadows on either side of the river become narrower in this section. Those on the Elmham side give good quality grazing grass but those on the opposing bank are rough with thistles and ragwort. The dominant aquatic plant is *Potamogeton perfoliatus*, although blanket alga is abundant over this section, as it is elsewhere in the system. The marginal *Glycerietum* is important in forming microhabitats for invertebrates. The pond skater *Gerris lacustris* (L.) and the whirligig beetle *Gyrinus aeratus* Stephens are favoured by the sheltered waters in the marginal vegetation. *Crangonyx pseudogracilis* Bousfield, an amphipod introduced from North America and first recorded from Great Britain in the 1930's (Crawford 1937), was not recorded from any of the samples upstream from North Elmham, although it is widely distributed in the river between North Elmham and Lyng. In contrast *Gammarus pulex*, the native species of amphipod typical of freshwater, is ubiquitous in the upper Wensum and its tributaries. Elsewhere in Great Britain *C. pseudogracilis* is still spreading and in time it may colonize the upper reaches of the Wensum.

The influence of mills on lowland river systems is again evident as the river broadens and deepens in its approach to Grint Mill. Yellow water lilies are favoured by the deeper waters and slower currents and they in turn act to slow the currents down even further to allow many of the smaller invertebrates to flourish. At Grint Mill the cladocerans *Eurycercus lamellatus* (Mull.) and *Simocephalus vetulus* (Mull.) are locally abundant, whilst the copepods *Cyclops agilis* (Koch, Sars) and *Cyclops distinctus* (Richard) are frequent. The water-measurer *Hydrometra stagnorum* is also common in these quieter waters above the mill.

The Wensum at its confluence with the Whitewater is fast flowing over a gravel bottom. A feature of this section is the presence of low islands which are liable to flooding. Both *Ancylus fluviatilis* and *Ephemerella ignita* are abundant within this section and stone loach are common amongst the weeds and stones. Of particular interest is the presence here of the calcicole bivalve *Pisidium moitessierianum* Paladilhe which was first recorded from West Norfolk (V.C.28) by Kerney at Gressenhall in 1970. This bivalve is known only from three other sites in Norfolk; Whitlingham marshes, Belaugh on the Bure and the Great Ouse (Kerney pers.comm.). Between Billingford and Waterfall Farm, Swanton Morley the Wensum flows alongside the road at Burgh Common where it is over 2m deep and 8m wide, fast flowing and silty. East of Burgh Common there are gravel workings which are important sites for Canada geese and other water fowl. In the river the major macrophytes are *Potamogeton perfoliatus*, *P. pectinatus*, *Sparganium emersum* and *Myriophyllum spicatum*. Blanket alga is abundant everywhere along this section. Above the mill at Waterfall Farm summer cutting of the weeds exposed *Zannichellia palustris*, *Sagittaria sagittifolia* L. and the free floating horn-wort (*Ceratophyllum demersum* L.). An interesting plant of the bank vegetation at this site is nodding bur-marigold (*Bidens cernua* var. *radiata* D.C.) which forms an attractive addition to the community. In the river a number of lesser waterboatmen (*Sigara dorsalis* (Leach)) carried parasitic watermite larvae, probably *Hydrachna globosa globosa* (Geer), which in some seasons in the River Yare show very heavy infestations on the water bugs. Several damsel and dragonflies quarter this stretch of the river. An adult *Ischnura elegans* (van der Linden) and an adult *Aeshna grandis* (L.) were noted over the river in September 1977, whilst two specimens of *Sympetrum striolatum* (Charpentier) were observed mating over a nearby dyke. The caddis fly larva *Molanna angustata* Curtis occurs in the sandy gravels of the shallower areas near the mill. This species is reported by Daniels (1958) to be quite common on the Wensum Bridges from May to September.

At Waterfall Farm there is a mill bypass stream and some dykes which are of considerable biological interest.

The river between Castle Farm and Elsing Mill was examined in some detail by boat. For most of its length this section is similar in form, except that as Elsing Mill is approached the flow slackens and the water deepens. The dominant macrophytes are *Potamogeton perfoliatus*, *P.pectinatus*, *Sagittaria sagittifolia* and blanket alga. The only stand of mare's tail (*Hippuris vulgaris* L.) noted in this survey occurs at Castle Farm. The influence of the mill may be seen as the dominance of the pondweeds gives way to *Sparganium emersum*, *Sagittaria sagittifolia*, *Enteromorpha* sp. and *Nuphar lutea* as the weir is approached and the water deepens. The yellow water lily is present mainly in the submerged form in depths over 2m. Besides the common mayfly larvae *Ephemerella ignita*, *Cloeon dipterum* (L.) and *Baetis rhodani.* Castle Farm is of considerable interest for the presence of larvae of *Caenis robusta* Eaton, which has been noted previously in Norfolk from Wheatfen Broad and Scoulton Mere. Both these sites lack any appreciable water movement but the larvae have been collected from slowly flowing water in the River Ijssel (Kimmins 1972). Another interesting species noted at Castle Farm is the leech *Glossiphonia heteroclita* (L.) which was not recorded elsewhere during the present survey.

From Elsing Mill to Lyng Mill the sequence of conditions is repeated with a fairly fast flowing section below Elsing becoming slow flowing and deeper near Lyng with subsequent silting of the bed. The macrophytes associated with this part of the river are similar to those above Elsing Mill. Near the bridge *Fontinalis antipyretica* and *Ceratophyllum demersum* are more frequent and more widely distributed. An interesting find above Lyng was Leach's Bythinia (*Bythinia leachii* (Sheppard)) which, although known to be widely distributed both in Norfolk and England, was not found elsewhere during this survey. The Wensum between Elsing and Lyng flows through grazing meadows and extensive old gravel workings now used as trout fisheries. The bypass at Lyng flows over a sluice into a small millpool before forming a fairly fast flowing stream which discharges back into the river in the main pool below the mill. The brickwork of the sluice is colonized by the aquatic moss *Fissidens crassipes* Wils., which was first recorded from East Norfolk by the British Bryological Society in 1967 at Lyng, and the liverwort *Conocephalum conicum* (L.) Underw.. On a shingle bank by the pool an open community contained seventeen species of flowering plants which included the only record of Policeman's helmet (*Impatiens glandulifera*

Royle). This balsam was more frequent in the bank community at this same site.

The Whitewater

The Whitewater forms a major tributary which enters the Wensum below Billingford Bridge. For much of its course it is fast flowing over a gravelly-stony bottom, although in some reaches mud and silt predominate. Botanically the river offers a wide variety of interesting species, including river water-dropwort (*Oenanthe fluviatilis* (Bab.) Colem.) and *Ranunculus peltatus* Schrank. The latter species was identified from its flowers but at other sites only non-flowering material was available which could not be identified with certainty. Algae present include *Enteromorpha intestinalis* (L.) Link and *Cladophora glomerata* (L.) Kutz, although the shallow waters and the speed of flow restricts the latter species to small threads attached to the stones. *Vaucheria sessilis* (Vauch.) DC. was identified by Mr. K. B. Clarke from sexually active filaments and the red alga *Bangia atropurpurea* (Roth) C.Ag. was provisionally identified. Mr. Clarke notes, 'I know this alga from the River Bure at Horning where it is fairly extensive. This is an estuarine species but as it has been reported from Lake Balaton I see no reason why it should not occur occasionally in the Wensum valley'.

The fauna is rich both in numbers and species diversity. Crayfish (*Austropotamobius pallipes* (Lereboullet)) are very common and may readily be collected by running a net through the semi-aquatic marginal vegetation. Mayfly larvae include the rare *Caenis robusta, Baetis rhodani, Ephemerella ignita* and *Ephemera danica* Mull.. The latter species favours rather fast flowing streams with alkaline waters and in the present survey it was recorded elsewhere only from Penny Spot Beck. Widely distributed along the Whitewater are three species of riffle beetles, *Elmis aenea, Oulimius tuberculatus* and *Liminius volckmari* (Panzer), although nowhere are they common. The only Norfolk record for the pond skater *Gerris rufoscutellatus* (Latr.) was made by Mr. K. C. Durrant in March 1948 in a pit bordering the river at Hoe Common. Over a two week period a total of seven fully winged individuals were noted. Unfortunately the pit has now been infilled by the local authority as a rubbish dump.

The Blackwater

The source of the Blackwater may be found in a series of ditches to the east of the village of Mileham. The high land on which this village is built provides the source of the River Nar in the west. The Blackwater derives its name from a corruption of the Old English 'Blaec' meaning shining. It is a name often given to dark muddy waters or those produced from a dark river bed. The name is sometimes used in contradiction to a sister stream, the Whitewater. *Callitriche* sp., *Sparganium emersum, Zannichellia palustris, Myosotis scorpioides* and *Veronica catenata* form small patches of vegetation but rarely are closed communities formed. Lampreys are generally found in this river and they were especially common in 1972 (K. C. Durrant pers. comm.). Other common fish include the three spined stickleback (*Gasterosteus aculeatus* L.) and the miller's thumb. The three spined stickleback is everywhere more common than the nine-spined stickleback (*Pungitius pungitius* (L.)) and it prefers the fast flowing stretches of water with high oxygen content. In contrast the nine-spined stickleback is more tolerant of lower oxygen levels in the water (Lewis *et al* 1972). *Brychius elevatus* (Panzer) was first recorded in the Blackwater by R. W. Turner in 1954 at Beetley and in the present survey it showed a local distribution in the river. A second Haliplid beetle of interest noted in the river is *Haliplus lineatocollis* (Marsham) which in the slow moving waters is locally distributed and rare; this contrasts with its wide distribution and frequency in Broadland ditches (Driscoll 1976). The pond skater (*Gerris lacustris*) and the lesser waterboatman *Hesperocorixa linnei* (Fieb.) occur near the junction with the Whitewater.

The marshes and marginal areas of the Blackwater provide very good habitats for insects, particularly *Sciomyzid* flies. The demoiselle *Agrion virgo* (L.) was first taken in 1946 at the edge of a small pond near the river (Durrant 1958). The margins are also regular sites for *Agrion splendens* (Harr.).

Penny Spot Beck

This is a small fast flowing stream with a bed partly of pebbles with tufa deposits. For much of its length it lacks macrophytes, although *Pellia endiviifolia* encrusts many of the stones. The marginal vegetation includes narrow-leaved water parsnip (*Berula erecta* (Huds.) Coville) which was not found elsewhere during the survey.

Dykes

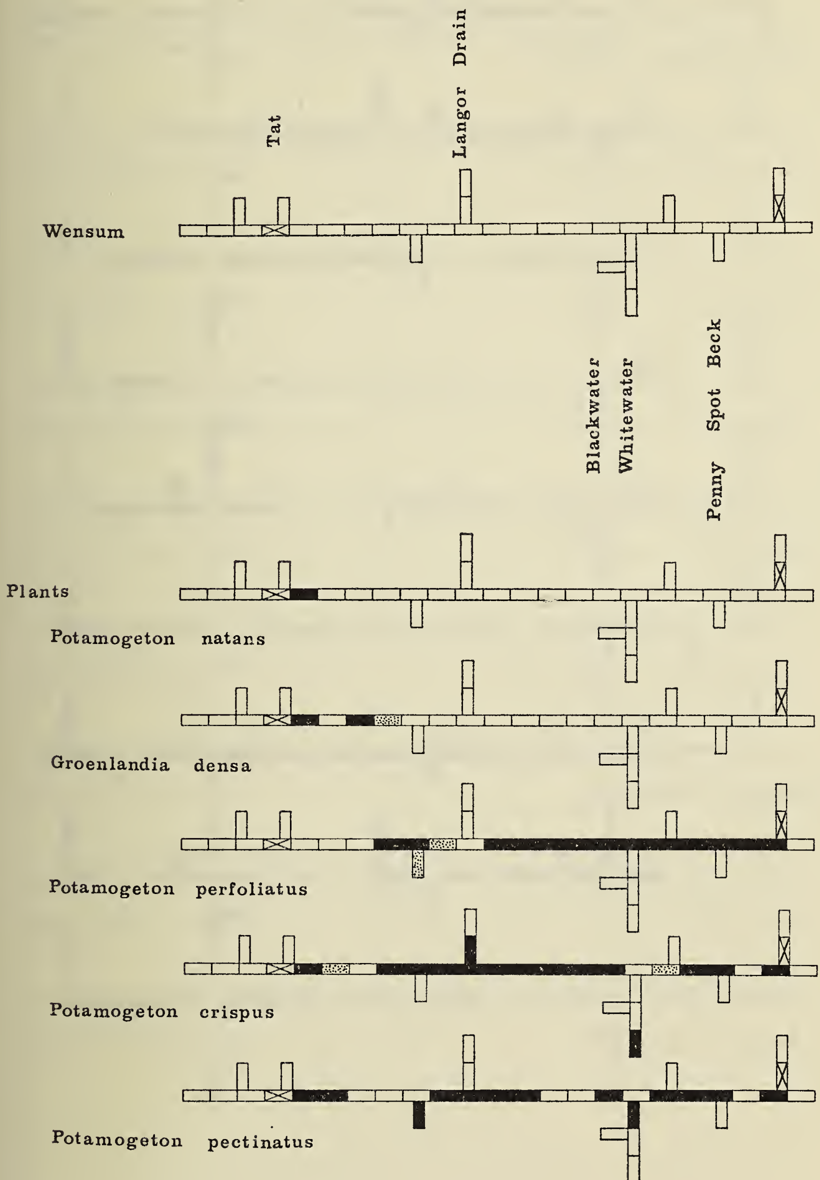
The dykes draining the land adjacent to the Wensum and its tributaries are of two types: the smaller dykes, whose maintenance is the responsibility of the land owner or tenant whose land they drain, and the larger main drains which are the responsibility of the River Wensum Internal Drainage Board. Most of the dykes sampled in this survey were of the second type. The dyke vegetation is similar to that of the river, although their reduced width and depth favours the growth of emergent and marginal species, e.g. *Veronica* spp., *Myosotis scorpioides*, *Rorippa nasturtium-aquaticum* agg. and *Glyceria maxima*. Many of the dykes examined were virtually overgrown with plant life.

A major difference between these dykes and those found in Broadland is the almost complete absence of *Phragmites australis* in this part of the Wensum valley, where its place is taken by *Glyceria maxima*. In Broadland dykes *Phragmites australis* is the commonest and most widely distributed species of macrophyte, often forming pure stands in dykes draining arable land (Driscoll 1975). The invertebrate fauna was similar to that of the river, although in general the density of animals was higher.

Dyke Management

Dyke maintenance involves the removal of vegetation and accumulated mud and detritus to improve the flow of water along the dyke. The equipment used by the Internal Drainage Board consists of tractor mounted scoops which are dragged across the bottom of the dykes. Whilst these scoops remove most of the vegetation and some of the accumulated mud, a considerable amount of rhizomes and turions is left behind and regeneration of the vegetation rapidly takes place. Periodic clearing of this form prevents the taller emergent species totally filling the dykes and shading out the smaller species. The scoop and drag method used at present is beneficial in maintaining the diversity of the plant communities.

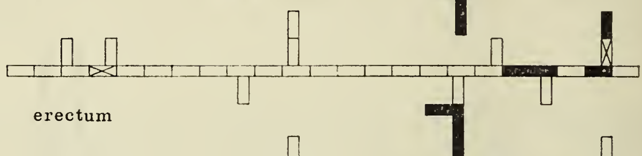
Fig. 2. Examples of the distribution patterns of selected species throughout the upper Wensum valley river system surveyed in 1976-77. The diagrams are based on presence or absence data for 2 km stretches of the river upstream from Lyng. Key: black-present; white-absent; stippled-detached plants or dead animals; crossed-not sampled.



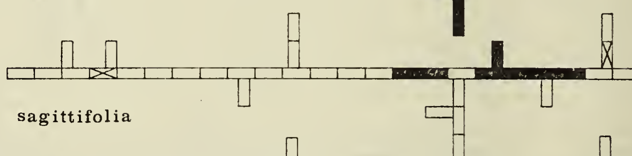
Myriophyllum spicatum

Zannichellia palustris

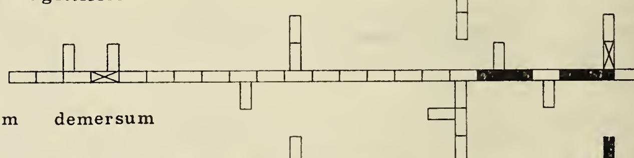
Sparganium emersum



Sparganium erectum



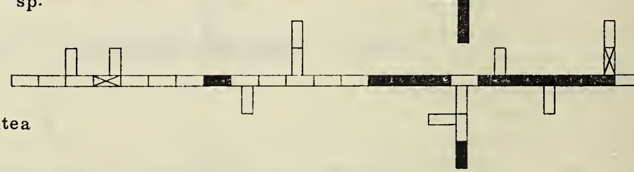
Sagittaria sagittifolia



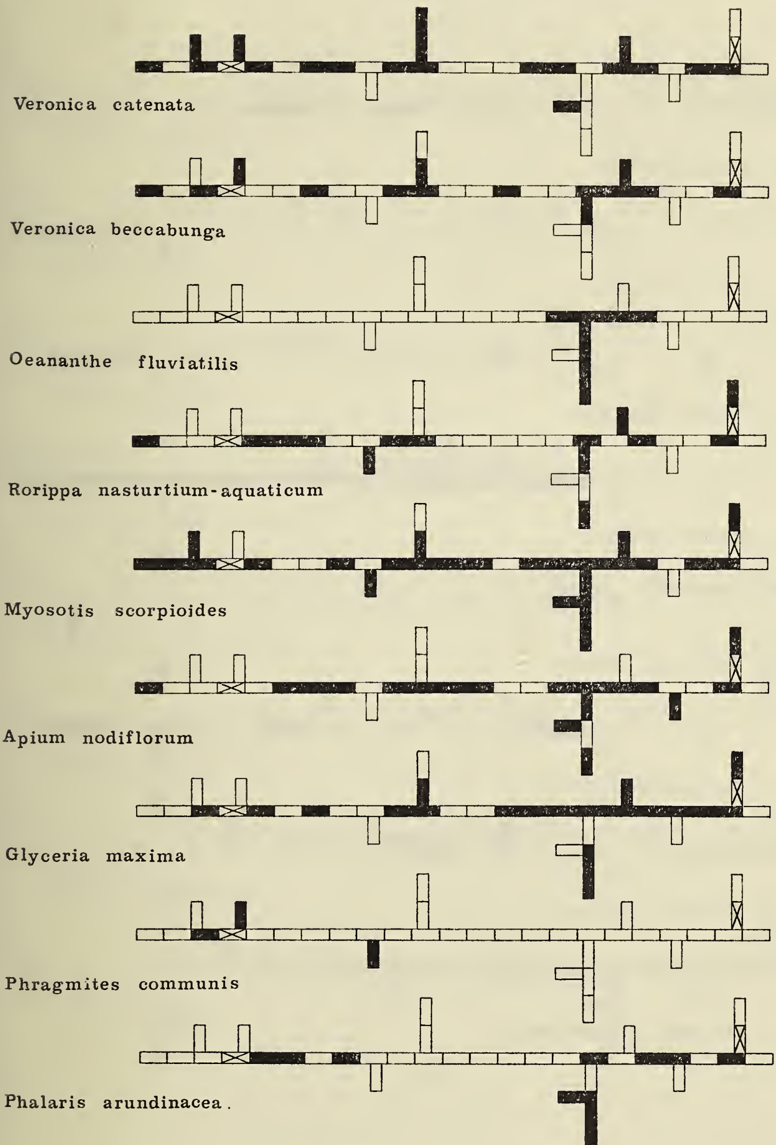
Ceratophyllum demersum

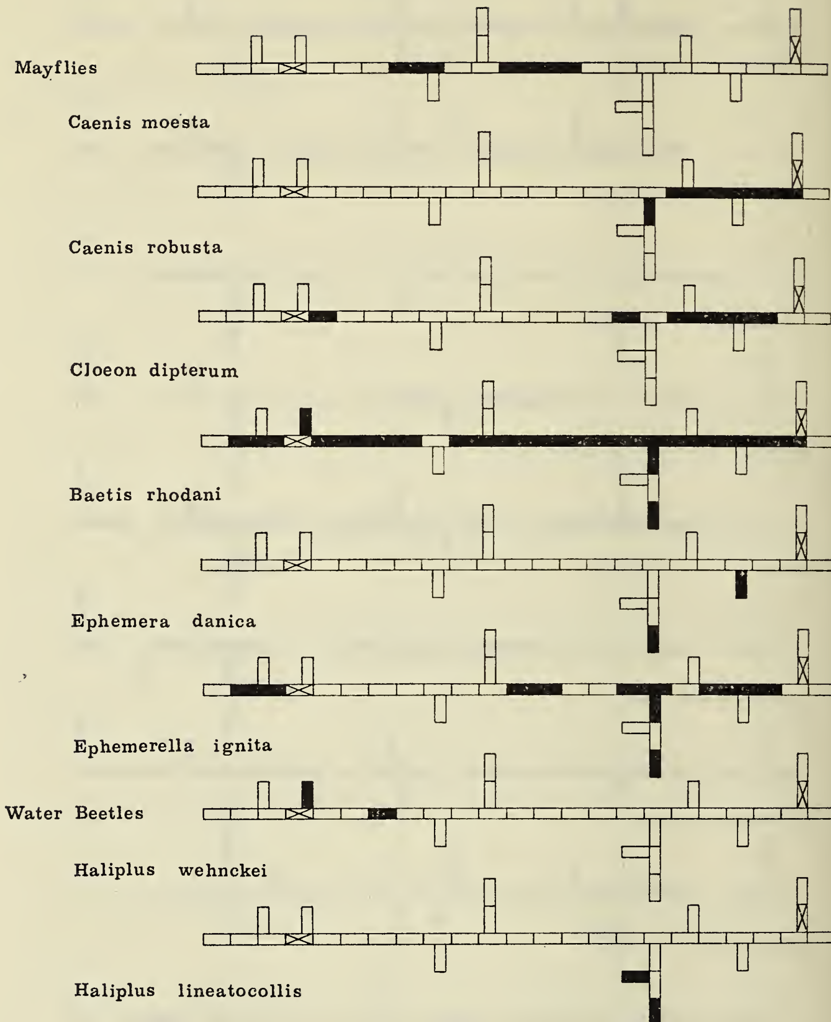
Elodea canadensis

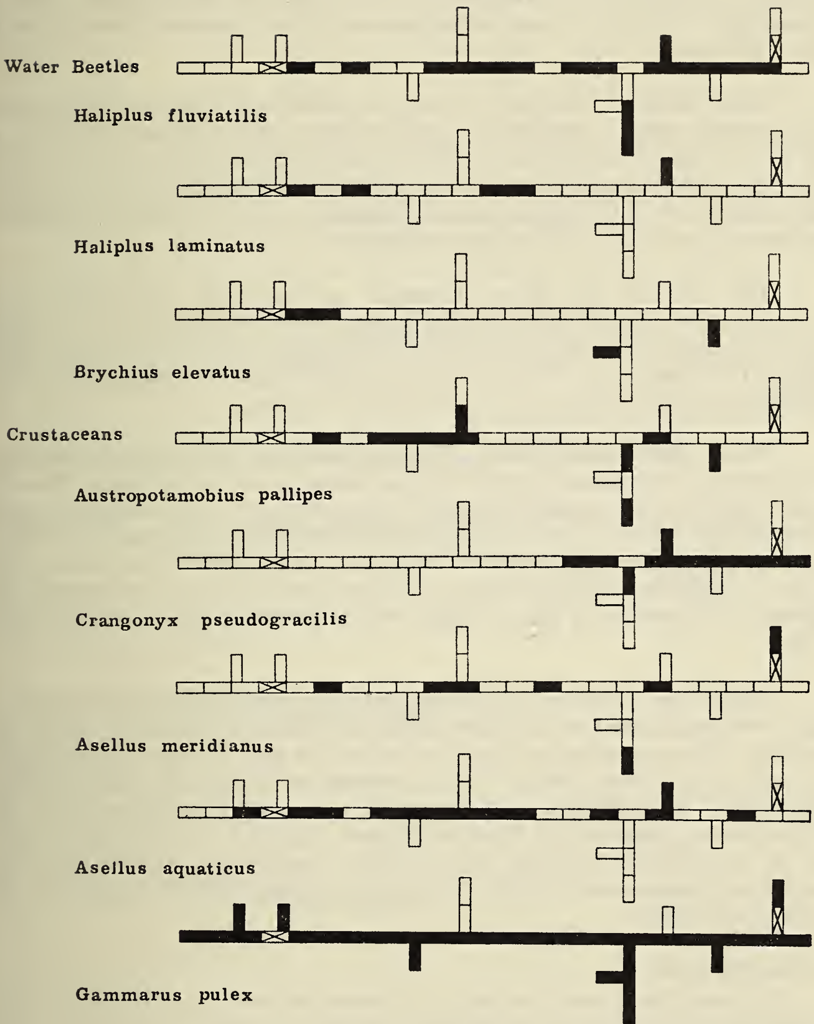
Callitriche sp.



Nuphar lutea


Veronica catenata
Veronica beccabunga
Oeananthe fluviatilis
Rorippa nasturtium-aquaticum
Myosotis scorpioides
Apium nodiflorum
Glyceria maxima
Phragmites communis
Phalaris arundinacea.


Mayflies
Caenis moesta
Caenis robusta
Cloeon dipterum
Baetis rhodani
Ephemera danica
Ephemerella ignita
Water Beetles
Haliplus wehnckei
Haliplus lineatocollis


Water Beetles
Haliplus fluviatilis
Haliplus laminatus
Brychius elevatus
Crustaceans
Austropotamobius pallipes
Crangonyx pseudogracilis
Asellus meridianus
Asellus aquaticus
Gammarus pulex

Sites of Natural History Interest

Sculthorpe Moor and Fen. An extremely interesting site west of Fakenham where *Phragmites-Cladium* reed swamp with sallow-alder carr form extensive closed communities. The intermix of water-logged fen and drainage ditches is botanically rich and in need of survey since little is known about either its flora or fauna.

Great Ryburgh Common. An area of sallow-alder carr with *Phragmites-Glyceria* fen which is bisected by a main drainage ditch. *Epilobium angustifolium* L. forms locally dominant stands. The common is fringed with pine and oak and in some sandy clearings *Succisa pratensis* Moench, *Potentilla erecta* (L.) Rausch. and *Rumex tenuifolis* (Wallr.) Love are common. The site is extremely difficult to traverse and worthy of further investigation.

Turf Common and Broom Common. An interesting complex of water meadows with shallow dykes and alder copses. Near Well House there is a small field dominated by common reed, reed-grass, tussock sedge and the giant water dock. The management of the land is not intensive and in consequence it combines both scenic beauty and a natural history interest.

White Mill Meadow, Beetley. This large meadow slopes down to the River Whitewater and possesses a series of active springs on the upper slopes. The habitats range from dry neutral grassland to bryophyte rich mires along the spring line. In July the drier areas are a blaze of colour from the meadow saxifrage (*Saxifraga granulata* L.), whilst in the wetter sites bogbean (*Menyanthes trifoliata* L.) and red-rattle (*Pedicularis palustris* L.) are common. Of particular interest is the presence of green winged orchids (*Orchis morio* L.) on the eastern side.

Gravel Pits. Deposits of valley gravels have been excavated from many of the river terraces and in time these flood and become colonized by plants and animals. They are important habitats for bird life and deserve to be made into a study in their own right. In 1977 the vegetation of Sparham Pits, a Norfolk Naturalists' Trust Reserve, was mapped by a team of ecologists as part of the Government sponsored Job Creation Scheme. Although the bottom was found to be very irregular the depth of water rarely exceeded 2m. Aquatic vegetation and invertebrates were virtually restricted to a single shallow area at the west side of the reserve.

Acknowledgements

We would like to thank the many land owners and farmers who kindly allowed us access to the river valley. We are indebted to Messrs E. L. Swann, K. C. Durrant, K. B. Clarke and G. N. Foster for help in identification and information about the natural history of the Wensum valley; M. P. Kerney for information about *Pisidium moites sierianum* and T. Warwick for examining some of the *Potamopyrgus jenkinsi* material.

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APPENDIX 1. List of plants recorded during 1976-77 in River Wensum survey.

SPECIES	HABITAT		
Angiospermae	*A*	*E*	*B*
Aegopodium podagraria L.			*
Agrostis stolonifera L.			*
Alisma plantago-aquatica L.		*	
Alliaria petiolata (Bieb.) Cavara & Grande ..			*
Alnus glutinosa (L.) Gaertn.		*	*
Apium nodiflorum (L.) Lag.		*	
Atriplex sp. L.N			*
Berula erecta (Huds.) Coville		*	
Bidens cernua L.		*	
Bidens cernua var. radiata DC.		*	
Brachypodium sylvaticum (Huds.) Beauv. ..			*
Callitriche platycarpa Kutz. ?	*		
Callitriche stagnalis Scop. ?	*		
Callitriche sp. L.	*	*	
Cardamine amara L.		*	
Carex ripara Curt.		*	
Carex sp. L.		*	
Ceratophyllum demersum L.	*		
Chrysosplenium oppositifolium L.			*
Circaea lutetiana L.			*
Cirsium arvense (L.) Scop.			*
Cirsium vulgare (Savi) Ten.			*

Cirsium sp. Mill.			*
Crataegus monogyna Jacq.			*
Dactylis glomerata L.			*
Elodea canadensis Michx.	*		
Epilobium angustifolium L.			*
Epilobium hirsutum L.		*	*
Epilobium parviflorum Schreb.		*	*
Epilobium sp. L.			*
Eupatorium cannabinum L.		*	*
Fagus sylvatica L.			*
Filipendula ulmaria (L.) Maxim.			*
Fraxinus excelsior L.			*
Geranium robertianum L.			*
Geum rivale L.			*
Glyceria fluitans (L.) R.Bt.		*	
Glyceria maxima (Hartm.) Holmberg		*	*
Groenlandia densa (L.) Fourr.	*		
Hippuris vulgaris L.	*		
Holcus lanatus L.			*
Impatiens glandulifera Royle			*
Iris pseudacorus L.		*	
Juncus effusus L.			*
Juncus inflexus L.		*	
Lamium album L.			*
Lapsana communis L.			*
Lemna minor L.	*		
Lemna polyrhiza L.	*		
Lemna trisculca L.	*		
Mentha aquatica L.		*	
Mentha sp. L.			*
Mercurialis perennis L.			*
Mimulus sp.L.			*
Myosotis scorpioides L.		*	
Myosoton aquaticum (L.) Moench			*
Myriophyllum spicatum L.	*		
Myriophyllum sp. L.	*		
Nuphar lutea (L.) Sm.	*		
Oenanthe fluviatilis (Bab.) Colem.	*		
Phalaris arundinacea L.		*	*
Phragmites australis (Cav.) Trin. ex Steud.		*	*
Poa annua L.			*
Polygonum amphibium L.		*	
Polygonum persicaria L.			°
Populus sp. L.			*
Potamogeton crispus L.	*		
Potamogeton natans L.	*		
Potamogeton pectinatus L.	*		
Potamogeton perfoliatus L.	*		
Potamogeton pusillus L.	*		

Potamogeton pusillus L. ?	*		
Potentilla anserina L.			*
Prunus spinosa L.			*
Pulicaria dysenterica (L.) Bernh.			*
Ranunculus aquatilis L. ?	*		
Ranunculus fluitans Lam. ?	*		
Ranunculus peltatus Schrank	*		
Ranunculus repens L.			*
Ranunculus sceleratus L.		*	
Ranunculus sp. L.	*		
Rorippa nasturtium-aquaticum agg.		*	
Rosa canina L.			*
Rubus fruticosus agg.			*
Rumex conglomeratus Murr.			*
Rumex crispus L.			*
Rumex obtusifolius L.			*
Rumex sanguineus L.			*
Sagittaria sagittifolia L.	*	*	
Salix alba L.			*
Salix sp. L.			*
Sambucus nigra L.			*
Scirpus lacustris L.		*	
Scirpus sp. L.		*	
Scrophularia auriculata L.			*
Senecio jacobaea L.			*
Solanum dulcamara L.			*
Sonchus arvensis L.			*
Sonchus asper (L.) Hill			*
Sparganium emersum Rehm.	*		
Sparganium erectum L.		*	
Stachys palustris L.		*	
Torilis japonica (Houtt.) DC. ?			*
Tripleurospermum maritimum (L.) Koch			*
Urtica dioica L.			*
Veronica beccabunga L.		*	
Veronica catenata Pennell		*	
Zannichellia palustris L.	*		
Musci			
Fontinalis antipyretica Hedw.	*		
Fissidens crassipes Wils.	*		
Unidentified	*		
Hepaticae			
Pellia endiviifolia Dicks.	*	*	
Conocephalum conicum (L.) Underw.	*	*	*
Algae			
Bangia atropurpurea (Roth) C.Ag. ?	*		
Batrachospermum boryanum (Ag, ?) Sirodot	*		

Cladophora glomerata (L.) Kutz.	*		
Cladophora glomerata (L.) Kutz.?	*		
Cladophora sp. Kutz.	*		
Enteromorpha intestinalis (L.) Link ..	*		
Enteromorpha sp. Link in Nees	*		
Oscillatoria sp. Vauch.	*		
Spirogyra sp. Link	*		
Spirogyra sp. Link?	*		
Vaucheria sessilis (Vauch.) DC.	*		
Unidentified	*		
Number of species of macrophyte & bryophyte	24	31+	56
Number of species of alga	7	0	0
Number of species of macophyte, bryophyte & alga	31	37+	56

Total number of species of macrophyte & bryophyte	99+
Total number of species of alga	7
Total number of species of macrophyte, bryophyte & alga	106+

A submerged and floating flora

B emergent and marginal flora

E bank flora

+ excluding one variety

APPENDIX 1a. List of animals recorded during 1976-77 in River Wensum survey.

Phylum *Porifera*
  Ephydatia fluviatilis (L.)
Phylum *Cnidaria*, Class Hydrozoa
  Hydra oligactis (Pallas)
Phylum *Platyhelminthes*, Class *Turbellaria*
  Polycelis nigra (Mull.)
  Polycelis sp.
  Dugesia polychroa (Schmidt)
  Dendrocoelum lacteum (Mull.)
Phylum *Aschelminthes*, Class *Rotifera*
  Pleurotrocha petromyzon Ehrenberg
Phylum *Mollusca*, Class *Gastropoda*
  Viviparus contectus (Millet)
  Valvata cristata Mull.
  Valvata piscinalis (Mull.)
  Potamopyrgus jenkinsi (Smith)
  Bithynia tentaculata (L.)
  Bithynia leachii (Sheppard)
  Physa fontinalis (L.)
  Lymnaea peregra (Mull.)
  Lymnaea stagnalis (L.)
  Planorbis planorbis (L.)
  Planorbis carinatus Mull.
  Anisus leucostoma (Millet)
  Aniscus vortex (L.)
  Bathyomphalus contortus (L.)
  Gyraulus albus (Mull.)
  Armiger crista (L.)
  Ancylus fluviatilis Mull.
Class *Lamellibranchia*
  Anodonta cygnea (L.)
  Anodonta sp.
  Sphaerium corneum (L.)
  Pisidium milium Held
  Pisidium nitidum Jenyns
  Pisidium moitessierianum Paladilhe
  Pisidium sp.
Phylum *Annelida*, Class *Oligochaeta*
  Unidentified
Phylum *Annelida*, Class *Hirudinea*
  Piscicola geometra (L.)
  Theromyzon tessulatum (Mull.)
  Glossiphonia complanata (L.)
  Glossiphonia heteroclita (L.)

Helobdella stagnalis (L.)
Erpobdella octoculata (L.)

Phylum *Arthropoda*, Class *Crustacea*

Eurycercus lamellatus (Mull.)
Simocephalus vetulus (Mull.)
Cyclops agilis (Koch, Sars)
Cyclops distinctus (Richard)
Asellus aquaticus (L.)
Asellus meridianus Racovtza
Crangonyx pseudogracilis Bousfield
Gammarus pulex (L.)
Austropotamobius pallipes (Lereboullet)

Class *Insecta*

Baetis rhodani (Pictet)
Cloeon dipterum (L.)
Ephemerella ignita (Poda)
Ephemera danica Mull.
Caenis moesta Bengtsson
Caenis robusta Eaton
Caenis sp. Stephens
Ischnura elegans (van der Linden)
Coenagrion sp. Kirby
Aeshna grandis (L.)
Sympetrum striolatum (Charpentier)
Hydrometra stagnorum (L.)
Gerris lacustris (L.)
Nepa cinerea L.
Notonecta glauca L.
Corixa punctata (Illinger)
Hesperocorixa linnei (Fieb.)
Sigara dorsalis (Leach)
Sigara distincta (Fieb.)
Sigara falleni (Fieb.)
Corixidae (unidentified)
Sialis lutaria (L.)
Limnephilidae (unidentified)
Molanna angustata Curtis
Brychius elevatus (Panzer)
Haliplus fluviatilis Aube
Haliplus laminatus (Schaller)
Haliplus lineatocollis (Marsham)
Haliplus wehnckei Gerhardt
Haliplus sp. Latreille
Laccophilus hyalinus (Degeer)
Potamonectes depressus (Fab.)
Agabus bipustulatus (L.)
Ilybius ater (Degeer)
Ilybius fuluginosus (Fab.)
Gyrinus aeratus Stephens
Gyrinus natator (L.)
Helophorus sp. Illiger
Elmis aenea (Muller, P. W. J.)
Limnius volckmari (Panzer)
Oulimnius tuberculatus (Muller, P. W. J.)
Dicranota sp. Zetterstedt
Rheotanytarsus sp. Bause
Chironomidae (unidentified)
Simulium aureum species group
Simulium erythrocephalum (De Geer)
Simulium ornatum Meigen

Class *Arachnida*

Hydrachna globosa globosa (Geer)
Sperchon squamosus squamosus Kramer
Lebertia insignis insignis Meuman
Limnesia maculata maculata (Mull.)
Hygrobates fluviatilis (Strom)
Hygrobates longipalpis (Hermann)

Phylum *Chordata*, Class *Osteichthyes*

Salmo trutta L.
Salmo gairdneri Richardson
Esox lucius L.
Phoxinus phoxinus (L.)
Rutilus rutilus (L.)
Leuciscus leuciscus (L.)
Noemacheilus barbatulus (L.)
Anguilla anguilla (L.)
Gasterosteus aculeatus L.
Pungitius pungitius (L.)
Cottus gobio L.

NOTES TO CONTRIBUTORS

1. All manuscipts submitted for publication should be sent to Dr. E. A. Ellis, Wheatfen Broad, Surlingham, Norwich.

2. Manuscripts should be typed double spaced on one side of the paper. Latin names of genera and species should be underlined. Dates should be in the form 1 January 1972. Text figures should be referred to as Fig. 1, etc.

3. All Latin names should be followed by the authority when the name is first mentioned in the text or table.

4. References should be in alphabetical order at the end of the paper, in the form of:

Bloomfield, E. N., 1905. Fauna and flora of Norfolk. Trans. Norfolk & Nor. Nat. Soc., 8. 117-37.

5. Tables should be set on separate sheets and numbered in arabic numerals.

6. Drawings should be in jet-black indian ink. Shading should be in lines or dots but not in half-tone washes.

7. Page-proofs only will be sent. They should be returned with the least possible delay, and the minimum of essential correction should be made.

8. Authors are supplied with 15 offprints gratis. Additional copies may be ordered when the proofs are returned.

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NORFOLK Bird & Mammal Report 1977

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Norfolk Naturalists' Trust Properties

Date Acquired		Acreage		Status*
	On the Coast			
1926	Cley Marshes	435	Gift	S.S.S.I.
1937	Duchess's Pightle, Burnham Overy	1	Gift	——
1937	Great and Little Eye, Salthouse	10	Purchased	S.S.S.I.
1945	East End of Scolt Island	76	Purchased	N.N.R.
1955	The Eye, Salthouse	21	Purchased	S.S.S.I.
1965	Holme Dunes	400	Purchased, Gift & Agreement	S.S.S.I.
1971	Salthouse Marshes	200	Agreement	S.S.S.I.
	Broadland			
1928 and 1974	Starch Grass (Martham)	43½	Purchased & Gift	S.S.S.I.
1930	Alderfen Broad	72	Purchased	S.S.S.I.
1945 and 1969	Hickling Broad	861	Purchased	N.N.R
1945	,, ,,	500	Leased	N.N.R
1945	Barton Broad	355	Half Gift &	S.S.S.I.
1952	,, ,,		Half Purchased	S.S.S.I.
1948	Surlingham Broad	253	Purchased	S.S.S.I
1949	Ranworth Broad	124	Gift	N.N.R
1949	Cockshoot Broad	12	Gift	N.N.R
1964	Firs Marsh, Burgh St. Peter	2½	Leased	——
1971	Martham Broad	103	Leased	S.S.S.I
1972	Hardley Flood	90	Leased	——
1972	Chedgrave Common	10	Leased	——
1974	Barton Marshes	10¼	Gift	——
	Breckland			
1938	East Wretham Heath	362	Purchased & Gift	S.S.S.I
1942	Weeting Heath	343	Gift	N.N.R
1949	Thetford Heath	250	Gift	N.N.R
	Other Areas			
1957	Thursford Woods	25	Gift	——
1960	Hethel Old Thorn	⅛	Gift	——
1961	Scarning Fen	10½	Gift	S.S.S.I
1962	Hockham Fen (Cranberry Rough)	20	Purchased	S.S.S.I
1963	Roydon Common	140	Purchased	S.S.S.I
1966	Stoke Ferry Fen	25	Agreement	S.S.S.I
1968	Lenwade Water	37	Agreement	——
1968	Dickleburgh Pightle	1	Agreement	——
1972	Smallburgh Fen	19	Leased	S.S.S.I
1972	Ringstead Downs	26	Agreement	S.S.S.I

(Continued on inside back cover

Norfolk Bird Report - 1977

Editor: MICHAEL J. SEAGO

County Recorders: D. A. DORLING & P. R. ALLARD

Editorial Assistants: P. R. ALLARD, A. D. BOOTE, J. F. W. BRUHN, G. E. DUNMORE and DR. M. P. TAYLOR

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Editor: REX HANCY

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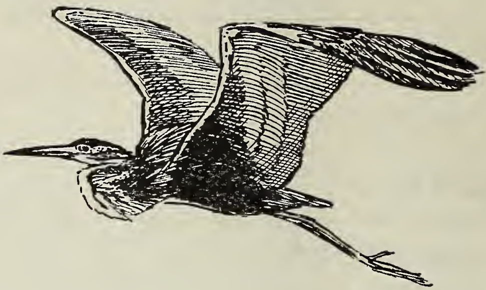
NORFOLK BIRD REPORT 1977



Editorial

The Council of the Norfolk Naturalists Trust, in co-operation with the Norfolk & Norwich Naturalists Society, is pleased to present the annual report on the birds of Norfolk.

Review of the Year: Somewhat surprisingly, 1977 produced four additions to the county list: Ruddy Duck, Sociable Plover, Thrush Nightingale and Isabelline Wheatear. Whilst the first three species were not entirely unexpected, the last one breeding no closer than Greece, was undoubtedly the surprise vagrant of the year.

Mild weather in the first half of March resulted in an exceptionally early arrival of summer visitors with records of Chiffchaff and Wheatear on 6th, House Martin on 8th and Yellow Wagtail on 13th. These early arrivals were closely followed by a Tawny Pipit at Holme on 19th, by far the earliest ever British record of this vagrant from southern Europe.

April was again disappointing with below average temperatures and no large influxes of migrants. Nevertheless a Serin was found at Wells and what was almost certainly the same Crane observed at various north coast localities in the second half of the month.

The cold weather continued for the first week of May, being followed by a week of wet westerlies. On the 14th high pressure commenced building up and the associated north-easterly winds produced a Thrush Nightingale at Holme on this date and a Red-throated Pipit at Cley on 18th. Warmer conditions at the end of the month, with generally south-easterly winds, resulted in the appearance of 3 White-winged Black Terns, another Red-throated Pipit (at the same locality as one in 1973) and an Isabelline Wheatear at Winterton, only the second British record and the first this century.

Whilst the vast majority of migrants have passed through the county by June the first half of the month invariably produces one or more overshooting vagrants from southern or eastern Europe and 1977 proved to be an above-average year in this respect. Another White-winged Black Tern was at Cley, together with a Red-rumped Swallow. Breydon Water attracted a Broad-billed Sandpiper and a brief visit from a Gull-billed Tern. A fortunate inland observer also discovered a Lesser Grey Shrike near Downham Market. The cold weather for most of the month did have some compensations: north-east winds and torrential rain on 10th resulted in unprecedented numbers of Manx Shearwaters moving east along the north coast, together with other seabirds including a Cory's Shearwater at Holme.

The highlight of the summer was undoubtedly the successful breeding of Avocets at Cley, where a pair of Bitterns was also successful in rearing young. The number of Marsh Harriers reared by the slender population was well above average. Despite the downward trend elsewhere in England, Red-backed Shrikes bred in compatible numbers compared with 1976; the small number of young reared is disturbing, however, despite the discovery of two new breeding sites.

July is generally regarded as a 'wader' month, but it produced a number of unusual records: a Caspian Tern at Swanton Morley GP, a Woodchat Shrike at Sheringham and a Cory's Shearwater picked-up alive on the beach at Yarmouth.

In the past, most large autumn 'falls' of passerines have occurred in September, but in recent years August has proved increasingly rewarding. On 6th August an anti-cyclone became established over southern Scandinavia and from 7th until the 23rd a large number of 'falls' occurred on both the north and east coasts as a result of a series of small depressions circling the North Sea, causing north-easterly or easterly winds, frequently accompanied by rain. Unprecedented numbers of Icterine Warblers and Red-backed Shrikes were present during this period in association with other migrants, including large numbers of Wrynecks and at least 3 Greenish Warblers. The place of origin of the migrants was noticeably different in the various 'falls' in view of the wide variance in the proportions of the actual species involved, as evidenced by the lack of any Aquatic Warblers which occurred in similar conditions in the previous year. Two other rarities were recorded during August: a White-rumped Sandpiper at Holme and a Gull-billed Tern at Cley.

September produced a scattering of unusual migrants including a Ferruginous Duck in the Brecks, an obliging Sociable Plover at Welney, another Broad-billed Sandpiper at Breydon and a Woodchat Shrike at Cley. Despite a spell of north-easterly winds for several days from mid-month onwards, no large 'falls' of migrants were recorded due to unsettled weather over southern Scandinavia. Nevertheless the small trickle of migrants included several Yellow-browed Warblers and two well-observed rarities: an Arctic Warbler at Wells from 18th to 23rd and a Little Bunting at Stiffkey from 22nd to 26th. The same winds also produced excellent sea-watching on 17th, including several petrels and 2 Long-tailed Skuas. Most large sea-bird movements occur with onshore gales, but on this occasion the wind only averaged force 6; the presence of large numbers of birds in the southern North Sea was obviously due to continuous northerly winds for several days beforehand.

October was disappointing with many days of southerly winds and a lack of easterlies. The only rarity was a Great Spotted Cuckoo at Cley. However, many observers were pleased to see the large number of Richard's Pipits and Lapland Buntings which appeared at many coastal localities, in addition to the exceptional number of rarer divers and grebes throughout the autumn.

The most exciting period of the late autumn was in mid-November with several large sea-bird movements on different dates. On 16th the wind veered to the north-west and then to the north the next day. Large immigrations of winter thrushes and starlings occurred at this time, much later than normal, with big movements of geese, ducks and gulls at sea. A Corncrake at Holme was the month's surprise.

Acknowledgements: Thanks are due to G. M. S. Easy for the cover drawing and for text illustrations; also to Dr. K. J. Carlson, P. R. Clarke, R. Powley and Dr. R. Vaughan for photographs and vignettes; to Holme Bird Observatory/N.O.A. for access to records; to the Norfolk Naturalists Trust Wardens; to the National Trust (Blakeney Point); to the Nature Conservancy Council (Scolt Head, Holkham, Bure Marshes (Woodbastwick) and Hoveton Great Broad); to the Cambridge Bird Club; to the Gt. Yarmouth Naturalists Society; to P. R. Allard and D. A. Dorling (for compiling the annual record cards); to Mrs. M. Dorling, J. T. Fenton, P. D. Kirby, Mrs. P. Rix and Mrs. M. J. Seago for valuable assistance and to all other contributors.

Recording: Records for the 1978 Report (including field descriptions of rarities and semi-rarities) should be sent *by the end of January* to Michael J. Seago, 33 Acacia Road, Thorpe St. Andrew, Norwich NR7 0PP. Contributors are requested to submit notes in the order followed in Dr. K. H. Voous' *List of Recent Holarctic Bird Species* (1977). In order to minimise the work involved, records will not normally be acknowledged. The names of all contributors will be included in the Report. It will be appreciated that delays in receiving observations create considerable problems for the Recorders, the Records Committee and the printers. For several reasons it is essential that publication is achieved by early September.

The County Records Committee (P. R. Allard, G. E. Dunmore, D. Holman, S. C. Joyner and Dr. M. P. Taylor) considered an increased number of written descriptions of semi-rare birds in 1977 compared with the previous year, the majority of records being accepted and included in the Classified Notes. Regretfully, many observers did not include descriptions, where applicable, of those species listed in the 1975 Report, necessitating follow-up letters causing additional costs and delay. Only two observers failed to reply and the relevent records of species (which could well have been correctly identified) have not been included. In a number of cases the Committee considered that the birds had been incorrectly identified, eg. Black-necked Grebe instead of Slavonian Grebe, but it was resolved to include the records on the basis of the Committee's amended identification.

Due to the large number of accepted records received, details of some of the divers and grebes have had to be summarised in the Classified Notes. Observers are still requested to submit descriptions of such species where required in future years, however, as they are likely to revert to their normal uncommon status.

In 1975 it was decided that no records of species considered by British Birds Rarities Committee would be included in this Report unless accepted by that Committee. Unfortunately, the Committee has been unable to consider many 1977 rarities until recently due to administrative problems so as a result decisions on many records are still outstanding. In view of this situation, it has been decided—for 1977 records only—that a number of rarities should be included in this Report on the basis that they were seen by many observers, thus anticipating future acceptance by the Rarities Committee. There are still several outstanding records, however, mainly seen by individual observers only, which have not been included in this Report. Such records, if accepted, will be published in next year's issue.

The new Secretary of the Rarities Committee has devised a system of improved liaison between the Committee and County Editors and in future all observers are requested to submit details of rare birds to the Editor who will then forward them to the Secretary.

OBITUARY

Mr. R. A. Richardson

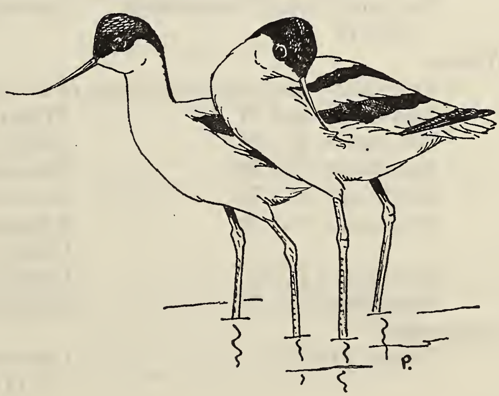
The untimely death of Richard Alan Richardson on 9th October, 1977, at the comparatively early age of 55 is a severe blow to Norfolk ornithology. A Londoner by birth, he spent the last 28 years of his life at Cley, living simply in a small cottage where he happily produced the drawings and paintings which gained him an international reputation. His major publications were the illustrations he did for Richard Fitter's *Pocket Guide to British Birds* and its companion volume on their nests and eggs. He also published *A Checklist of the Birds of Cley* and his drawings appeared in this Report for many years and can be found in many other publications and journals—most recently in *The Atlas of Breeding Birds in Britain and Ireland* published late in 1976.

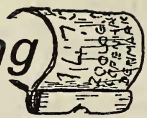
Richard regarded himself primarily as a field ornithologist and devoted most of his time to that end. He never took a notebook or pencil with him in the field, but when an unusual bird appeared he would study it closely with those bright blue long-sighted eyes that missed nothing and within an hour or so of returning home would have produced a drawing and sometimes even a painting that omitted no detail of plumage or attitude and was also a good picture.

He had a hard childhood and it was perhaps this that made him so kind and thoughtful to all young people. He was a superb teacher and the many youngsters who came along the East Bank could be sure that Richard would help and advise them in every possible way. Many of the young professional ornithologists of today owe him a great debt for the technical knowledge and insight which they acquired in his company. He contributed greatly to organised ornithology and conservation, including the founding of the Cley Bird Observatory and its ringing station, work for the Norfolk Naturalists Trust and was President of Holme Bird Observatory.

He was deeply devoted to Fair Isle, which he visited every spring and again in the autumn. He was a member of the committee of the Observatory there and an honorary member of the Shetland Bird Club. He also founded the John Harrison memorial trust—the object being to help young ornithologists to visit and to enjoy Fair Isle.

Richard was innocent of conventional schooling and had never seen the inside of an art school, but despite these apparent drawbacks he had an enormous knowledge of birds. He was modest and totally unassuming which allowed people of all ages to ask him questions with the assurance that he would answer both seriously and carefully.



Bird Ringing  Report

Ringing activity in the County is more or less restricted to certain areas including Norwich, Sheringham, Happisburgh and East Runton, one or two sites in Broadland, the North Coast centred on Titchwell and Holme, and Downham Market, and in some parts it tends to be seasonal.

There is also all-year-round activity on the Wash, between Holme and Gibraltar Point, catching waders. These are aged, weighed and measured as part of a continuing study by the Wash Wader Ringing Group, to whom we are indebted for permission to publish their recoveries.

The list of recoveries for Norfolk includes Spanish and Italian-ringed passerines, which are of infrequent occurrence in the British Isles; some long-distance movements of various species into USSR and to Africa; one or two proved to live an exceptionally long time; and others that have been controlled a second or third time.

A bird ringed before it reaches the free-flying stage is referred to as a pullus, and a control is a bird that is handled by a ringer when it is already carrying another person's ring.

Fulmar

Sheringham (pullus) 3.8.76	Zandvoort, N. Holland, Netherlands (dead) 21.5.77

Shag

Farne Is., Northumberland (pullus) 26.7.76	Old Hunstanton (caught and released) 3.12.76

Heron

Two birds moved to Lincs. and Notts. The following lived longer, and moved more than 250 km.

Barton (pullus) 30.5.69	Garstang, Lancs., 14.6.77
Ranworth (pullus) 26.5.70	Keighley, Yorks., 6.11.77

Teal

Snettisham winter-tinged Teal were recovered between August and October in Denmark (2), Netherlands and France.

De Koog, Texel, Netherlands 16.9.75	Salthouse (shot) Sept. 1977

Wigeon

Previously unreported recoveries of the species include:

Snettisham 24.1.74	Pitlyar, Tyumen, USSR 29.5.75
Snettisham 28.1.74	Ukhta, Komi ASSR 25.6.75
Snettisham 22.1.75	Zelenogradsk, Kaliningrad USSR 30.8.75
Snettisham 22.2.72	Kondinskoye, Tyumen, USSR 15.5.76
Snettisham 28.1.74	Khatanga, Krasnoyarsk (72 °N, 102 °E) USSR 9.6.76
Snettisham 1.2.73	Lappajarvi, Kuopio, Finland 18.9.76
Snettisham 28.1.74	Langerak, Jylland, Denmark 9.10.76

Sparrowhawk

Holme 20.4.76	Canterbury, Kent (dead in barbed wire) 29.11.76

Kestrel

Thorpe-le-Soken, Essex (pullus) 28.6.77	Shouldham Warren (dead) 3.8.77

Great Black-backed Gull

Gt. Ainov Is., Murmansk, USSR (pullus) 27.6.75	Breydon (dead) 26.12.76
Utsira, Rogaland, Norway (pullus) June 1976	Breydon (recently dead) 30.6.77
Kuli, More & Romsdal, Norway (pullus) 11.7.75	Breydon (dead) 21.8.77
Haram, More & Romsdal, Norway (pullus) 4.7.74	Breydon (dead) 30.10 77

Common Gull

Suur-Harjamaa, Estonia (pullus) 15.6.77	Norwich (control) 19.1.78

Black-headed Gull

Recoveries include a bird shot well north in USSR. Others were to usual areas at usual times of the year, and involved birds up to ten years old.

Buxton 4.1.71	Onega, Arkhangel'sk, USSR 10.7.77

Common Tern

Stiffkey (pullus) 16.6.67	Seaforth, Lancs. (controlled and worn ring replaced) 18.9.77

Little Tern

A pleasing live recovery, albeit from foreign breeding grounds, of an endangered species.

Snettisham (juvenile) 31.7.72	East Frisian Is., Germany (controlled, breeding) 16.6.77

Sandwich Tern

The majority of Sandwich Terns recovered end their days off West Africa, particularly Ghana and, as in this case, Senegal.

Stiffkey (pullus) 22.6.67	Thiaroye, Dakar, W. Africa (caught) April 1977.

Cuckoo

An interesting, though regrettable, example of reorientation.

Holme 15.5.77	Finningham, Suffolk (dead) end May 1977

Swallow

Included are two interesting reports of birds controlled on spring passage.

St. Pryve-St. Mesmin, Loiret France (juvenile) 16.9.76	Weybourne (control) 20.8.77
Zele, E. Flanders, Belgium (pullus) 12.6.76	Happisburgh, 19.5.77
Wainfleet, Lincs., 18.9.76	Happisburgh, 12.5.77

Sand Martin

Roost netting in France continues to provide recoveries.

Coltishall, 3.8.77	Rochford, Charante Maritime, France, 5.9.77

Long-tailed Tit

Long distance movement of two birds, that kept together no doubt. It would be interesting to speculate when the movement took place, and whether they would have remained resident in Essex. See N.B.R. for 1963, 1973.

Holme 16.10.75	Benfleet, Essex (traffic casualty) 20.1.77
Holme 16.10.75	Benfleet, Essex (control) 8.6.77

Bearded Tit

For comparable movements of the species see N.B.R. for 1963/4/6.

Goole, Yorks. 18.10.75	Titchwell 8.10.76
Titchwell (two) 2.7.76	Goole (control) 28.10.76
Titchwell 21.7.76	Goole (control) 8.11.76

Fieldfare

Sprowston 30.1.76	Valkeakoski, Hame, Finland (dead) 1.7.77

Song Thrush

Sheringham 26.10.76	Estibeaux, Landes, France 18.12.77

Blackbird

Finland features prominently among recovery localities with four, including one near the border with USSR. Others were from Sweden (2), Denmark, Germany (3) and Eire.

Tunstead 2.1.77	Viitaa, Kuopio, Finland (shot) 10.7.77
Titchwell 31.10.74	Kildare, Eire 8.2.77

Reed Warbler

Two useful, if unspectacular, autumn journies.

Weybourne 29.7.77	Attleborough (cat) 24.8.77
Earlham 8.7.77	Wheathampstead, Herts. (control) 21.8.77

Sedge Warbler

Le Migron, Loire Atlantique France 7.9.76	Sheringham (control) 26.4.77

Garden Warbler

Holme 21.8.77	Helgoland (control) 21.9.77

Goldcrest

Brasschaat, Antwerpen, Belgium 15.11.76	Sheringham (control) 30.3.77

Spotted Flycatcher

Sheringham 17.9.76	Rabat, Morocco, May 1977

Pied Flycatcher

Winterton 4.9.74	Sando, Buskerud, Norway (dead) 23.5.76

Tree Pipit

This is the first foreign-ringed Tree Pipit to be found in Britain. The few autumn recoveries of individuals ringed elsewhere in Britain have mostly been from Portugal, and none very far from the Atlantic seaboard.

Varese, Italy 26.9.76	Sheringham (killed by car) 14.5.77

Yellow Wagtail

Cap Breton, Landes, France 2.10.76	Tottenhill (control) 22.6.77

Starling

Foreign recoveries include seven from USSR. There is only one report of a British-ringed Starling further east than the following.

Sheringham 30.1.76	Ukhta, Komi ASSR (53°43'E) 26.5.76
Tunstead 12.2.76	Ekofisk field, N. Sea 14.1.77

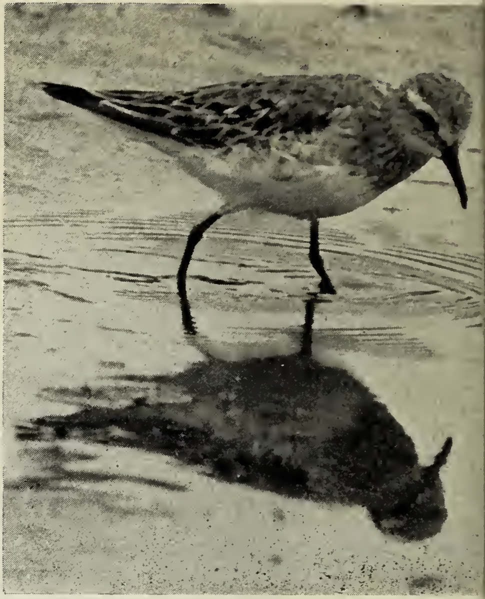
Greenfinch

Holme 30.3.75	Cleethorpes, Lincs. 19.1.77
Sandwich, Kent 20.11.76	Sheringham (control) 13.3.77

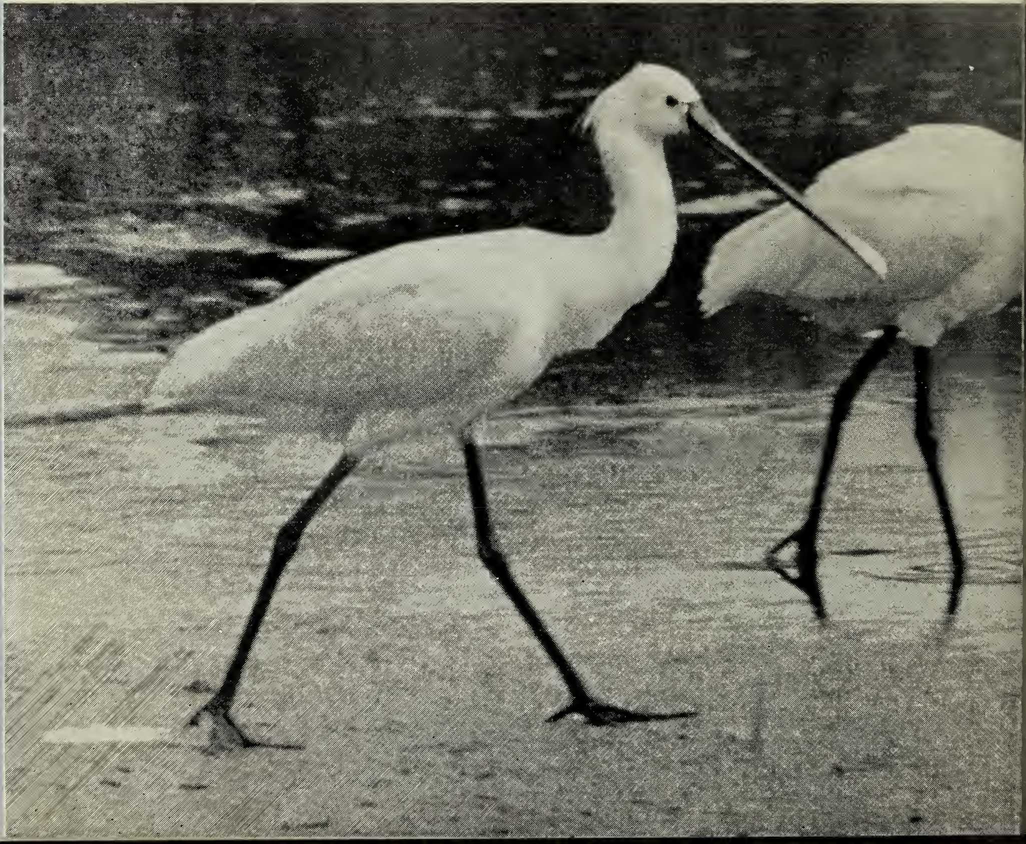
Goldfinch

Happisburgh 6.5.76	Walberswick, Suffolk (control) 8.5.76
Westmalle, Antwerpen, Belgium 10.10.76	Sheringham (control) 18.4.77
Lezo, Guipuzcoa, Spain 18.4.74	Hellesdon (caught by cat) 15.7.75

Two pairs of Avocets each reared three young to the flying stage at Cley in 1977; the first successful breeding in Norfolk this century. A small colony of five nesting pairs became established in 1978 when a total of 16 young left the reserve. *Photos Dr. K. J. Carlson*



Among the year's exciting visitors at Holme were these Spoonbills and White-rumped Sandpiper. The latter stayed six days and was seen by many observers
Photos P. R. Clarke and Dr. R. Vaughan



Redpoll

The case for a spring movement from wintering grounds across the North Sea onto the Norfolk coast and west and south into eastern England finds support from the following two recoveries. There are other recoveries within East Anglia, and between Norfolk and Belgium, but they do not indicate the precise period of movement to the same degree.

Kruisberg, N. Holland, Netherland 16.3.77	Sheringham (control) 20.4.77
Sheringham 9.5.77	Wisbech, Cambs., 24.5.77

Bullfinch

South Runcton 14.8.76	Burnham Overy (shot) 24.3.77
Sheringham 5.11.76	Leiston, Suffolk, March 1977
Sheringham 23.7.77	Fakenham 24.10.77

Reed Bunting

Further evidence of seasonal movement in this species; the timing remains rather a mystery.

Jersey, Channel Islands 7.1.76	Titchwell (control) 5.1.77

WADER RINGING ON THE WASH

The Wash Wader Ringing Group has now been functioning for nearly nineteen years, with well over 100,000 individual birds ringed, and many more controlled from Britain and overseas. The Group's activities extend to the Lincolnshire side of the Wash, and whereas recoveries published are only for Norfolk, statistics quoted include Lincolnshire birds. The following comments and recent recoveries are reproduced from the Report 1975-76.

Oystercatcher

183 out of 253 recoveries abroad during the past eighteen years have come from Norway, revealing the main breeding area of the Oystercatchers found on the Wash. 1975 also brought the first recovery from Iceland. There are four earlier recoveries from the Faeroe Islands, and nine from Orkney and Shetland. Also given is a recovery of local interest.

Heacham (ad) 20.2.72	Kjosarsysla, Iceland (dead) 26.4.75
Terrington 12.7.75	Lakenheath, Suffolk (taken by peregrine) 25.2.76

Ringed Plover

The recovery in Senegal, listed on page 101 of the N.B.R. 1976, was only the third from Africa. The first from Norway came in 1975.

Snettisham (juvenile) 27.9.73	Varangerfjord, Finnmark, Norway (70°N Lat.) 23.8.75

Grey Plover

1976 produced the second Moroccan recovery of the species.

Terrington (juvenile) 1.11.75	Ait Melloul, Agadir (taken) 7.1.76

Turnstone

It is evident from recoveries that Turnstones occurring on autumn passage on the Wash are of Finnish origins, and over-wintering birds are from Greenland and N.E. Canada. The following has been controlled twice:

Terrington 28.8.72	(1) Alert, Ellesmere Is., Canada 3.6.75
	(2) Snettisham 4.1.76

Woodcock

This is the second recovery of the species from the Wash area. It suggests the possible wintering area of a bird on passage through the north of the county.

Holme 14.10.72	Tamworth, Staffs., (shot) 25.11.72

Curlew

Autumn and wintering Curlew have been ringed in fair numbers over the years, and breeding season recoveries have been from as far east as Finland and USSR.

Terrington 6.9.75	Ilmajoki, Vaasa, Finland (dead) 16.6.76
Oulunsalo, Oulu, Finland (pullus) 11.6.66	Brancaster (shot) 22.11.74

Redshank

Some interesting movements were noted during the years under review; one individual was at least in the nineteenth year of its life when controlled in August 1976, having been ringed in the Group's first-ever catch on 18.8.59. Others include:

Terrington 20.7.74	Gulf Tide Drilling Rig (dead) 8.5.75
Snettisham 1.1.72	(1) Reykjavik, Iceland (Ring No. read through binoculars) 23.6.74
	(2) Snettisham (control) 4.1.76

Spotted Redshank

The Group's first recovery came in 1976, though an earlier one from Cantley is listed in the Norfolk Bird Report for 1969.

Terrington 27.7.75	E. Jadida, Morocco (shot) 25.3.76

Knot

Recoveries for this species from Greenland and N. Canada number 64 and 6 respectively, and from Iceland on passage, 123. By contrast the Knot mentioned in the N.B.R. for 1973, page 101, was again caught in S. Africa in January 1976, having travelled a minimum of 50,000 miles between controls. Regular ringing on both sides of the Wash reveals that the Knot moves rapidly from place to place, whereas the Dunlin, for instance, will rarely be controlled more than a few kilometres from where it was originally ringed. Two individuals were at least 15 years old when handled in 1975.

Dunlin

Dunlin recovery areas extend from USSR (14 recoveries) to Eire (13), and France (68) and from Greenland (1) to Mauritania (6). An interesting quick double foreign control, over a distance of 300 miles in four days.

Snettisham, 13.4.68 & 4.4.69	(1) Pori, Turku & Pori, Finland 21.7.75
	(2) Lake Vattern, Sweden 25.7.75

Curlew Sandpiper

The few recoveries have ranged from Leningrad and the Crimea in USSR to Tunisia and Senegal in Africa.

Wisbech S.F. 1.9.69	Mikoszewo, Poland (control) 21.7.74
Wisbech S.F. 13.9.75	Dakar, Senegal (dead on ship) October 1975

Sanderling

As previously indicated, the Sanderling moves far and wide, to and from USSR (2), Greenland (1), N. and W. Africa (11) and S. Africa (1), and many parts of Europe.

Snettisham 29.7.73	Palmi, Reggio Calabria, Italy (killed) 31.3.74
San Rossore, Pisa, Italy 9.5.75	Snettisham 26.7.75

Ruff

The Ruff has produced some of the most distant recoveries into Siberia. More humble are the following:

Wisbech S.F. 23.8.69	(1) Shotton, Flints., 6.3.71 (2) Wel ey (dead) 20.1.74
Wisbech S.F. 14.8.71	Lago de la Tancada, Tarragona, Spain 16.11.75

AVOCETS AT CLEY 1977

New Year 1977 started promisingly at Cley with the occurrence of a single Avocet that heralded the long anticipated breeding of this species in Norfolk. Thirty years of expectancy were finally realised, since in 1947 this magnificent, pied wader with its remarkably aristocratic upswept bill decided to make Suffolk's Minsmere and Havergate its first British nurseries in modern times.

Plundering of a Salthouse nest in 1941 may have denied Norfolk the hosting of this attractive bird until this year, but dedicated bird lovers had willed the breeding, and in 1977 breed it did. The long wait was over and the long anticipated settling was at last factual. This was due in no small measure to the work of the Warden and the dedication of many helpers who created the unique habitat so necessary to the well-being of the breeding Avocet.

The story unfolds thus: Our New Year's bird was joined by a mate on 5th Feb. A second pair made it a mini-colony on 28th March, and early in April nesting activity was evident. By 21st April a pair was settled on precious eggs, but like many other treasures they went to the rat thief.

All was not lost, however. By the 4th May three pairs of Avocets were in evidence on Cley Marsh, and although the nest of the first pair had been destroyed by rats on 12th May, mating again took place on the 18th, and five days later a new clutch had been laid on Pat's Pool, whilst a second pair was on eggs on North Scrape by 26th May.

During early June the build up of nesting birds continued with four pairs on the third. Pair number three duly laid, and were noted sitting on eggs on 10th June, to be followed closely by a fourth pair's clutch on the 12th, the North Scrape being the chief centre of all this exciting activity. Two more pairs joined the nesters bringing the total Avocet adult population to a good, highly viewable, round dozen, Nesting, however, was to remain restricted to the four pairs already established, and from here on expectancy, anxiety, excitement and tension followed each other as hopes for successful breeding mounted. There were anxious moments when rumours of egg collectors in the vicinity were whispered. Watches were organised at all hours to protect the prized but highly vulnerable eggs. Dawn and dusk eyes were strained into the half light towards the sitting, patient silhouettes of the pied birds.

Yet probing eyes are not enough to counter rodent predators or assuage the violence of the weather. For a second time, on 15th June, rats plundered the nest on Pat's Pool. On the following day cold weather prevailed and forced the third pair on North Scrape to desert. A quick decision was made to remove the two eggs and place them under a broody bantam. In part this operation proved a success, for both eggs hatched on the 8th July. There was no triumphant outcome alas, the heavy-footed bantam trod on, and despatched one chick soon after hatching, whilst its brood-mate only survived for five days.

Numbers of Avocets continued to be attracted to the area, for on 18th June there were thirteen on view on the North Scrape.

Three rats and a large male stoat were humanely removed to make life easier for the remaining two breeding pairs, which still sat through all the tribulations. Happiness and relief came on 22nd June when the pair on North Scrape successfully coaxed three fluffy and very live chicks from their encasing shells. Watchers through telescopes on the evening of the 22nd had the unique privilege of seeing the first known Norfolk-born Avocets within living memory.

Wader chicks are highly mobile. Shortly after emergence, they negotiated, with the help of their parents, the 300 metres of intervening terrain, and were on Simmond's Scrape within 48 hours. From there they moved on to Pat's Pool, settling there to be filmed by both B.B.C. and I.T.V. enabling thousands of home viewers to share the intimacies of family life with this most elegant of waders.

The remaining sitting pair eventually hatched three eggs on 2nd July. From then on six chicks and their parents had the nutritious Cley ooze in which to probe and thrive. This they did whilst Warden and watchers relaxed and glowed. Throughout July 'Avocets normal' was recorded with satisfaction in the Warden's log.

The growing young were watched daily from the fluffy stage onwards. The flying stage was reached on 28th July, just five weeks from emergence from the eggs. From then on the free-winged young were able to move territory, to migrate, and perhaps to return as adults to the place of their birth, and establish a thriving colony, and so give pleasure to the many who flock to Cley to see what flocks to Cley.

There were still three adults and three young on view on 20th Aug. and Avocets continued to be seen into September with 8 on North Scrape on the 2nd and 6 on the 7th. Indeed one bird was regularly present from the 18th Sept., (when all the others had left), through the remainder of the year.

Cley was not the only locality to have nesting Avocets in 1977. A pair settled in the Snettisham area where eggs were laid, but the attempt to raise young ended when the nest was trampled by the clumsy hooves of browsing cattle.

As previously suggested, nesting of this species at Cley was not altogether unexpected. For more than twenty years records of Avocets in Norfolk have been an annual feature. 1967 was unusual with only one bird noted, that at Breydon on 24th April. In most years birds have been seen in Spring, especially at Cley and Breydon Water, whilst other favoured localities have been Snettisham, Holme, Brancaster and Morston. Following the singleton, the next year 1968 was a prolific contrast when 26 birds were at Breydon and 10 at Cley, where mating took place, and hopes were raised. In this memorable year Avocets were also noted at Morston, Holme, Heacham, Scolt and Wisbech S.F. 1974 was also a year of numbers with 27 at Cley on 4th May and 9 at Snettisham during the first week of May. Breydon again had eleven on 23rd March 1975, and in 1976, 7 were at Hardley Flood on St. George's Day and 4 at Snettisham in mid May.

Winter sightings have also been more numerous over the past decade, usually of single birds, with the most regular areas being Breydon, Cley and Holme.

H.R.R.

Classified notes

These notes are based on *Birds of Norfolk* (revised edition 1977) where fuller details regarding status, distribution, migration and ringing recoveries may be found. Important records for Wisbech Sewage Farm (part of which is on the Lincolnshire side of the county boundary) have been selected from the files of Cambridge Bird Club. Fuller details of Fens records may be found in the *Cambridge Bird Club Report* for 1977.

The order used is that of Professor K. H. Voous (1977) *List of recent Holarctic Bird Species*. Observations refer to 1977, unless otherwise stated. To save space, all but the most essential initials have been omitted. Records are of *single* birds unless otherwise stated.

Red-throated Diver: North: Sheringham, interesting movements include 92 east Jan. 15th (in 20 minutes) and 182 east on 16th. Only two inland records: Strumpshaw and Colney.

Black-throated Diver: North/East: In first winter period Cley Feb 13th and May 4th. In autumn more records than usual especially between Blakeney and Cromer from Aug. 28th. Peak of 5 at Cley Nov. 10th.

Great Northern Diver: North/East: Many more records than usual from mid-Sept. onwards including 3 at Salthouse Oct. 15th. Broads: Hickling Jan. 2nd.

Little Grebe: Breydon: At least 12 breeding pairs in adjacent dykes. Wash: Peak of 41 at Snettisham in Nov.

Great Crested Grebe: Wash: 35 off Hunstanton Feb. 13th and 60 Nov. 13th. East: Breydon midsummer peak of 41 July 28th.

Red-necked Grebe: North: An increased number of observations including small influx Oct.-Nov. when as many as 7 off-shore at Cley Nov. 16th. East: Winterton 3 Sept. 25th.

Slavonian Grebe: North: More records than usual. Sheringham one dead April 14th and up to 5 Oct. 30th to Nov. 13th; Weybourne 4 in late Oct.; Wells peak of 12 Nov. 5th; Cley-Salthouse 2 in late Oct. and 4 in mid-Nov. Ones and twos elsewhere at Titchwell, Holkham, Hunstanton, Overy Staithe and Snettisham. Broads: Ranworth Nov. 30th. East: Horsey 2 Oct. 21st.

Black-necked Grebe. Remains the rarest of the grebes. North: Morston Jan. 2nd to 16th; Hunstanton Feb. 13th; Weybourne 2 Nov. 13th; Sheringham 2 Nov. 13th and Cley Sept. 2nd. West: Tottenhill G.P. Aug. 29th to Sept. 2nd.

Albatross species: North: Cley Oct. 19th (MK, CO)

Fulmar: North: Total of 24 young counted on cliff ledges between Weybourne and Cromer (JCM) as follows: Weybourne-Sheringham 12, Sheringham-West Runton 3, West Runton-East Runton 2, East Runton-Cromer 7. At Sheringham present on ledges until Sept. 24th and from Nov. 5th. Wash: Hunstanton. over 40 pairs present Jan. 29th, 7 young still on ledges in early Sept. and over 50 pairs back at end of year. East: Bacton, nest with an egg but later robbed. Happisburgh, 5 pairs on cliffs but no evidence of breeding and Hopton singles April to Aug. Wash: 112 passing Snettisham in two hours Sept. 23rd.

Cory's Shearwater: East: Yarmouth, one of the North Atlantic race picked up alive July 23rd was released on 28th but later died (PRA). North: Holme June 10th (PRC)

Sooty Shearwater: North: Cley Aug. 18th, 30 on 27th, 2 on 28th, 2 Sept. 9th, 7-8 on 17th and 2 Oct. 1st. Blakeney Point 15 Sept. 16th. Sheringham Aug 17th-18th, Sept. 9th, 13 on 17th. Wash: Snettisham 2 Sept. 17th and Hunstanton 9 Oct. 2nd. East: Winterton 43 in 4 hours Sept. 17th, 6 on 18th and one on 25th.

Manx Shearwater: Unprecedented numbers recorded June 10th moving east along north coast in strong NNE winds and rain: Hunstanton 48, Holme 113, Brancaster 30 and Cley 126. Also 8 off Holme next day with 9 on 15th/16th. Sheringham 8 June 7th and 3 on 11th. Usual late July to Oct. records off North coast and in Wash including 26 Snettisham in 2 hours Sept. 17th and 19 Sheringham same date. Birds of the Balearic race Snettisham and Cley Sept. 17th. East: 1-4 Aug. 7th to Oct. 2nd including one Balearic Sept. 17th.

Storm Petrel: North: Holme Sept. 17th and Nov. 13th. Sheringham Sept. 17th. East: Yarmouth one brought into port aboard an oil rig supply vessel first week of Dec.

Leach's Petrel: North: Cley at least 3 Sept. 17th, one on 18th, Weybourne 2 Sept. 18th, 4 Nov. 21st, Sheringham Sept. 17th/18th, Cromer Nov. 15th. East: Winterton Sept. 18th.

Gannet: Impressive movement along coast Sept. 17th; 240 in 2 hours Snettisham, 300 Hunstanton, 282 into Wash at Gore Point in 1½ hours, 250 Holme, 230 Cley, 260 Sheringham and 150 at Winterton.

Cormorant: East: Feb. maximum of 102 at Breydon. Broads: Ranworth, 250-300 in winter roost. Fens: Welney up to 41 roosting in March. North: Wells harbour 72 Nov. 13th.

Shag: Coastal records between Wells and Gorleston and maxima of 20 at Sheringham Nov. 13th and 12 at Yarmouth on 27th. Breck: Barnham March 1st. Central: Costessey GP Nov. 27th. Fens: Denver Sluice Nov. 12th with 5 Dec. 27th.

Bittern: Broads: 7 regular boomers compared with 9 the previous year. North: Cley one pair bred rearing 2 young. *Further reading:* "Breeding Bitterns in Britain" (*British Birds* 71: 285-300.)

Grey Heron: The following heronries were counted: Borders of Wash: Snettisham 16. Fens: Hilgay 33, Islington 38 and Denver Sluice 2. Breck: Didlington 10, Shadwell 8, Hockham Fen one and Narford 5. Broads: Belaugh 7, Upton 6, Fishley 3, Wickhampton 4, Reedham Park Carr 4, Fritton 3, Ranworth 9, Horning Hall 5, Herringfleet 3, Mautby 4, Woodbastwick Marshes 10, Barton 8, Heigham Sounds 14, Hickling Colls Plantation 2, Buckenham 14, Strumpshaw one, Wheat fen 5, and Surlingham 3. Central: Lyng one and Keswick one.

Black Stork: Central: East Tuddenham Sept 11th (AB)

White Stork: Central: Brandon Parva Aug. 21st (JDG *et al*). Wash: Hunstanton /Snettisham Oct. 25th (AGH, PMH) and Dec. 4th-5th (HRR *et al*).

Glossy Ibis: Central: Hockering Aug. 24th (MDK).

Spoonbill: North Coast: Singles and parties up to 4 May 8th to Sept. 10th. East: Breydon 9 present June 15th-19th with smaller numbers June 7th to Sept. 12th. Winterton 7 south June 7th. Broads: Hickling maximum of 9 present June 11th to 18th with others May 26th to July 29th. Singles at Hardley Flood & Strumpshaw May 14th and July 21st.

Bewick's Swan: Recorded up to May 11th and from Oct. 12th. Largest concentration at Welney where over 1,000 by early Dec. and 1,777 in mid-Feb. Elsewhere exceptional numbers in East Norfolk during Jan.-Feb. with 397 in 3 herds Jan. 1st (including 224 at Upper Thurne). 330 still present Jan. 29th in 5 herds, 171 March 15th, 70 on 19th and last 16 on 25th. The largest single herd was 268 on lower Bure levels Feb. 21st A yellow-dyed bird on lower Bure March 10th-20th was one of 57 caught at Slimbridge Jan. 11th.

Breck: Fowl Mere 5 Dec. 26th and 14 Dec. 18th. North/Wash: Maxima of 92 at Wolferton-Snettisham Jan.-Feb. and 48 at Burnham Overy in March.

Whooper Swan: Recorded up to April 10th and from Oct. 9th at usual haunts with largest herds at Welney where 82 at end of Jan. (a new record) and over 50 in Dec.

Bean Goose: East: Up to 127 in usual area till Feb. 26th; 5 returned Nov. 17th with 70 Dec. 10th and 86 on 26th. North: Cley 4 Jan. 3rd-16th. Holkham 11 Jan. 8th-12th with 13 on 29th, 9 Feb. 19th and one Dec. 21st. Blakeney 4 Jan. 8th. Wash: Snettisham up to 15 Jan. 9th-18th and one Feb. 21st.

Pink-footed Goose: East: Yare valley one with Bean Geese until Feb. 8th and 3 on 15th. Halvergate one with Bewick's Swans March 15th-19th. Winterton 24 Oct. 2nd. Breydon 11 Oct. 1st. Wash: Snettisham 3700 in Jan., 68 returned Oct. 28th and 4572 at end of year. North: Titchwell 75 Nov. 4th. Holkham 43 Jan. 2nd with 34 on 12th and 5 on 29th.

White-fronted Goose: East: Yare valley 12 Jan. 2nd increasing to 23 Feb. 8th; 7 returned Dec. 4th later increasing to 10. Breydon 120 Jan. 7th with 32 remaining on 13th and last 8 on 30th; 20 returned Dec. 10th. Horsey 21 Dec. 2nd. North: Holkham 232 Jan. 22nd with 234 Feb. 19th and 170 still present March 15th; 75 returned Dec. 4th and 85 on 17th. Cley 35 Jan. 1st. Hunstanton 16 Feb. 13th. Holme 17 Dec. 6th. Wash: Snettisham 10 Jan. 6th, 25 Feb. 21st and 7 Dec. 13th. Fens: Welney 7 late Nov.

Barnacle Goose: East: Burgh Castle March 13th and Breydon 3-4 April 21st-30th. North: Cley Jan. 28th. Holkham 4 Jan. 22nd-30th. Wells 4 Oct. 3rd on golf course. Burnham Deepdale 4 Jan. 24th-27th. Wash: Snettisham 3 Jan. 9th-18th, 4 Feb. 3rd and one shot Nov. 19th. Fens: Welney March 27th.

Brent Goose: Maximum numbers at regular localities: Wells 2500, Blakeney 1200, Salthouse 150, Cley 2000, Stiffkey 3000, Scolt Head 1500, Hunstanton-Holme 2000, Snettisham 1200 and Terrington Marsh 650. Recorded monthly except Aug. Off Sheringham unusual numbers off-shore Nov. 17th during gales when 700 west in 3 hours and off Winterton on same date when 408 north in 1½ hours.

Egyptian Goose: Reported at Barningham, Blickling, Swanton Morley, Sparham, Shouldham, West Rudham, Flitcham, West Newton, South Raynham, Stradsett, Narford, Sandringham, West Acre Gunton Park, Hillingdon, Salthouse, South Acre, Narborough, West Litcham, Holkham, Hoveton, Berney Arms and Caister on Sea.

A county summary of recent observations is planned for the next Report, full details requested.

Ruddy Shelduck: East: Adult female at Cantley B.F. July 30th-Aug. 7th when it moved to Breydon.

Shelduck: Wash: Snettisham maximum of 2477 in Feb. and 1760 in March. Fens: 50 young at Welney, 36 young at Wissington B.F. and 188 young at Wisbech S.F. East: Breydon winter peaks of 855 Jan. 7th and 794 Dec. 9th; remarkable build-up of adults in June prior to departure to Continental moulting grounds including 810 June 23rd. Breeding records elsewhere include single pairs at Tottenhill G.P., Barningham Park, Blickling Park, Winterton, Pentney G.P. and Stanford Water with 27 young in Gunton Park.

Mandarin Duck: East: Smallburgh pair nested in next-box 15 feet from ground in an oak, but eggs failed to hatch. Broads: Hickling 2 Nov. 24th.

Wigeon: Fens: Welney maximum of 35,000 at beginning of year with 15,000 early Dec. East: Exceptional numbers at opening of year with 23,500 at 3 sites Jan. 19th (Breydon 6,500, Yare Valley 5,000 and Upper Thurne 12,000). Numbers reduced to 3,500 by end of month.

American Wigeon: Fens: Welney Cct. 23rd (DJF).

Gadwall: Breck: Largest counts: 105 Gooderstone Nov. 25th and 83 Thompson Water Oct. 23. Wash: Snettisham 21 Jan. 9th. North: Gunton Park 219 Sept. 21st, 469 Oct. 14th and 308 Nov. 11th. Broads: Hickling 76 March 13th. East: Breydon 16 Aug. 12th. Fens: Welney 5 broods.

Teal: Broads: Hickling counts include 960 Dec. 6th and 1318 on 8th. Fens: Welney 8 broods.

Pintail: Fens: Welney maximum 1,000 beginning and end of year; 2 broods noted. Hockwold pair on flood May 29th, but not proof of nesting. Wash: Snettisham 434 Feb. 6th. North: Cley 450-500 Jan. and 50 Oct. 21st. East: Breydon maximum 188 Jan. 1st and 108 Dec. 16th.

Garganey: Spring arrival from March 6th (Cley and Welney) and subsequently at Breydon, Hickling, Strumpshaw, Surlingham, Hardley Flood, Ranworth, East Wretham, Wisbech S.F. and Cantley. Only breeding record from Cantley (brood of 6).

Shoveler: Fens: Welney Maximum 250. North: Cley 60 Feb. 13th and Gunton Park 44 Oct. 14th

Pochard: Breeding records: 3 pairs in Breck at 2 sites; elsewhere 11 pairs bred at 4 sites. Fens: Winter total of 500 at Welney.

Ferruginous Duck: Breck: Fowl Mere Sept. 24th (JDG).

Tufted Duck: Breeding records: 40 pairs at 8 sites in Breck; elsewhere a minimum of 22 pairs at 8 sites.

Eider: Coastal records throughout year and largest flocks for main localities given below: East: Yarmouth 44 and Happisburgh 47. North: Brancaster 22, Sheringham 14, Holme 30, Overy Staithe 60 and Hunstanton 23.

Long-tailed Duck: Wash: Hunstanton monthly maxima: Jan. 24, Feb. 50, March 50, Oct. 1, Nov. 15 and Dec. 30. North: Occasional records of up to 25 until April and from Sept. 8th. East: Winterton Nov. 13th.

Common Scoter: Wash: Hunstanton 2000 Jan. 9th-Feb. 6th. North: Overy Staithe 1200 Dec. 14th. Broads: Ranworth April 1st.

Velvet Scoter: Wash/North: Recorded monthly except June to Aug.; maximum 42. East: Up to 8 noted off Hopton, Gorleston, Yarmouth, Winterton and Bacton up to May 1st and from Oct. 19th.

Goldeneye: Maxima as follows: North: 126 west off Sheringham Nov. 13th-18th. Wash: 50 at Snettisham. East: 46 at Breydon. Breck: 7 at Narford.

Smew: Ones and twos up to March 7th at Bawburgh/Colney G.P., Martham Broad, Snettisham and Welney.

Red-breasted Merganser: Largest numbers include 37 Hunstanton in Feb. and 35 Brancaster in Oct. Late bird at Snettisham June 2nd when 7 at Thornham. East: Ones and twos at Breydon, Winterton and Yarmouth.

Goosander: Winter observations at 8 localities including 8 at Welney and at Breydon, 17 at Gunton Park, 10 at Stanford and 6 at Sheringham.

Ruddy Duck: Fens: Welney Jan. 10th-18th (GHS). The first county record.

Honey Buzzard: North: Pair at one site from June 1st but no proof of successful nesting.

Red Kite: East: West Somerton Dec. 10th (SJB, ADB) and Belton Dec. 25th (MM). North: Titchwell Dec. 22nd (NS). Wash: Snettisham Dec. 24th (PG, CPP). South: Redenhall Dec. 8th and 12th (BS-D).

Marsh Harrier: Five breeding pairs at 4 sites reared 19 flying young. A female present at a fifth site from mid Feb. to end of year.

Hen Harrier: Recorded at 12 sites till May 7th (Winterton) and from Sept. 9th (Cley). Up to 4 at Roydon in Jan., March and Dec.

Montagu's Harrier: None bred, but occasional records of singles in Broads April 20th to Sept. 3rd. North: Titchwell May 25th-27th, Holme May 15th, Sept. 1st. Wash: Snettisham May 28th and Terrington Aug. 6th.

Goshawk: East: Female dead Waxham beach Nov. 30th (OF). North: Hunstanton Park Feb. 26th (HI).

Sparrow Hawk: Recorded at 43 localities, but only a single breeding record. Spring passage Winterton—Horsey Gap March 20th- May 7th with 6-8 April 16th.

Buzzard: North: Holkham Park Feb. 5th, Holme May 8th. East: Winterton March 3rd, 4 on 19th, April 16th. North Walsham 2 May 8th.

Osprey: Broads: Singles recorded between April 24th and June 29th at Blakeney Point, Cley, Earsham, Hickling, Holme, Narford, Pentney, Thornham and Titchwell.

Red-Footed Falcon: East: Winterton June 4th (TEB).

Merlin: Singles (and once 2) recorded at 17 localities till April 28th (Sheringham) and from Sep. 17th (Winterton).

Hobby: North: Cley May 5th, 28th, Sept. 25th-30th, Salthouse June 14th, Holme June 25th/26th, July 22nd, Sheringham May 6th and 13th, Titchwell June 6th, 26th, Oct. 10th, Felbrigg June 12th. Broads: Hickling Sept. 16th, 18th. East: Breydon June 6th, Winterton May 1st, 19th-27th. Wash: Hunstanton April 30th, Terrington Aug. 6th. West: Tottenhill G.P. July 7th.

Peregrine: North: Wintered at Scolt Head until April 8th; noted Holme Aug. 29th. Wash: Snettisham Dec. 31st. Fens: Wisbech S.F. July 12th with jesses and throughout autumn when jesses missing.

Quail: Calling during summer at Massingham Heath, Salthouse Heath, Weybourne (4 birds), Ridlington (2 birds) and 5 seen Aug. 14th, Sheringham (2 birds) with 5 at Happisburgh Aug. 14th. Additional 1976 record: An immature killed by combine out of a party of 6 at Brancaster Aug. 13th.

Golden Pheasant: Recorded at Swaffham Heath, Fowl Mere, Brandon, St. Helen's Well, Bridgham, Stanford, East Wretham, Thompson, Watton, Wolferton and Weeting.

Lady Amherst's Pheasant: Breck: Hockham May 20th.

Spotted Crake: North: Cley Aug. 28th and up to 3 until Sept. 19th; one Oct. 14th/15th. Fens: Wisbech S.F. late Aug. to mid-Sept. East: Earlham Oct. 17th.

Corncrake: North: Holme, Nov. 16th (PRC.)

Crane: North: Wells and Sheringham April 16th (KBS), Cley on 19th (BB, MPL) and Holme on 30th (HBO). East: Bacton April 21st (RC); doubtless same bird.

Oystercatcher: Records of breeding pairs include: East: Breydon area 7. North: Thornham 10-15, Brancaster 11, Scolt Head 170-175, Bob Hall's Sands 2, Overy 4, Wells 8, Stiffkey Binks 14 and Blakeney Point 200. Broads: Horsey 2. Wash: Snettisham 6. Maximum counts in East at Breydon 101 March 16th and 150 Aug. 21st, on Wash at Snettisham 8700 in Jan. and 11500 in Dec.

Avocet: for the first time this century bred successfully in the county. In addition a further pair attempted to breed on The Wash. Breeding: North: Cley one present at the start of the year, was joined by 2 more in early March. By the beginning of May 3 pairs were present increasing to 4 pairs by early June. Clutches were laid by each pair and 6 young were raised from two broods. Wash: one pair, eggs trodden on by cattle. Non-breeders: East: Breydon 1-3 on six dates Feb. 23rd-July 15th, Nov. 26th and Dec. 9th-15th. Broads: Hickling 1-2 May 1st, 3rd, 27th/28th and June 1st. North: Holme 1-3 irregularly May 12th-Sept. 18th, with 5 May 26th. Titchwell 5 flying east June 10th. Sheringham 2 flying west April 8th and Sept. 11th.

Stone Curlew: Extreme dates March 3rd and Oct. 25th. Away from breeding areas reported from Winterton May 8th with 3 May 10th and Holme May 2nd.

Little Ringed Plover: Breeding: 20 pairs at 12 sites. Elsewhere spring records from March 31st at Winterton, Breydon, Hardley Flood, Cley, Stanford and Thompson Water. Maximum counts at Cley 5 July 25th and 11 on 26th. In autumn reported only from Hickling and Earlham.

Ringed Plover: No significant change in number of breeding pairs since 1976, with area totals as follows—East: 17-19. North: 260-320 and West: 34. Of particular interest were 2 young reared on Yarmouth beach and 2 pairs breeding on cliff-top fields at Cromer/Overstrand.

Kentish Plover: East: Breydon April 18th-June 24th and July 5th, intermittent records, with several birds involved. Winterton May 28th, June 5th/6th. North: Cley/Salthouse 1-2 April 11th-June 9th. Blakeney Point 2 Aug. 12th and 14th.

Dotterel: East: Winterton May 26th-28th. North: Mundesley Oct. 8th. Cley May 10th, 11th and 18th-22nd. Wells 8 May 10th. Wash: Snettisham Oct. 8th-10th, 17th and Oct. 20th-Nov. 4th Fens: Ouse Washes Sept. 8th.

Golden Plover: Largest concentration of 2000 at Cley Oct. 29th.

Grey Plover: Wash: Unusually large concentrations at Snettisham with 515 Jan. 9th, 2000 in early April and 660 Sept. 4th.

Sociable Plover: Fens: Welney Sept. 3rd-15th (many observers). The first county record of this vagrant from south-east Russia and west-central Asia.

Sanderling: Single inland record at Hardley Flood March 22nd.

Little Stint: East: Breydon June 19th, 1-2 July 13th-Oct. 25th. Broads: Hickling March 10th, 2 May 22nd-26th, 6 June 2nd, 2 Aug. 7th and 1-9 Sept. 7th-Nov. 12th. North: Cley 2 in Jan., singles Feb. 3rd, March 20th and 27th, up to 5 May 8th-28th, 2 June 18th, 9 July 30th/31st and up to 4 Aug. 4th-Nov. 6th. Holme Oct. 5th-30th.

Weybourne 1 west Nov. 12th. Wash: Snettisham Nov. 20th. Fens: Wisbech S.F. April 2nd-10th and autumn maximum of 4 Aug. 20th.

Temminck's Stint: North: Cley May 10th, 3 May 27th/28th, 2 June 25th, 1-2 Aug. 3rd-Oct. 24th (one bird with a damaged right leg making a prolonged stay Aug. 11th-Oct. 16th.). Edgefield 1 by village pond April 24th/25th. Titchwell June 6th, Holme Aug. 28th. Broads: Hickling June 5th/6th, 2 on 12th, July 27th, 3 Aug. 7th. 19th, Sept. 3rd-8th, 18th, Oct. 17th, 27th and Nov. 4th. Hardley Flood May 23rd and a different individual May 27th. Fens: Wisbech S.F. May 6th and Aug. 20th.

White-Rumped Sandpiper: North: Holme Aug. 28th-Sept. 2nd (G. W. Maybury *et al*).

Pectoral Sandpiper: East: Breydon Sept. 3rd. Broads: Hickling Sept. 4th-20th, with 2 on 15th and another Oct. 13th. North: Cley May 19th and Oct. 2nd-4th. Fens: Wisbech S.F. July 9th and Sept. 2nd-10th.

Curlew Sandpiper: East: Breydon 1-2 May 24th-June 6th; present July 25th-Sept, 23rd with maximum of 12 on July 30th and Sept. 5th. Broads: Hickling May 26th. June 16th-19th, July 27th-Sept. 5th, with maximum of 18 on latter date. North: Cley May 14th-June 6th; present July 13th-Sept. 11th, with maximum of 30 on Sept. 2nd and 11th. Fens: Wisbech S.F. maximum 13 Aug. 27th, last recorded Sept. 12th

Purple Sandpiper: East: Winterton Aug. 28th. Yarmouth Sept. 16th (3) and Dec. 26th. Breydon Oct. 16th. Bacton Nov. 14th. North: during the first winter period recorded only at Sheringham, up to April 22nd. Unusual series of late spring/summer records with singles at Cley May 14th and 18th, Blakeney harbour June 18th and Titchwell June 18th, 26th, July 7th and 13th. Possibly only one bird involved. During second winter period recorded from Aug. 23rd at Brancaster, Holme, Blakeney Point, Cley, Kelling, Weybourne, Sheringham and Cromer. Usually 1-2 but 7 Holme Oct. 2nd and 5 west at Weybourne Oct. 1st. Wash: extreme dates April 10th and Oct. 2nd, with maximum of 4 Dec. 18th at Hunstanton and 7 at Snettisham Jan. 9th.

Dunlin: East: Breydon maximum 4,000 March 10th. Wash: Snettisham maxima 3650 in Jan. and 3500 in Aug.

Broad-Billed Sandpiper: East: Breydon June 5th/6th (PRA, ADB), and Sept. 21st (PRA).

Ruff: Breeding season: Fens: Welney at least one pair bred. North: Cley up to 7 displaying in early May, but no proof of breeding. At other seasons notable concentrations of 170 Welney Dec. 11th; 70 Wisbech S.F. Aug. 27th; 60 Cley Aug. 4th; 40 Hickling Feb. 23rd and 32 Sheringham Aug. 25th. At last locality a pair fed on the lawn of a town garden with starlings.

Jack Snipe: Extreme dates May 7th (Weybourne) and Sept. 18th (Hickling).

Woodcock: Breck: Hockham Fen, an early nest contained 3 eggs Feb. 2nd.

Black-tailed Godwit: Breeding season: North: Cley pair displaying in May and up to 13 present in June but no evidence of breeding. Fens: Welney 8 pairs bred raising 17 young. During winter recorded each month at Breydon except March and 1-2 Snettisham in Jan. and Feb.

Bar-tailed Godwit: Wash: Maxima at Snettisham 1900 Jan. 9th, 2080 Feb. 6th and 3000 Dec. 1st.

Whimbrel: Extreme dates April 16th (Winterton) and Nov. 27th (Holkham). Unusually heavy autumn passage with 100 Blakeney Point July 16th; 101 Breydon July 31st; 50 Wells Aug. 19th and 180 west in 20 minutes Sheringham Aug. 19th following heavy rain.

Spotted Redshank: Unprecedented numbers in Wash at Snettisham with 77 Aug. 3rd and 187 Sept. 13th (PG). Winter records from Breydon Jan. 1st-25th and 2 Dec. 9th-12th.

Greenshank: Maxima in Wash at Snettisham with 20 Aug. 3rd and 19 Sept. 13th. Recorded in winter at Titchwell Dec. 3rd.

Green Sandpiper: Highest counts at Cantley B.F. with 24 July 10th, 25 on 31st and 44 Aug. 7th, including a single party of 24. Recorded during winter months only in East at Breydon and Halvergate marshes.

Wood Sandpiper: Spring passage from April 29th at Breydon, Winterton and Holme. Autumn passage Aug. 2nd-Oct. 27th, with peaks of 25 Wisbech S.F. Aug. 20th and 17 Hickling Aug. 21st. Also reported from Breydon, Cley, Cantley B.F. and Tottenhill G.P.

Common Sandpiper: A wintering bird at Breydon until Feb. 26th. A pair summered at Pentney G.P. with 1 at Breydon June 18th-19th.

Red-necked Phalarope: North: Cley Aug. 23rd, 24th, 31st and Sept. 1st. Broads: Hickling Sept. 3rd and 24th.

Grey Phalarope: East: Yarmouth Nov. 23rd-25th. North: Cley Sept. 18th/19th and Nov. 17th; Sheringham Nov. 23rd; Holme Nov. 28th. Wash: Snettisham Nov. 17th.

Pomarine Skua: Total of over 30. East: Winterton Aug. 20th and 2 Oct. 2nd; Yarmouth Sept. 15th. North: Sheringham June 11th, 2 Sept. 10th, 2 on 16th, 5 on 17th, Oct. 1st and 2 on 2nd; Weybourne Oct. 1st; Cley Aug. 27th, Sept. 1st, 17th, Oct. 2nd and Nov. 12th; Blakeney Point Aug. 27th and Oct. 15th; Holme Aug. 15th, 30th, Oct. 10th, 12th and Nov. 13th. Wash: Hunstanton Sept. 17th; Snettisham 3 Sept. 17th

Arctic Skua: North coast/Wash: In spring a sick bird at Sheringham April 2nd. Autumn passage until Nov. 21st with peaks of 60 at Sheringham Aug. 8th and Snettisham Sept. 17th.

Long-tailed Skua: North: Blakeney Point July 16th (TW,JL) and Aug. 11th (LFW,SW); 2 Cley Sept. 17th (JK *et al*).

Great Skua: East: Winterton Sept. 17th, 25th, 8 Oct. 2nd, 16th, 10 Nov. 13th; Walcot Oct. 1st. North/Wash: Passage Aug. 7th-Nov. 22nd with monthly peaks of 22 Sept. 17th at Snettisham, 65 Oct. 2nd Holme-Hunstanton and 64 Nov. 13th entering Wash at Holme during 3½ hours observation. In addition one dead Old Hunstanton Dec. 18th.

Mediterranean Gull: East: Yarmouth adult July 29th-Sept. 17th. North: West Runton/Sheringham adult March 23rd-26th; Holme May 12th-15th; Scolt Head first-summer May 28th; Snettisham Sept. 17th; Stiffkey Sept. 25th; Sheringham Oct. 20th.

Franklin's Gull: North: West Runton Oct. 29th 1976 (GRH, JVH, DH). An addition to the county list.

Little Gull: Records of singles in May at Breydon, Cley and Holme. Recorded away from coast at Hardley Flood May 27th, Denver Sluice Aug. 5th/6th, Hickling Aug. 21st and Tottenhill G.P. Sept. 3rd. Remarkable numbers passing offshore Nov. 12th/13th with 213 flying south in 3½ hours at Winterton, 100 at Cley, 118 at Sheringham, 60 at Holme and 103 at Weybourne, including 12 moving inland, December records from Yarmouth and Burgh Castle (3rd), Overy Staithe (14th), and Sheringham (29th).

Sabine's Gull: East: Yarmouth Sept. 15th/16th; Winterton Sept. 17th. North: Blakeney Point 3 adults Aug. 27th; Cley Aug. 27th 1-2 Sept. 8th, 17th and Oct. 29th.

Black-headed Gull: Breeding colonies reported as follows: Cantley B.F. 130 pairs, North Wootton Marshes 10 pairs, Stiffkey Binks 30 pairs, Scolt Head 600 pairs, Titchwell 30 pairs (a new colony) and Blakeney Point 300 pairs.
Common Gull: North: Blakeney Point one pair bred rearing one chick.
Lesser Black-backed Gull: Peak passage totals of 54 west Sheringham April 2nd and 53 Breydon Aug. 25th.
Iceland Gull: North: Sheringham first winter March 5th; Holme March 26th.
Glaucous Gull: East: Yarmouth Oct. 16th, Nov. 22nd and 27th. North: Cley-Sheringham extreme dates of regular wintering adult (recognized by damaged right foot and leg) March 6th and Sept. 3rd. In addition a second bird flew east Feb. 27th, while gales in November resulted in 5-7 flying west on 17th and 6 west on 21st. Elsewhere noted at Holme Jan. 6th, Nov. 17th and Dec. 8th; Blakeney Point 2 Sept. 27th and Wells Nov. 23rd.
Kittiwake: North/Wash: Hunstanton several thousand passing west Nov. 12th/13th and Brancaster 5-10,000 on 17th.
Gull-billed Tern: East: Breydon June 6th (PRA). North: Cley Aug. 28th (RA, CRI).
Caspian Tern: Central: Swanton Morley GP July 11th (JK *et al*).
Sandwich Tern: Earliest record Scolt Head and Sheringham March 18th. Breeding: North: Scolt Head 3,000 pairs (1,200 flying young); Stiffkey Binks 91 pairs; Blakeney Point 1,700-1,800 pairs (600 flying young). Two reported inland in Fens at Downham Market June 15th and 20th. Late birds Nov. 13th at Sheringham, Cley (2) and Hunstanton.
Common Tern: Extreme dates March 27th (Cley) and Nov. 2nd (Cley) with reports of 'comic' terns at Blakeney Nov. 12th and Weybourne Nov. 21st. Breeding: number of pairs (with number of fledged young in brackets where known). East: Breydon 17 (6) a new colony on a man-made raft. Broads: Ormesby 3 (8), Ranworth 32 (55), Hoveton 4, Martham 3 (6), and Hardley Flood 16 (39). North: Thornham 3, Titchwell 3 (2), Overy Staithe 4-5, Wells 15, Stiffkey Binks 119, Bob Hall's Sand 34, Scolt Head 300 (175) and Blakeney Point 1200-1400. Wash: Snettisham 60 (45). Inland non-breeders (away from Broads): Swanton Morley G.P. 4 from April 30th and Earlham Park G.P. 1-6 July 20th-Aug. 8th.
Arctic Tern: Breeding: North: Stiffkey 1 pair, Scolt Head 2 pairs and Blakeney Point 2 pairs. Broads: Hickling 4 July 24th. Last recorded at Sheringham Oct. 16th.
Little Tern: Extreme dates April 21st (Winterton) and Oct. 2nd (Snettisham). Breeding: (number of pairs) East: Sea Palling-Waxham 3, Waxham-Horsey 9, Winterton 8-10, Winterton-Hemsby 1, Caister on Sea 8, Yarmouth 5 and Breydon 1-2. Broads: Hickling 30 (rearing 41 young). North-Blakeney Point 180-200, Brancaster 7 (10-12 young), Thornham 35 (only 2 young), Holkham 3, Wells-Overy Staithe 35-40, Overy Staithe Harbour 18-20, Stiffkey Binks 20, Bob Hall's Sand 7, Scolt Head 68 (18 young) and Titchwell 24. Inland recorded at Denver Sluice Aug. 7th.
Black Tern: Spring passage May 8th-June 22nd with noticeable peak May 26th/27th. During this two-day period 60 at Breydon, 34 Winterton, 11 Cley, 3 Titchwell, 5 Holme, 10 Hardley Flood, 14 Colney G.P., 20 Swanton Morley G.P. and 9 Denver Sluice. Also 3 flying north-east East Wretham Heath May 22nd. October records on 13th Cley (2) and 19th Hickling.
White-winged Black Tern: North: Cley adult June 2nd-9th (WFB, JK *et al*). Broads: Hardley Flood May 26th-28th (JCE, DAD, DJH). Fens: Welney 2 May 23rd-25th (GHS). Additional 1976 record: Cley July 14th (RL, SCL).
Razorbill: Largest numbers: North: Sheringham 240 east in 2 hours Oct. 11th (JCM). East: Winterton 174 north in 80 minutes Dec. 31st (PRA).
Black Guillemot: North: Sheringham Sept. 26th, Salthouse Oct. 31st and Wells harbour Jan. 2nd to 29th.

Little Auk: North- Cromer Nov. 16th, Cley oiled bird April 11th/12th, 10 Oct. 29th and Nov. 17th, Weybourne 6 Nov. 21st, Brancaster dead Feb. 1st, Thornham accompanying Starlings Oct. 22nd with same or another next day and Titchwell dead April 9th. East: Happisburgh dead on main coast road Nov. 24th, Yarmouth Nov. 16th.
Puffin: North: Fifteen autumn/winter records of up to 7. East: Winterton dead Dec. 19th.
Woodpigeon: North: Holme assembly of 4000 headed west April 27th.
Turtle Dove: Breck: 680 at a duck farm Foulden June 23rd increasing to 820 on 27th; all had dispersed by mid-July. North: Sheringham 270 west May 29th, Cley total of 406 west June 5th to 11th including 243 on 8th. East: Late individual Yarmouth Nov. 23rd.
Ring-necked Parakeet: Recorded at High Kelling Nov. 5th, Cley Oct. 13th, Winterton July 2nd, Blakeney March 8th/10th, Sheringham April 28th and Holme Feb. 6th.
Great Spotted Cuckoo: North: Cley-Salthouse Oct. 21st (CEH, MSH, GGW *et al*).
Barn Owl: Recorded at 76 localities.
Little Owl: Recorded at 24 localities.
Long-eared Owl: Single pairs bred at Fritton, Kelling Heath and East Wretham. Breeding season records from Massingham Heath, South Wootton and Hickling. Wintering birds at Massingham Heath, Ringstead, Strumpshaw and Welney (3). Single migrants in off sea at Holme April 9th and 23rd.
Short-eared Owl: Bred at Sculthorpe. Breeding season records at North Wootton and Tunstall (carrying food). Maximum winter numbers: Halvergate 8, Scolt Head 5 and Ouse Mouth 8. Single migrants in off sea at Cley Sept. 25th, at Winterton Oct. 7th, at Salthouse on 9th and at Cley Nov. 17th and 28th.
Nightjar: North: Blakeney Point migrant Aug. 21st. Breeding: Away from Brecks singing males as follows: Salthouse Heath 6, Kelling Heath 4, Sandringham 3, Wolferton 1 and Winterton 1.
Swift: First record, Hickling April 27th. 1000+ moving eastwards Sheringham Aug. 17th during ENE gale. Latest record, Cley Oct. 14th.
Kingfisher: Breeding confirmed at Brampton, Cantley B.F., Fritton area (3 pairs), Hunstanton, North Walsham, Snettisham, South Creake and Strumpshaw. At Brampton the nest was in overturned tree roots and one at Fritton was in the base of a fallen oak
Hoopoe: In spring singles between Bircham and Houghton April 30th and at Surlingham for at least a fortnight up to May 3rd. In autumn Sheringham Aug. 18th and Wells/Holkham Aug. 20th-30th joined by a second bird 26th-30th.
Wryneck: Spring records as follows: Wells May 2nd and 22nd. South Wootton May 5th and West Runton May 17th. In Autumn first recorded Aug. 13th, followed by large daily falls of migrants Aug. 18th-21st. on North and East coasts with maximum numbers as follows:- 14 Blakeney Point 19th, 10 Wells/Holkham 20th, 11 Winterton and 13 Sheringham 21st. During this period inland records at Reepham 21st, Hickling 19th-21st with 2 on 22nd, Norwich 23rd and Wickhampton (dead) 28th. Most migrants had moved on by end Aug. and surprisingly only two September records: Blakeney Point 3rd and Castle Acre 11th-14th. Two late records in October: Horsford 5th and UEA, Norwich 13th.
Woodlark: Recorded at 11 localities in Brecks in breeding season. Elsewhere Winterton March 6th, two flying south at Eaton, Norwich March 16th, Weybourne Nov. 5th and Salthouse Nov. 12th.
Shore Lark: Extreme dates May 14th and Sept. 25th. Occasional records of up to 5 at Breydon, Winterton, Morston, Holkham, Scolt Head, Burnham Overy, Holme and Snettisham. Majority of records from Sheringham-Cley where monthly maxima as follows: Jan. 30, Feb. 35, March 31, April 30, May 12, Oct. 12 and Nov/Dec. 8 Also 14 Hickling Nov. 27th.

Sand Martin: Late October migrants at Weybourne on 28th and Cley on 31st.
Swallow: Under a low railway bridge between Berney Arms and Reedham a nest which had accumulated over 8/10 years to a height of 18 inches had eggs in topmost nest. An Albino between Little Melton and Hethersett Oct. 23rd. A considerable number of late birds on North coast in November with latest at Cley on 17th. One December record, Toftwood on 17th.
Red-rumped Swallow: North: Cley June 11th (RJF, PN, NJR). The third county record.
House Martin: An early migrant at Winterton March 8th. Many November records including 82 north at Winterton and 23 west at Sheringham on the 12th. Latest birds, Hardley Flood (2) on 20th, Framingham Earl on 21st and Norwich on 28th.
Richard's Pipit: Largest numbers since 1970. East: Winterton-Horsey 1-4 almost daily Oct. 1st-23rd and one Dec. 31st, the latest county record. North: Sheringham Sept. 28th and up to 4 Oct. 20th-25th, Weybourne 2 Oct. 27th and Nov. 5th-7th, Cley 1-2 Oct. 13th-28th; Blakeney Point Oct. 13th, Stiffkey Sept. 22nd and 25th and Oct. 10th, Warham Oct. 1st/2nd, Wells Oct. 7th, 3 11th, 2 12th-18th (one different bird from the 11th) and 23rd, Holkham (Gun Hill) at least 2 Oct. 11th-13th and 2 Oct. 29th, Scolt Oct. 16th-29th with 2 on 27th, Burnham Overy Oct. 16th and Holme Oct. 1st/2nd and 10th-28th.
Tawny Pipit: North: Sheringham Sept. 24th (MF, KBS, MPT) and Cley Oct. 21st (IRC, CRL, GGW). Holme March 19th-April 10th. A very early arrival date and a prolonged stay.
Meadow Pipit: East: A pale buffish bird Breydon Jan. 1st-30th.
Red-throated Pipit: North: Cley May 18th (MFS) and Kelling May 29th-31st (many observers). The fifth and sixth county records.
Water Pipit: Most regularly seen at Hickling where singles Jan.-April, first recorded in Autumn Oct. 22nd increasing to 6 early Nov. and up to 3 in Dec. Elsewhere singles at Cley in April and Oct., Winterton in Oct. and Dec. and Cantley B.F. in Jan. and Oct., where 3-4 end Nov.
Yellow Wagtail: A very early bird at Sheringham March 13th.
Blue-headed Wagtail: East: Breydon April 28th-May 27th with other singles May 1st and 6th, Happisburgh 2 April 26th and 4 on 28th. Broads: Hickling 2 April

22nd and one 30th. North: Cley/Salthouse April 10th/11th, up to 2 20th-23rd, May 8th/9th, 2 June 4th and singles July 17th and 30th, Titchwell May 30th.

Grey-headed Wagtail: North: Salthouse June 5th.

Ashy-headed Wagtail: North: Cley May 7th-9th (RC, KB *et al*). The fourth county record of this race.

Grey Wagtail: Breeding records from Taverham, Lenwade, Lyng, Ellingham, Gressenhall and along River Nar (6 nests).

Pied Wagtail: An unusual concentration of 200 near Rackheath Church Oct. 5th. A roost of 100 birds in small reed bed at East Tuddenham early Nov.

Waxwing: Only a small number of records: Costessey Feb. 5th, Wells Nov. 17th with 2 19th/20th, Swaffham Nov. 21st and 23rd, Eaton 2 Nov. 26th, Wiveton 2 Dec. 1st and Hellesdon Dec. 24th-27th.

Black-bellied Dipper: Singles recorded at the following localities: Old Costessey Jan. 22nd, Keswick Mill Feb. 4th, Hellesdon Mill Feb. 6th, Gunton Park Feb. 14th-20th, Honingham up to Feb. 24th and Gressenhall in Nov./Dec.

Thrush Nightingale: North: Holme trapped May 14th (PRC). The bird was not seen in the field before or after capture. The first county record.

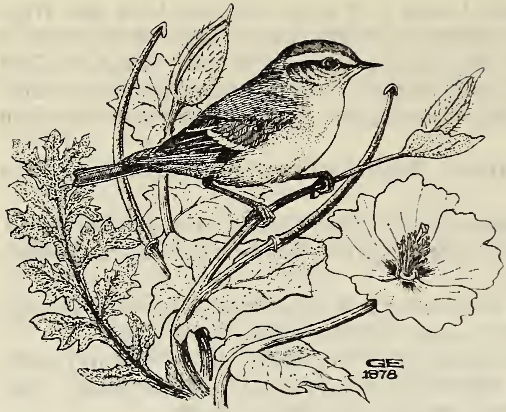
Nightingale: Passage birds at Sheringham April 30th, Titchwell May 14th and Blakeney Point Aug. 20th.

Bluethroat: Two spring records: Holme May 8th/9th and Weybourne May 21st. The only two autumn records were both unusually late: Happisburgh Oct. 2nd and UEA, Norwich Oct. 12th, the first inland record for many years.

Cetti's Warbler

Black Redstart: Breeding: Yarmouth 3 pairs, 2 of which definitely bred, and Weybourne one pair, but no proof of breeding. Winter records from Sheringham in Jan. and Feb. and Titchwell Jan. 9th. Spring migrants March 10th-April 25th including inland records at Mulbarton, Norwich and Reepham. Isolated records Holme May 13th and Aug. 7th. Autumn records Sept. 18th-Nov. 6th with maximum of 4 Blakeney Point Oct. 15th.
Redstart: Breeding season records from 9 Breck localities. A very late migrant at Holme Nov. 18th.
Whinchat: Present in breeding season at Bridgham Heath, Frog Hill, Stanford, Sturston Warren and Weeting. Late migrants at UEA, Norwich Nov. 8th and Snettisham Nov. 12th.
Stonechat: Two breeding pairs at Weybourne and six pairs at Winterton-Horsey. A sudden influx at Holme March 6th when 24 present with 6 next day.
Isabelline Wheatear: East: Winterton May 28th (PRA, TEB). The first county record.
Wheatear: Extreme dates—March 6th (Holme) and Nov. 12th (Snettisham). Only breeding locality reported away from Brecks was Kelling Heath.
Siberian Thrush: East: Yarmouth male Dec. 25th (P. J. Wilkinson). First county record of this vagrant from Asia. Accepted by Rarities Committee Sept. 1978.
Ring Ouzel: An early record Burnham Overy March 12th. Main Spring migration March 26th-May 28th with largest numbers April 17th-27th including 13 Salthouse Heath on 21st. A male at Wiveton Down on the unusual date of June 23rd. Autumn passage Sept. 24th-Nov. 3rd with maximum of 7 at Wells/Holkham Oct. 7th.
Fieldfare: Latest spring record Swafield May 24th. East: a pair summered for third year running, but again no evidence of breeding. First recorded in Autumn Aug. 21st at Wells and Blakeney Point.
Redwing: Late spring records at Holme May 19th (singing) and Holkham May 22nd. At an East Norfolk locality 4 still present May 29th and a pair again summered, but no evidence of breeding.
Mistle Thrush: A large flock of 75 at Gunton Feb. 21st.
Cetti's Warbler: Broads: Total of 25 singing males in Yare valley at Rockland, Wheatfen, Surlingham and Strumpshaw. Elsewhere, 2 males in song at Hoveton and at Hickling (from Oct. 11th) and another at Smallburgh.
Grasshopper Warbler: Two October records, Hickling on 5th and Happisburgh on 19th (trapped).
Savi's Warbler: Broads: Hickling present from April 26th and 3 singing by July. One bird also seen carrying food (SEL). Horsey pair seen, male singing, in August (JJB).
Sedge Warbler: A pure albino at Wells on Aug. 14th (GED, SCJ)
Icterine Warbler: A remarkable series of falls in the Autumn, mainly on the North coast. All records are listed *and refer to August*, unless otherwise stated:

East: Winterton 21st. Waxham 16th, 18th, 21st, 22nd and 28th. Inland: North Walsham (Crane Fruehauf factory) 10th. North: Sheringham 15th, 17th, 20th, 30th and Sept. 3rd (all trapped). Blakeney Point 8 7th, 4 8th, 2 13th, 5 14th/15th, 2-3 16th, 3 17th, 4 18th, 8 19th, 2 20th, 4 21st, 22nd/23rd, 29th and Sept. 1st. Morston Sept. 1st. Wells/Holkham 3 8th, 11th, 14th, 15th, 2 17th, 4 20th, 3-4 21st, 27th, 28th, 30th and 31st. Holme 7th a new bird 8th, 4 9th, 13th, 17th, 18th, 3 19th, 20th, 22nd and 23rd. Old Hunstanton 15th (retrapped 20th) and 18th (also trapped).
Barred Warbler: East: Winterton Aug. 27th/28th. North: Beeston Regis Aug. 24th Sheringham Aug. 16th & 20th (retrapped 24th). Weybourne Aug. 16th and Oct. 3rd. Cley Aug. 28th and Sept. 1st-4th. Blakeney Point 2 Aug. 8th, 12th, 13th, 2 18th, 19th, 2 20th, 22nd, 23rd and Sept. 15th-17th. Wells/Holkham Aug. 21st, 27th, 2 28th and 2 Sept. 5th. Holme 2 Aug. 23rd and Sept. 3rd. Hunstanton Aug. 22nd.
Garden Warbler: October records at Wells until 18th and Sheringham until 22nd.



Greenish Warbler

Blackcap: January records: 3 separate birds at Sheringham (2 trapped), Cley 13th/14th, Acle 23rd and up to 4 at Holme. In February 2 at Holme, 3 at Sprowston (2 trapped) and Hunstanton 23rd.

Greenish Warbler: North: Blakeney Point Aug. 12th (AMH), two 13th, one remaining until 15th (many observers). Holkham Aug. 20th/21st. (SDH, SCJ).

Arctic Warbler: North: Wells Sept. 18th-23rd (GED, S. Gantlet, *et al*). The eighth county record.

Yellow-browed Warbler: North: Wells/Holkham 2 Sept. 20th/21st, Oct. 7th, 3 Oct· 8th and 2 Oct. 9th, Blakeney Point Sept. 20th, Holme Sept. 21st-24th and Weybourne Sept. 22nd.

Dusky Warbler: Additional 1976 record: North: Wells Oct. 16th (JDS, GGW) the eighth county record.

Bonelli's Warbler: Additional 1976 record North: Holkham Sept. 14th (HS, DW). Almost certainly the same bird as that seen on Sept. 5th (1976 NBR).

Wood Warbler: Spring migrants at Thornham May 20th and Wells May 22nd. Singing males in breeding season at Blickling, Castle Rising, Felthorpe, Great Hockham, Kelling, Narborough, Sheringham and West Runton. Autumn migrants as follows: East: Yarmouth Aug. 18th and 23rd. North: Sheringham Sept. 25th (trapped), Blakeney Point Aug. 10th, 2 13th/14th and 15th, Wells/Holkham 2 Aug. 17th, 18th and 3 21st, Holme Aug. 7th, 9th, 18th, 21st and 22nd, Old Hunstanton Aug. 19th (trapped).

Chiffchaff: Early spring arrival from March 6th (Beeston Regis). Up to 3 Wells/Holkham late Sept.-early Oct., showing characteristics of *abietinus*. A late bird at Salthouse Nov. 20th feeding on shingle with Snow Buntings. Winter records: Cantley B.F. Feb. 12th and birds of Northern race *abietinus* trapped Sheringham Jan. 15th-18th and Dec. 4th (2).

Firecrest: Only a small number of records: Holme 2 March 20th, one 21st-24th, Wells/Holkham 2 April 11th, 12th, 17th and Oct. 28th, Yarmouth Sept. 24th, Winterton Sept. 25th and Bradwell Nov. 9th.

Red-breasted Flycatcher: North: Holme Sept. 17th, Blakeney Point Sept. 20th and a different bird Sept. 22nd/23rd and Wells Oct. 9th.

Pied Flycatcher: A total of 14 migrants in Spring April 30th-June 1st, including inland records at Felbrigg, Kelling Heath, Honing and Swafield (2). Large Autumn falls of 75 Blakeney Point Aug. 15th and 50 Aug. 19th; 70 Yarmouth Aug. 18th. A late bird at Yarmouth Oct. 23rd.

Bearded Tit: Breeding records include one pair at Dersingham, 15 pairs at Titchwell (maximum count of 76 Dec. 4th), at least 12 pairs at Cantley B.F. and 10 pairs at Strumpshaw, where late Autumn maximum of up to 300 birds. Other Autumn migrants as follows: Mundesley 2 Oct. 8th, Sheringham 2 Oct. 29th, Weybourne up to 5 Oct. 14th-Nov. 29th, Scolt Head 13 Oct. 20th, Holme 15 Oct. 8th and Snettisham where 4 Sept. 27th and 8 Oct. 14th, with 2 remaining until Nov. 12th.

Golden Oriole: East: Winterton May 15th and June 11th (PRA, ADB). North: males seen in flight at Holkham May 28th (GED, SCJ), Titchwell June 28th (RK) and Sheringham July 5th (BB).

Red-backed Shrike: Spring migrants at Cley May 8th, Holkham May 24th, Holme May 27th/28th and June 1st and Gorleston May 28th and 31st. In breeding season at least 10 pairs present at 6 localities but young only reared from 3 nests, including a new site in North-east Norfolk. Isolated records also from 6 other localities including several former breeding areas and at least one other suitable new locality. A major Autumn influx, on a larger scale even than that which occurred in 1976: Broads: Hickling Aug. 20th-22nd, and 27th. East: Gorleston up to 3 Aug., 18th-Sept. 2nd, Yarmouth 1-3 Aug. 18th-26th, Winterton influx commenced Aug. 18th, peak of 12 on 21st, 9 still present on 27th (last record Oct. 1st), Waxham Aug. 16th, 3 18th and 21st, 6 22nd, 3 remaining 28th, Happisburgh Aug. 14th-22nd and 28th. North: East Runton 2 Aug. 30th and one 31st, Beeston Aug. 13th, 2 20th/21st, 24th, 27th and Sept. 1st-4th, Sheringham Aug. 7th, 11th and 1-4 15th-28th and one Sept. 25th-28th, Cley Aug. 13th, 3 Aug. 14th, 17th, 22nd and 27th. Blakeney Point 1-4 on most days Aug. 7th-23rd, Morston Sept. 1st, Wells/Holkham up to 7 Aug. 13th-Sept. 2nd, Scolt Aug. 20th/21st, Burnham Overy Aug. 21st, Brancaster Aug. 24th & 29th and Sept. 3rd, Titchwell 2 Aug. 20th and Holme Aug. 13th, up to 4 Aug. 17th-Sept. 4th.

Lesser Grey Shrike: Fens: Downham Market June 8th (CO'N).

Great Grey Shrike: Winter records up to April 15th and from Oct. 9th. Recorded at 22 localities.

Woodchat Shrike: North: Sheringham July 5th-8th (JCM *et al*) and Cley Sept. 24th-25th (BR *et al*)

Hooded Crow: Following heavy snowfall 23 arrived at Smallburgh Jan. 16th; also 27 Sandringham Jan. 18th. Most records in April when concentration of birds during cold weather prior to departure, including 44 at Sheringham on 16th, 24 at Winterton on 21st and 36 at Bacton on 22nd.

Brambling: Concentrations of 6-800 at Heggatt March 25th and 1500 at Marham Nov. 26th.

Serin: North: Wells April 11th/12th (LE,DF).

Goldfinch: East: Happisburgh 750 moving north early on May 6th and a similar movement of 1,200 on May 13th.

Siskin: Only flocks reported were in second winter period including 48 at Narford Oct. 6th and at least 80 Gunton Park Dec. 16th.

Linnet: North: Sheringham peak westerly movements 3,000 on April 16th and 2,500 on 26th. East: Happisburgh largest northerly movement 2,000 early morning May 1st.

Twite: North: Winter counts included 500 at Titchwell, 300 at Wells and 250 at Thornham.

Mealy Redpoll: Only records: Morston Sept. 22nd and Happisburgh 3 Oct. 28th, one trapped on 29th.

Crossbill: Recorded at several localities in Brecks with maximum of at least 25 East Wretham March 3rd. Elsewhere several parties Felthorpe area in June including immatures, 10 Kelling Heath June 5th, 3 Sheringham third week of July and 5 there Oct. 21st and Wells Sept. 23rd.

Hawfinch: Only regularly recorded at East Wretham where maximum of 36 Jan. 22nd and April 3rd. Also irregularly seen at Santon Downham (two juveniles recorded), Felthorpe (unsuccessful breeding) and Framingham Earl. Elsewhere: Tottington Jan. 3rd, 6 Narford Jan. 6th, 2 Didlington Jan. 23rd, Tommy's Belt (Stanford Battle Area) April 24th, Buckenham Tofts May 28th, 3 Lower Kelling Sept. 8th and Gooderstone in Dec.

Lapland Bunting: In Jan. and Feb. up to 5 noted at Kelling, Cley and Morston. A male at West Runton May 27th-29th. In Autumn recorded in much larger numbers than in recent years with at least 150 birds on the North coast and Wash in October at numerous localities with a maxima of 38 Cley 22nd/23rd and 15 at Sheringham and Holme. On East coast total of 46 flying south at Winterton Sept. 14th-Oct. 29th including 14 on latter date. Peak of 10 at Breydon Nov./Dec. One Gorleston Oct. 18th-20th. Two inland records: one flying west Norwich (Thorpe) Oct. 16th (when noticeable arrival on north coast) and 15 Halvergate Dec. 26th.

Snow Bunting: In first Winter period 200 at Holme and 88 at Snettisham in Jan. and 250 at Kelling and 100 at Happisburgh in Feb. Last noted at Cley April 23rd. In Autumn recorded again from Sept. 14th (Winterton) with 300 at Cley/Salthouse and 100 at Weybourne in Oct. and up to 55 at Breydon in November.

Ortolan Bunting: North: Blakeney Point Aug. 13th/14th (many observers), Stiffkey Sept. 23rd (GED) and Salthouse Sept. 24th (SCJ).

Little Bunting: North: Stiffkey Sept. 22nd-26th (PM *et al*). The ninth county record.

The following, not mentioned in the Classified Notes, were also recorded in 1977 ((*breeding species in italics*): *Mute Swan*, *Canada Goose*, *Mallard*, Scaup, *Kestrel*, *Red-legged Partridge*, *Grey Partridge*, *Pheasant*, *Water Rail*, *Moorhen*, *Coot*, *Lapwing*, Knot, *Snipe*, *Curlew*, *Redshank*, Turnstone, Herring Gull, Great

Ortolan Bunting 

Black-backed Gull, Guillemot, *Stock Dove, Collared Dove, Cuckoo, Tawny Owl, Green Woodpecker, Great Spotted Woodpecker, Lesser Spotted Woodpecker, Skylark, Tree Pipit,* Rock Pipit, *Wren, Dunnock, Robin, Blackbird, Song Thrush, Reed Warbler, Lesser Whitethroat, Whitethroat, Willow Warbler, Goldcrest, Spotted Flycatcher, Long-tailed Tit, Marsh Tit, Willow Tit, Coal Tit, Blue Tit, Great Tit, Nuthatch, Treecreeper, Jay, Magpie, Jackdaw, Rook, Carrion Crow, Starling, House Sparrow, Tree Sparrow, Chaffinch, Greenfinch, Bullfinch, Yellowhammer, Reed Bunting and Corn Bunting.*

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FEEDING WILDLIFE IN THE GARDEN

by Dr I F Keymer

Providing food for wild creatures is a satisfying pastime for many people. It is practised even by those who have only the slightest interest in or knowledge of natural history. Birds such as house sparrows, chaffinches, blackbirds and tits are the species most eager to take advantage of the household scraps provided in this way. The enthusiasts, however, take more trouble to provide a greater variety of food and thereby attract a wider variety of birds and sometimes squirrels and hedgehogs. There is little doubt that in hard winters the lives of some species, especially small birds, are saved by such artificial feeding. It is important to realise, however, that providing food artificially is not always as beneficial or harmless as it may seem.

The fact that wild species have similar nutritional requirements to ourselves and to domestic animals is often not realised. Even when some species have evolved to eat highly specialised foods they still need water and a basic diet that contains carbohydrates, fats, protein, vitamins and minerals, although the proportions may vary according to the type of animal.

It is a common fallacy that animals instinctively know what is good for them. Unfortunately, like ourselves, they can develop cravings for foods which are harmful when eaten in large quantities. Foods which should *never* be fed include long strips of bacon rind, especially if raw, and shredded or dried coconut. This type of coconut and even dry bread can swell up inside the crop or stomach and cause impaction that can lead to discomfort or death. Only fresh coconut should be offered, and bread should be soaked in water or milk before feeding. Long strips of bacon rind may choke birds and also produce impactions because they take a long time to digest. Most people love salted peanuts and the same applies to many birds and squirrels. For this reason therefore peanuts containing high concentrations of salt are not recommended because an excessive amount of salt in the diet can be dangerous, especially to young birds. Only fresh nuts should be fed. However, nuts contain a high proportion of phosphorus and a substance called phytic acid which interferes with the absorption of calcium. If nuts, therefore, are eaten in quantity by young growing animals over a long period there is a danger that they will interfere with normal bone formation and help to produce the disease known as rickets. Indeed, I have found evidence that feeding nuts in large quantities may have caused a disease of this kind in a young red squirrel that died of pneumonia in Norfolk.*

Other foods which should be presented in small quantities, or for strictly limited periods of the day, include lumps of fat and even soaked bread. Such foods are of limited nutritional value, although they are a source ot energy and quickly fill an empty stomach. This is important for small birds first thing in the morning after roosting through a cold night or late in the afternoon before going to roost, but if birds are given this type of food in the middle of a winter's day the sense of well being that is probably produced could easily slow down normal feeding activities. It is quite possible that this could result in death later in the night,

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*See I. F. Keymer and J. M. Hime (1977) Nutritional osteodystrophy in a free-living red squirrel (Sciurus vulgaris). Veterinary Record 100. 31-32.

because it is important for birds, especially small ones, to go to roost with a full crop and enough food inside them to maintain their body temperature until dawn.

In addition to the disadvantages already mentioned of feeding foods such as nuts, there is also published evidence that feeding excessive quantities of white bread to birds can lead to vitamin deficiencies. This is most likely to affect pigeons and some other birds in town parks where other sources of food supply are limited. It is also on record that when an excessive amount of fat is fed by parent tits to their nestlings this can prevent proper feather development with the result that the young readily fall prey to cats.

The experiences that I have quoted clearly show that regular artificial feeding of wild birds, and even of such animals as squirrels, may interfere with their natural feeding habits and make some species too dependent upon man, thus leading to unfortunate and unexpected results. Any regular concentration of birds around feeding tables soon becomes well known to local cats, as many bird watchers will be aware. What is not well known, however, is that there is evidence that a build up of disease producing bacteria known as *Salmonella* may sometimes occur in places where small birds such as house sparrows and greenfinches regularly gather. In addition to being lethal to wild birds many strains of these organisms can also infect domestic animals, and even man occasionally causing severe illness. This, therefore, is yet another consequence that should be borne in mind. The obvious problem which now arises, is how the above disadvantages can be overcome. Firstly, in my opinion, wild birds and other animals should not be allowed to become too dependent upon artificial feeding. There is, I agree, a very good case for providing food and water during severe weather conditions such as frost, snow, or drought, especially early in the morning and late in the afternoon. The food should be placed where it is easily found by the animals for which it is intended. Wild animals spend most of their waking hours searching for food, so there is little reason to worry about the food being overlooked if it is scattered about the garden instead of always being put in the same place.

The next thought which will come to mind is the type of food which should be fed. There is surprisingly little advice readily available on this important topic, although the R.S.P.B.† produces a leaflet which gives guidance on how to present food to garden birds and encourage them by growing types of shrubs which bear berries. Briefly, however, the greater the variety of food that is provided the better. Not only will this minimise the possibility of dietary deficiencies occurring, but it will also attract a greater variety of species. In addition to halved, fresh coconuts to attract tits and household scraps comprising the usual crumbs, pieces of meat, stale cakes or buns and lumps of fat, the following are also suitable and will attract both seed eaters and fruit eaters:—cheese and rinds, baked potatoes, hard-boiled eggs, corn, and bruised apples or other fruit including sultanas and currants. Proprietary seed mixtures for cage birds such as canaries, budgerigars and parrots and the special mixtures prepared for so-called "softbills" (predominantly insectivorous species) are very good, but expensive. Meal worms and maggots are also appreciated by insectivorous species, but are also relatively expensive to buy. Similarly proprietary wild bird foods and even tinned cat and dog foods are relished by many birds. Some ornithologists even make special "puddings" based chiefly on mixtures of mutton fat, coarse oatmeal, flour and water. In fact most of the foods I have recommended can be used in the preparation of these puddings and, if thought necessary, baked in an oven.

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†Leaflet entitled "Information on Feeding Birds". Obtainable from the Royal Society for the Protection of Birds, The Lodge, Sandy, Bedfordshire, SG19 2DL.

Most people seem to know that hedgehogs relish bread and milk and in moderation this is a suitable diet for them. However, being carrion eaters they will also eat meat scraps as well as eggs. In addition to liking nuts, squirrels will also take currants and sultanas, but all these should be fed in moderation and indeed especially in Norfolk and Suffolk the destructive grey squirrel should not be encouraged by artificial feeding, because our native red squirrel that still occurs in soms areas is slowly dying out and being replaced by this species. You are unlikely to want to encourage other mammals into your garden, but don't forget that foxes are rather partial to poultry!

Dr Keymer has offered to carry out post-mortem examinations on wild mammals and birds, free of charge to NNT members.

Carcases should be refrigerated (NOT deep frozen) for 12 hours before dispatch securely wrapped in airtight containers. A complete history should be provided where possible.

Address packages to Dr I. F. Keymer, M.A.F.F. Veterinary Investigation Centre, Jupiter Road, Norwich NR6 6ST and mark "Urgent: pathological specimen".

This offer is confined to wild animals, NOT pets.

HIBERNATION HABITATS OF BATS IN NORFOLK

JOHN GOLDSMITH

"Where do bats go in winter?" This is a question often asked me. Do they perhaps seek the same places as the proverbial fly, their insect food? Reading the standard text books on the subject will supply only part of the answer. Recent research provides a little more and conjecture has to fill in the rest! Most of my searching for the winter habitats of bats has, in fact, been confined to those species in this county which "go underground", that is, Long-eared, Natterers, Daubenton, Whiskered and Brant's bat.

Hibernation for these species is not usually the uninterrupted sound slumber for for six months that may be imagined. They certainly fatten up during the autumn then become torpid in their chosen site. However, they will wake up as frequently as humidity and temperature changes occur and move to a site where better conditions prevail. This means, of course, that even a single visit by a human to a particular site could upset this delicate balance and force a site change. The humidity recorded at sites where bats are hibernating shows they usually need over 80% relative humidity. This prevents the delicate wing membranes drying out. The temperature must not fluctuate much and must lie somewhere between the approximate figures of 3 deg. C and 12 deg C. Good indicators of suitable conditions are mosquitoes, *Eristalis* flies and Herald Moths. The latter, incidentally always face towards the entrance of the cave.

The traditional site in which hibernating bats are found is of course caves, but Norfolk has no natural caves, only man-made caves in chalk at four sites which are still penetrable. There are many records of chalk workings details of which have been long forgotten. Some of these are rediscovered by accident during building operations, such as those at Thetford and Grape's Hill in Norwich. Another category is exemplified by the "Harford tunnels", south of Norwich, whose whereabouts

Brent Geese at Holme Broadwater. Brents lingered at Brancaster until the last days of May; the first birds returned to Snettisham, Brancaster and Blakeney by mid-September.
Photos P. R. Clarke

The Yellow-necked Mouse surpasses its closest relative, the Wood Mouse in size and vividness of colouring. *Photo R. Hancy*

This attractive white Fallow Deer buck was seen by many observers at Taverham until it met an untimely end at the beginning of the year. *Photo Eastern Daily Press*

is known fairly precisely, but the enthusiasm, the will or the money is not forthcoming to re-open them for further geological research and, of course, to provide more winter homes for bats. Besides these, there are the fictional ones which appear in local tales and ghost stories, such as those under Norwich Castle. The construction of any tunnel in soft sands here would have caused the collapse of the massive keep many centuries ago! Forgotten ice-houses, brick kilns, lime kilns, cellars, water towers, tunnelled watercourses and various military structures can all look like an interesting cave to a bat and many of these may provide the requisite conditions. A card index of most of the known structures in at least the eastern half of the county has been compiled. This has been made partly by scouring old 6in. Ordnance Survey maps and partly by the exchange of information with several industrial archaeologists (to whom I extend my thanks) who have their own, differently angled, interest in these types of buildings. From the conservation point of view, these places are best not being disturbed during the winter for detailed measurements, photographs or excavation if there is any likelihood of bats being present. They will almost certainly be woken and will use up valuable fat reserves trying to reach another safe site. In return for this consideration, I on my part refrain from poking out pieces of loose mortar from between bricks, even though most bats love to squeeze themselves into such cracks rather than hang upside down from the ceiling, as is popularly supposed. They may even be found almost flush with the brickwork, having squeezed into what is to our eyes the slightest of recesses. Several hundreds of bats are safely accommodated in this way each winter, usually with less than a dozen at a site, but many more must find other inaccessible sites above ground in which they can winter such as hollow trees, barns and churches. Our commonest species, the Pipistrelle, certainly winters in this way.

Grimes Graves near Thetford is undoubtedly the oldest man-made chalk tunnel site in this area with a discontinuous record of bat occupation for perhaps four and a half thousand years since stone-age man first dug the tunnels seeking the prized black flint from which he could fashion tools. Bat bones recovered during various digs have recently been re-examined by Dr. R. E. Stebbings, who has also fostered the work on Eaton Chalk Caves. Dr. Stebbings has shown that Bechstein's bat, a high forest species now confined to a few sites in the Southern Counties, occurred there in some numbers, along with the same species that can occur in Norfolk tunnels today. Some preliminary discussions have already taken place over this site with a view to allowing bats to utilise the tunnels unmolested. It seems especially possible now that further mine-shafts in the complex have been re-excavated. Long-eared, Daubenton's and Norfolk's first record of Brant's bat come from this site, while earlier records of Whiskered bats now need confirmation.

Two remaining "open' sites of former chalk workings in Norwich are both inaccessible and rather unsuitable for bats. The one under Earlham Road is mainly a solid brick tunnel, probably lined in this way to construct a war-time explosives dump. It was later used for growing mushrooms. The other, near the old Gas Works still contains blocks of latrines dating from its use during the Second World War as an air-raid shelter.

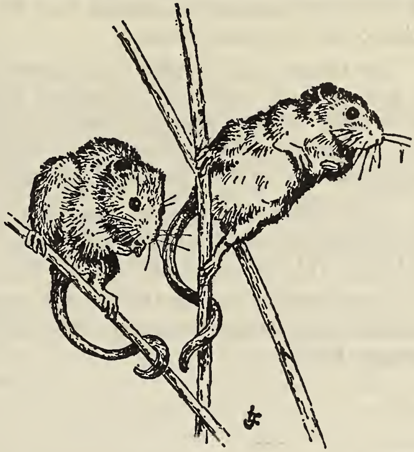
The last and most interesting place is Eaton Chalk Caves, on the southern outskirts of Norwich. The origins of this pit probably go back to the early part of the 19th century, but by about the turn of the century the overburden of sands and gravels began to be too much to move by hand and work began on addits or tunnels bored into the almost vertical chalk face. War-time activities in 1944 brought about the filling over of all the eight or more addit entrances. However, in 1947 some of the fill slipped and one entrance was partially reopened and became known to me secretly during my school days as a Daubenton's winter roost. Material was again bulldozed over the edge in March 1969 to prevent children entering the dangerous hole. As the site had been selected as a Nature Conservancy Council Site of Special Scientific Interest a decision was taken to open the tunnels again, with the land-owner's permission. As it was not possible to drive a mechanical digger into the pit, the entrance was dug out by hand. More than 250 man-hours were expended between October 2nd, 1971 and August 4th, 1972 by Norfolk Young Naturalists' work parties before the final break-through. The hole was subsequently enlarged and a 5m. semi-circular steel grille with a padlocked access door was welded in place on September 1st, 1972. This allows free passage of air and bats, and summer access to geologists. More details of the opening of this tunnel and its geological significance are given in Hornby, Goldsmith and Goff, 1973, *Bulletin of the Geology Society of Norfolk*, No. 23 pp. 3-14.

The two "caves" average nearly 5m. in width and up to 6m. high. The first tunnel is about 15m. long, while the second is in the form of a cross, roughly 25m. by 30m. Obviously it is of interest to bat conservation to know how quickly a safe hibernacular will be recolonised once reopened.

At Eaton a single Daubenton utilised the cave in its very first winter and two during the second. It has now been open for six winters and during the past two, monthly visits have been made to coincide with a check on a similar Suffolk site to see if any comparisons can be made. As well as counts of bats, temperature and humidity readings have been recorded. The peak number of bats found so far was on January 28th, 1977, with Dr. E. A. Ellis present, when 7 Natterers, 5 Daubenton's, 2 Long-eared and 1 possible Brant's bat were counted—a total of 15 individuals. Since the policy over these winters has been to make as short a visit as possible and not to touch the bats in any way it has not always been possible to identify every bat found, but for each visit, every bat is plotted on a map. Very few will "stay put" for more than two visits. When they do, the high humidity condenses in tiny droplets on their fur and they become "bedewed" with a frosty appearance. Natterers do not become "bedewed" as often as Daubentons, perhaps because they tend not to arrive at the caves until after Christmas and go again after February. As they all have a tendancy to disappear it is often thought that twice as many are actually using the caves as can be found at any one time. Eaton therefore could already be utilised by 30, but we are hoping that more will arrive eventually, once they have had a chance to find it.

We are anxious to find or hear of any new localities which may be suitable for bats. There are still several species to record in Norfolk and indeed much more for us to discover about bats generally.

NORFOLK MAMMAL REPORT 1977



Editorial

The Editor is pleased to present the 22nd Norfolk Mammal Report.

This year we publish two specialist articles. Most of us try to help our wildlife through the difficult winter months, though we may not be aware of what constitutes a balanced diet. In the course of his work, Dr. Ian Keymer has studied many animals suffering from nutritional deficiencies and is well equipped to point out some of the pitfalls. He is familiar to our members as a regular contributor to both the Bird and the Mammal Reports and as the pathologist who has been attempting to isolate the virus which causes "red squirrel disease". His article could well be included in the Bird Report and demonstrates, as does the single cover, that there is little between us but a slight difference in classification.

John Goldsmith is another local naturalist with wide-ranging interests. One of these is a unique knowledge of bats in Norfolk. He has explored caves and tunnels in chalk, kilns, ice-houses and other difficult and at times potentially dangerous structures in his efforts to learn more about the distribution and wintering habits of this group. His article describes species that can be found in our county.

We tend to forget how many of our mammals are, historically speaking, recent additions to our list. They include invaders such as the brown rat, introductions such as the rabbit, while escapees are represented by the coypu. Some other species cause little trouble and add interest to our rather restricted fauna but the examples given do remind us of the potential havoc in unwise and unrestricted importations and inefficient housing. This report may not be the proper place for discussion of the issues involved but we may ask the question how soon will such mammals as porcupine and capybara be included in our classified notes? Both of these species are included in the card index for 1977!

Another major cause for concern is the increasing disturbance of habitat by thoughtless misuse. Modern personal transport makes every once quiet corner of Norfolk easily accessible. To quote an example, unleashed dogs running through such a seemingly suitable exercise ground as Thetford Forest may put up otherwise undetected deer or ground nesting birds. On some occasions no harm may be done, but on others irreparable damage may be done beyond the observation or imagination of the ignorant owner.

Our thanks are extended to all contributors mentioned here and in the following text, to such specialists as Arthur Woodhams, Pest Control Officer, MAFF, Rex Whitta, Wildlife Ranger, Forestry Commission District Office, Santon Downham, and to the growing number of friends from all over the county, many still recognised only by their names at the end of increasingly informative notes.

John Goldsmith, as ever, has given invaluable help and encouragement. He will continue to answer queries addressed to him c/o The Castle Museum, Norwich, NR1 3JU. Tel.: Norwich 22233 ext. 649.

Contributions for the 1978 report should be sent to R. C. Hancy, 124 Fakenham Road, Taverham, Norwich, NR8 6QH (Tel: Norwich 860042) by the end of January, 1979.

Classified notes

INSECTIVORA

Perhaps it is appropriate that the Hedgehog *Erinaceus europaeus* should head our classified list. Have we a more easily identifiable mammal? It saddens us by the corpses we see on our roads, endears itself by, in human terms, its eccentric behaviour in our gardens. There is no doubt that many of our contributors come to a more detailed study of Norfolk mammals by way of an initial enthusiasm for the urchin. Perhaps eccentricity is transferable. A Brooke cat fostered an orphaned family. There are areas in the county where massive clearance and hedge removal have reduced numbers to a very low level. Elsewhere, the population appears to be static and, in some places, is reported to have increased.

Records are not full enough nor do they extend back far enough to arrive at a proper conclusion regarding numbers of many species. This is true of the Mole *Talpa europaea*. When most villages had their resident mole-catcher large numbers were taken and it is interesting to speculate on their effect on the population and whether natural controls work as effectively. The theme from 1977 reports is "excessively abundant", "considerable activity". One contributor offers one to a good home, with little hope of takers. At Brooke, a golden variant was caught by a cat, rescued, and later released.

The smaller insectivores do not accommodate themselves so readily to the immediate presence of man. Pygmy shrew *Sorex minutus* reports exemplify methods used to detect their presence and estimate trends in numbers. Records include remains found in owl pellets and a skull found in a discarded drink can on Kelling Heath. Cats often toy with shrews but rarely eat them so this portion of their catch is easily identified. In Corpusty, a Common shrew *Sorex araneus* took over a discarded voles nest under a tin in the garden. Reports of Water shrews *Neomys fodiens* were more plentiful and widespread this year. They were boosted by the analysis of owl pellets from Corpusty and Morston. Sightings came from Ranworth, Hoveton, Keswick, Kirstead, Seething and from the East Bank, Cley, where one was actually touched before it ran off. A strong contender for the oddest report of the year was the water shrew caught in a mouse-trap in a cupboard under the stairs at Mill House, Corpusty.

CHIROPTERA

It is gratifying to see that more contributors are taking an interest in our flying mammals. Most notes, of necessity, record impressions of numbers rather than hard facts and are mainly of decreases in particular areas. The provision of boxes in gardens has been a minimal hit and maximum miss affair but can be most rewarding. The Noctules *Nyctalus noctula* at Ludham reached a record total of 53 in the one box on June 7th and provided a spectacular show as they streamed out at dusk. Large scale experiments such as the Nationwide Bat Box Scheme will eventually provide the information that will enable prefabricated accommodation to be provided where necessary and justified. Thetford Forest is a site where the experiment is going particularly well. Most bats using the boxes have been Long-eared *Plectotus auritus* and Pipistrelles *Pipistrellus pipistrellus*. One of our problems is that our thinking is coloured by observations of birds using garden nesting boxes, forgetting that bat roosting and breeding behaviour is entirely different. There can be a great deal of movement from site to site even when parturition is imminent. Large maternity colonies of Pipistrelles that sometimes cause such unwarranted alarm at mid-summer may move from house to house along a modern street. One Taverham colony was dogged by misfortune. 360 plus were roosting under hung tiles. The householder had booked cavity insulation and feared the bats would be disturbed and the young endangered. Sadly, the colony moved from what may have been the comparative safety of the hung tiles into the cavity itself. After small-hour attempts to prevent re-entry, female and young bats were subsequently found in the most unikely places in sheds and garages. Bats on the wing belie their true size and can roost in apparently impossible crevices. One temporary roost was in a crack in a flag-staff!

LAGOMORPHA

Brown Hare *Lepus capensis* distribution follows the pattern noted in recent Reports, increasing in some areas but rare in other districts in central Norfolk. On the other hand, the continuing battle between the Rabbit *Oryctolagus cuniculus* and the myxomatosis virus with its multiple strains of varying degrees of virulence in different districts can be pictured as an intriguing tangle of threads with many loose ends and knotty problems. The Editor would be pleased to receive reports of regular observations of colonies noting some or all of the following points: distances to nearest other colonies, earliest appearance of young, estimates of rates of build-up of numbers, how does the latter correlate with estimates of births, the form of an effects, in any, of disturbance, date of first signs of myxomatosis, appearance and behaviour of possible survivors, does the colony appear to have been deserted, if so when do rabbits reappear or recolonise the site, are these rabbits young adults or old adults.

At Weeting, a summer estimate of 3,000 over the Reserve was made. Amongst these one adult melanistic and one albino were present.

RODENTIA

The time is rapidly approaching when we will draw tight circles on maps delineating the remaining colonies of Red Squirrels *Sciurus vulgaris*, giving up the rest of the county to the Grey Squirrel *Sciurus carolinensis*. Most contributors tell of fewer reds and more greys, many of the latter in districts we once imagined would not be penetrated. Road casualties show they are prepared to cross comparatively open country. One was found quite close to the Editor's own doorstep. A live grey was in Surrey Street, Norwich, in October and another was reported from Trafford Road. Shooting grey squirrels is generally recognised as inefficient and potentially inhumane. Where numbers need to be controlled, advice on trapping methods that are efficient and humane is readily available.

Thetford Forest still contains our largest colonies of red squirrels. The numbers in Thorpe Woods, Norwich, where we have a squirrel enthusiast, remain stable. This territory extends almost to the Wensum where it skirts the Cathedral but the gross overuse of the Telegraph Plantation for canine and human exercise on the "Trim-track" have seriously reduced its wildlife potential. Attempts to isolate the elusive virus responsible for "red squirrel disease" continue. Speed is essential and if a sick squirrel is sighted please contact Dr. Ian Keymer at the Vetinary Investigation Centre, Norwich, immediately.

The group of traps that accounted for the Corpusty Water shrew also caught three Bank voles *Clethrionomys glareolus* in November. They had been baited with cheese after tulip bulbs had been eaten. Short-tailed voles *Microtus agrestis* had a good year and the Water vole *Arvicola terrestris* continues its slow come-back. It was plentiful at Saxthorpe and Corpusty where a high proportion were black or dark brown with black backs. Numbers continue to rise along the middle reaches of the Wensum.

In many respects, the year under review could be called "The year of the Mouse." The Wood mouse, *Apodemus sylvaticus* was plentiful and was described as a nuisance and as a winter pest, eating lettuces at East Tuddenham. At Holkham and Narborough it provided ultra-close daylight sightings. Black-headed gulls at Saxthorpe were seen following the plough and eating wood mice, while a mother and young made a successful passage through a working potato harvester in Aldborough during October.

The status of the Yellow-necked mouse *Apodemus flavicollus* as a Norfolk mammal has been in doubt for some years, the only record coming from Ellingham, in the Waveney Valley, almost two decades ago. As the site was very close to the Editor's birthplace he regarded the removal of the question mark as something of a personal crusade! The owner of Ellingham Hall, Colonel H. Smith, was most helpful and a joint live trapping experiment was arranged with John Goldsmith in February. A total of 84 trap/nights over four days was undertaken. Out of the 60 small mammals found, two were Yellow-necked mice, both during the first inspection and both at the base of separate hollow trees. One has been retained for observation. Later in the year, a cat in the neighbouring parish of Broome left the remains of a Yellow-neck and later still some were trapped in the next parish along the valley, Ditchingham, after they had raided a bulb store. The end of the year brought further news from Forncett St. Peter where another positive identification was made. This last site is coincidentally on the same degree of latitude as our main area along the Waveney Valley. When further specimens turn up, please communicate as soon as possible preferably posting any dead examples in plastic bags to the Editor.

The accolade for oddity mentioned earlier must surely go to the House Mouse *Mus musculus*. At East Tuddenham one found its way into a shoulder bag in our contributor's bedroom where it ate two extra strong mints and half a Menthol and Eucalyptus sweet. In Thorpe, a pet female white mouse was relegated to a cage in the garage. There she was visited by a wild male small enough to slip through the bars. Transferred to the Norfolk Room, Castle museum, for observation, the succeeding generations of her offspring would have brought a very smug expression to the face of Mendel.

We are once again indebted to Dr. L. M. Gosling, Coypu Research Laboratory, MAFF, for his note on the Coypu *Myocaster coypus*. It reveals the delicate state of balance that exists in our attempts to control this escapee. While we await the report of the Coypu Strategy Group with interest, we do wonder why the trapping campaign could not be stepped up to reduce numbers to an easily controllable minimum. Is the publicised choice of total extermination possible without serious danger to other species? Has a modest number of coypu now become part of "New Broadland"? There are other invaders that pay for the privilege of creating even greater disturbance and destruction of habitat!

Dr. Gosling reports: "About 11,874 coypus were killed during 1977 and the majority of these (87%) were accounted for by the 15 trappers employed by Coypu Control. The number of adult coypus at large in the spring of 1978 is estimated at about 5,000 which is somewhat higher than the 3,000 predicted in the 1976 Mammal Report. This discrepancy is largely due to our improved understanding of the type of cold weather that affects coypus. It now appears that the cold fortnight in early 1976 had a larger impact than we believed at the time. This led us to overestimate the effect of trapping and thus to an underestimated prediction of the current spring population. The future depends on trapping intensity and weather: with the existing trapping force and a run of mild winters the population would slowly increase; with winters of the slightly colder type that we have experienced over the last three years the population should continue its present very slow decline. It is of course critically important to maintain at least the present number of trappers: our simulation model suggests that pre 1962 population levels would be reached within three years if control were abandoned."

CETACEA

The rather tenuous position on our Norfolk list held by this order is maintained by the few remains that were washed up on our shores. The Common Porpoise *Phocoena phocoena* at West Runton in July had lacerations that had possibly been caused by a propeller. The Lesser Rorqual *Balaenoptera acutorostrata* which finally beached at Heacham caused a great deal of embarrassment to the local council before its great bulk was cleared.

CARNIVORA

The Fox *Vulpes vulpes* is described as "very much with us" by observers in Central Norfolk and this is the county-wide pattern. An interesting point concerning the gathering of information is highlighted by one contributor who was told by the keeper on one estate that numbers were high, whilst his neighbour from an adjacent estate with hunting interests sought to paint a very different picture. Our Bird Report Editor had a Boxing Day bonus on Halvergate Marshes when he saw a fox being mobbed by a Short-eared owl.

Stoats *Mustela erminea* and Weasels *Mustela nivalis* have been active and prolific, numerically and anecdotally. A stoat at Lyng was seen being kicked from the back of a young rabbit by the doe and conceding defeat. Another at Corpusty, after careful observation of the Mandarin ducks, sought less formidable prey. On Weeting Heath, stoats had an adverse effect on Wheatear breeding success and may have taken two young Stone Curlew.

Reports of Badgers *Meles meles* are very confusing in that we have received reports of single badgers being seen or tracked at a number of long disused sites outside their present enclave. However, hopes of re-establishment have not been realised and without positive encouragement there seems little prospect of halting their continuing decline.

The Otter *Lutra lutra* has far more references in the file than any other species but only as the result of the campaign at the beginning of the year that culminated in the addition of the Otter to the list of animals protected under the Conservation of Wild Creatures and Wild Plants Act. Sadly, very few references are of positive identifications and we must ask if we have done too little, too late. There is no justification for complacency and, like the Badger, positive help must be given to retain this carnivore on our list. Non-disturbance of key habitats is vital and the promises of Otter Hunters to seek coypu instead must be viewed in this light.

The Common Seal *Phoca vitulina* colony breeding in the Wash appears to be naturally regulated. They are at the apex of one food-triangle in the North Sea and will reflect a decline in its basic resources. An unusual number of seals were sighted up-river, including the young common seal held at Acle till the turn of the tide in July and the intruder that upset the fishing match at Potter Heigham in December. The main event of the year was the loss of Scroby Sand which coincided with the birth of the Grey Seal *Halichoerus grypus* pups. Several cows pupped on the mainland beaches but the loss was total. Grey seals will desert after minimal disturbance. Two intriguing questions are, firstly, will Scroby reappear soon enough for the present generation of cows to re-establish a breeding colony there, or secondly, will its loss induce them to find an alternative site further south and thus extend the east coast range?

ARTIODACTYLA

Norwich had its now regular excitement this time caused by a Red Deer *Cervus elephas* stag crossing the Dereham Road during the rush-hour. It was later seen in several localities to the south and west of the city. The Muntjac *Muntiacus reevesi* that tried crossing the Plumstead Road was less successful. It was knocked to the roadside, though not seriously injured. The policemen who went to its aid found it very difficult to handle. As well as tiny horns and sharp tusks, the hoofs of small deer can be very dangerous. Great care must be exercised by the inexperienced when attempting to help confused and frightened animals. Further examination showed that this specimen had previously suffered a broken leg which had set itself. It was released in a suitable locality the next day. These recent introductions seem to be slowly gaining ground while our native species are holding their own.

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1973	East Winch Common	80	Gift	S.S.S.I.
1974	Sparham Pools	30	Agreement	——
1974	Buxton Heath	159	Agreement	S.S.S.I.
1975	Pope's Drift	8	Agreement	——
1975	Wayland Wood	80	Purchase	S.S.S.I.

In addition, the Trust shares with the National Trust in the management of the coastal reserve at Blakeney Point (1,335 acres), and it manages Arnold's Marsh, Cley (29 acres) on behalf of the National Trust.

By arrangement with the Nature Conservancy Council, Scolt Head Island, Ranworth Broad, Hickling Broad and the Breckland Heaths now form part of the National Nature Reserves.

*Status: N.N.R. denotes National Nature Reserve
S.S.S.I. „ Site of Special Scientific Interest

†In 1966 Cley Reserve was established as a Bird Sanctuary under the Protection of Birds Act, 1954.

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Editor Dr E. A. Ellis

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A. M. GELDART	1930-31
E. J. SALISBURY, D.Sc., F.L.S.	1931-32
MAJOR A. BUXTON, D.S.O., M.B.O.U.	1932-33
MAJOR A. BUXTON, D.S.O., M.B.O.U.	1933-34
W. P. PYCRAFT, F.L.S., F.Z.S.	1934-35
COLIN McLEAN	1935-36
G. J. COOKE	1936-37
J. M. FERRIER, F.Z.S., M.B.O.U.	1937-38
E. T. BOARDMAN	1938-39
HUGH WORMALD, M.B.O.U.	1939-40
J. A. STEERS, M.A.	1940-41
E. C. KEITH	1941-42
A. J. RUDD, O.B.E., F.Z.S.	1942-43
C. E. GAY	1943-44
SIR H. E. S. UPCHER	1944-45
H. W. BACK	1945-46
R. G. BUXTON	1946-47
THE EARL OF LEICESTER	1947-48
R. PEARCE GOULD	1948-49
JAMES FISHER	1949-50
J. E. SAINTY, B.Sc.	1950-51
J. M. LAMBERT, M.A., F.L.S.	1951-52
R. P. BAGNALL-OAKELEY	1952-53
E. A. ELLIS, F.L.S.	1953-54
E. A. ELLIS, F.L.S.	1954-55
R. JONES	1955-56
E. L. SWANN, F.L.S.	1956-57
E. DUFFEY, O.B.E., Ph.D.	1957-58
F. J. TAYLOR-PAGE	1958-59
L. C. JOHNSON	1959-60
K. C. DURRANT, F.R.E.S., J.P.	1960-61
J. M. LAMBERT, M.A., Ph.D., F.L.S.	1961-62
M. J. SEAGO	1962-63
JOHN BUXTON	1963-64
RUTH M. BARNES, A.M.A., F.L.S.	1964-65
T. A. BENNET-CLARK, C.B.E., F.R.S.	1965-66
B. FORMAN, Ph.D.	1966-67
R. P. BAGNALL-OAKELEY	1967-68
E. A. ELLIS, F.L.S.	1968-69
ETHEL M. BUTTERY, B.Sc.	1969-70
P. A. BANHAM, B.A.	1970-71
J. A. KITCHING, O.B.E., F.R.S.	1971-72
K. B. CLARKE, B.Sc., F.G.S.	1972-73
CATHERINE GURNEY	1973-74
A. BULL	1974-75
EARL OF CRANBROOK, C.B.E., F.L.S.	1975-76
M. GEORGE, Ph.D.	1976-77
D. M. MAXEY	1977-78
P. J. TRETT, J.P.	1978-79
E. T. DANIELS	1979—

SOME EFFECTS OF THE SEA FLOOD AT WELLS-NEXT-THE-SEA 11th JANUARY 1978

by P. R. BANHAM

Wells Field Centre, Wells-next-the-Sea

The damage caused by the exceptional high tide on the East Coast on the evening of the 11th January 1978, though less than that which was experienced in 1953, was still considerable, especially at Wells-next-the-Sea. Between noon on Tuesday the 10th January and 8 a.m. on Wednesday the barometric pressure in Wells dropped from 29.8'' to 28.9'', at which very low level it stayed until 2 p.m., rising steeply to 30.4'' by 8 p.m. on Thursday. During Wednesday afternoon a N.N.E. gale sprang up, being of storm force by early evening. High tide was predicted for 29 minutes past eight at Wells Quay on Wednesday evening, with a height of 3.2 metres above Mean Sea Level. The tide normally starts to flow at the Quay some 3½ hours before high water, but by 5 p.m. there was already the appearance of a normal high tide there, with more than three hours to go; obviously something exceptional was on the way. In fact, the tide peaked about an hour early, just touching an incredible 5 metres. In practical terms, this meant that all the low-lying parts of the town East and West of the Quay were flooded, as well as the Quay itself.

Some sections of the main Sea Wall running North from the Quay to the Beach were only about 4.6 metres above Mean Sea Level (though most of it was 5m or more), so that parts of the wall were over-topped by the sea for nearly two hours; it must be remembered, too, that this takes no account of the height of the waves which, with a Northerly wind, have a considerable fetch available! Consequently we were not surprised, though dismayed, on Thursday morning to see that the wall had been breached in two places. So much is now, in August, ancient history; the wall has been rebuilt higher and much more substantial than before, the Beach Road is open again, the Caravan Site is getting back to normal and even the Wells Harbour Railway is re-established. The representatives of the media and their paraphernalia, so thick on the ground in January, have deserted us, but the really interesting time for naturalists and ecologists is now, the first growing season after the salt flood.

When the sea broke through the Sea Wall it flooded not only the Caravan Site and adjoining agricultural land (all former saltmarsh) but also the lower parts of the pinewoods, including much birch scrub, grassland and freshmarsh. Next to the northern breach in the wall a number of 20-year old mainly Corsican pines were swept away, first inland by the onrush of water and later (many of them) out with the tide, to be deposited up to two miles away on the outer bank of the beach between Wells and Holkham. Of the pines generally, those nearest this breach are mainly dead, while others which were

Fig. 1. The second breach in the Sea Wall, photographed on 15th January. This was the breach nearest the "Orchidetum", and also shows where a whole section of the 20 year old Pines was swept away.

Fig. 2. The "Orchidetum" a fortnight after flooding (photographed on 26th January). The water was unable to drain away through any of the established drainage dykes.

inundated for a shorter time and which looked dead earlier in the season are in many cases showing new growth at the tips of the twigs. The Monterey pines, however, all of which were planted as seed in 1956 principally in the area just west of Abraham's Bosom, suffered badly, with only a few surviving. They seem to have a lower salt-tolerance than Corsican or Scots pine, some of which are looking healthy next to Montereys standing stark and bare.

Other trees, notably birches and sallows, were less affected than the pines, though some died and others have dead branches amongst the living. This may be because most of the salt would have been leached away by the time their growing season began. Brambles, rather surprisingly, were quite badly affected; perhaps their roots go deeper than other species, into zones not reached in time by the leaching rainwater. Ground flora, be it grasses or broad-leaved plants, seems quite unaffected in all places where there was nothing to stop the eventual run-off of seawater.

One area, however, will take a long time to recover. This is a large depressed stretch of marshy ground whose raised boundaries were just lower than the level reached by the flood, and from where the seawater was unable to escape except by slow percolation through the silty substrate. In fact, it is because of its retention of water even in drought conditions that this part of Wells was so interesting, supporting a good selection of marsh and wet meadow plants. We called it Wells "Orchidetum", and regularly found the following orchids there: early purple, common spotted, southern marsh, bee, pyramidal, twayblade and marsh helleborine. In 1977 we found adder's tongue fern, in a rather lanky etiolated form among fairly long grasses.

On the 26th January the water was still nearly a metre deep; assuming at least a full metre's depth of water at the time of the flooding, a rough calculation shows that the area had to cope with at least 500 tonnes of salt. For weeks the smell of salt-affected rotting vegetation was pervasive and, as winter turned to spring, we looked, without much hope, for signs of normal plant growth. Our lack of hope was reinforced by the knowledge that the salinity of standing water in the Orchidetum was still 17°/oo on the 4th March (standard North Sea salinity is about 35°/oo) and 10°/oo on the 26th April. It was not until the 9th May that it had dropped to 3°/oo; by then, 213.5mm (= 8.5") of rain or snow had fallen since the flood.

By the end of May it was apparent that the pines in the Orchidetum were all dead, while many birches and sallows were showing signs of die-back after producing leaves and flowers. Brambles and hawthorn were quite dead, though there was some life in privet and dog rose. Of the ground flora, silver-weed was doing well, flowering even in the lowest parts of the marsh, and rosebay willowherb was growing strongly, as were rushes, grasses and sedges. Of orchids and adder's tongue, not a single plant could be found. In August the situation is still much the same, except that some sallows in this maximum salted area are looking surprisingly healthy, while a halophytic plant, sea milkwort, has appeared in some quantity on otherwise bare patches of mud. This, like the now common marsh arrow grass, we have not noticed in previous years, though of course we cannot guarantee that either of them was not there.

Scientific names of plants mentioned in text

Corsican pine	*Pinus nigra maritima* (Ait.) Melville
Scots pine	*Pinus sylvestris* L.
Monterey pine	*Pinus radiata* D.Don
Birches	*Betula pendula* Roth & *B. pubescens* Ehrh.
Sallow	*Salix caprea* L.
Bramble	*Rubus fruticosus* agg.
Early purple orchid	*Orchis mascula* L.
Common spotted orchid	*Dactylorhiza fuchsii* (Druce) Soó
Southern marsh orchid	*Dactylorhiza praetermissa* (Druce) Soó
Bee orchid	*Ophris apifera* Huds.
Pyramidal orchid	*Anacamptis pyramidalis* (L.) Rich.
Twayblade	*Listera ovata* (L.) R.Br.
Marsh helleborine	*Epipactis palustris* (L.) Crantz
Adder's tongue fern	*Ophioglossum vulgatum* L.
Hawthorn	*Crataegus monogyna* Jacq.
Privet	*Ligustrum vulgare* L.
Dog rose	*Rosa canina* L.
Silverweed	*Potentilla anserina* L.
Rosebay willowherb	*Chamaenerion angustifolium* (L.) Scop.
Sea milkwort	*Glaux maritima* L. (L.) Scop.
Marsh arrow grass	*Triglochin palustris* L.

THE EFFECTS OF THE STORM OF 11 JANUARY 1978 ON BLAKENEY POINT

by D. J. B. WHITE

Department of Botany and Microbiology
University College London

High water at Morston on Wednesday 11 January 1978 was due at 8.00 p.m. but water was up to the Quay by about 4.15 p.m. The height finally reached by the tide was lower than in the East Coast storm-surge of 1953 (some two feet lower judging by the height of the water reached in the Old Lifeboat House). But the gale blowing as it did from the North East generated much bigger waves and much of the damage to the Point resulted from wave action.

The sea wall or bank was breached at Cley (east of the Windmill) and the bank on the west side of the beach road was breached in two places.

The breaches were caused apparently by boats being driven against the bank by the waves. The bank between Morston and Blakeney held. The water just failed to reach the top of the bank as was shown by the position of the debris, seaweed, etc., left behind as the water level fell.

Morston Creek and Morston Marshes on the east side of the Creek were protected from the force of the waves by the Headland and although deeply covered by water, there was no violent action. The bridges over the Creeks were undamaged.

The main shingle bank felt the full force of the gale and the wave action. Enormous quantities of shingle were moved. Right along from the Cley beach to the bend at East Point, ("aeroplane gap"), large tongues of clean, fresh looking shingle project into the marsh. These shingle tongues are often 3 ft high. The bank appears to have moved landwards some 30—40 yards and in the region of East Point rather more. It is my impression that there was as much movement of shingle as there was in the 1953 East Coast Surge. In places, sand that was carried over by the water has been deposited on the marsh in front of the shingle tongues. In some places, a fair amount of sand was deposited between the tongues.

At the bend (aeroplane gap), much shingle and sand was moved into the low. The sand in this region extended as far as the last telegraph pole—forming a large wedge shaped mass 6 in. deep at the foot of the shingle, thinning out regularly until, just beyond the telegraph pole, there was only a thin dusting of sand.

The plants, mainly *Armeria maritima,* in this region of the Low were, of course, buried.

The landward movement of the main shingle bank has covered most of the plants of *Suaeda fruticosa* along what was its back edge and has completely obliterated the footpath which had become established there. Some idea of the amount of shingle which has been moved is seen by the exposure of the bases of several telegraph poles which used to stand on the crest of the ridge. These poles were removed shortly after the war. They were cut off near to ground level. The remains of about four of these poles now stand some three feet above the shingle.

When one stands on the main bank the Watchhouse seems very close. Watchhouse Bank is so much shorter because a further 30 or so yards of it have been buried by the landward movement of the main bank. The marsh on the west side of Watchhouse Bank is smaller for the same reason.

A creek in the marsh east of Watchhouse has been truncated by the advancing shingle. The channel towards Cley has received a lot of shingle; movement of any more shingle in the future would more or less block it. This channel was cut in 1921 (?) after the previous channel had become blocked in the same fashion.

As might be expected following such massive shingle movements, most of the vegetation on the main bank has disappeared, and the shingle looks bright and fresh.

In one or two places a few underground stems of *Rumex crispus* and some of the underground parts of *Silene maritima* remain, having been exposed by the moving shingle. There were no signs of the plants of *Crambe maritima* which were growing on the main bank east of the Hood. *Crambe* grows on the seaward face of the bank, just above high water level - a very vulnerable position at the best of times.

The dunes on the Hood do not seem to have suffered very much. Fresh shingle has moved right up to the foot of the dunes, so obliterating the vegetation which occurred there.

The Headland dunes have not been badly affected; nothing like they were in the 1953 floods. There has been some erosion of the dune face at East Point. This erosion only extends for a short distance along the dunes and is no greater than the amount of erosion which occurred in this position in the winter of 1976 when there were some high tides.

The dunes at the end of the Headland near the tea room have been cut back by the sea for a few yards, but, fortunately, the recent dune growth in the funnel-shaped area which we have been trying to repair was not completely destroyed. The dunes on both sides of the gap opposite the end of the tea room have been eroded and much of the dune on the marsh side (S.W. side) has been washed away. Some of the small dunes between the sea and the main dune ridge have suffered some erosion, as sand was washed away from around them as the water first advanced swirling around and then later retreating.

The tide swept over the dunes on the base of the old Far Point and over the embryo dunes on the new, now the true, Far Point, but did not completely destroy them. Providing there are no more heavy seas in the near future these dunes should start regenerating.

The Observation Hut on the seaward edge of the dunes suffered little damage.

All the Lows were flooded. Over a week later water was still standing in Glaux Low, Great Sandy Low and, to a lesser extent, in Long Row.

Water entered the Lows from three main points:

1) Via the shingle low (which is like a water course) which runs from the beach East of the observatory, through the dunes, into the Great Sandy and Glaux Lows.
2) From the landing area near Pinchen's Creek and thence towards the Lifeboat Houses.
3) Through the gap opposite the end of the tea room.
4) Over the main bank at the aeroplane gap.

The depth reached by the water in the lows and elsewhere, is shown by the tide marks left as the water level fell.

In Boathouse Low, the hummocks of sand around the bushes of *Suaeda fruticosa* are smaller and much sand has been distributed over the Low. The corner of the marsh enclosed by the Britannia bank has received much sand, largely washed over it by the water carrying sand from the dunes near the tea room.

As a result of all the water movement, the beach has been cleaned in a remarkable fashion. There are hardly any polythene bottles, light bulbs and other debris of this kind to be seen. Nor is there much driftwood on the foreshore. The larger pieces have been carried up the beach and left someway up the face of the main dunes. In one place, much driftwood was washed over small dunes and left more or less out of sight in one of the blowouts.

It will be interesting to see what happens to the vegetation in 1979. One might anticipate a paucity of strand line plants and that plants like *Cakile maritima* and *Salsola kali* may be found in unusual places where their seed may have been carried by the tides. There will probably be few plants on the main shingle ridge, although there should be a steady increase in vegetation as the crest and back of the ridge again become stabilised.

My thanks are due to the Warden, Mr W. E. Eales, for his help in compiling this report.

THREE RARE SPECIES ON THE NORTH NORFOLK COAST

by J. P. Skipworth

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Introduction

Suaeda vera, Frankenia laevis and *Limonium bellidifolium* are three plant species often found growing together in the North Norfolk coastal area. Although locally quite common they are rare in the wider context of the British Isles each being rated A ("rare") by Perring and Walters (1976) the last named among them in fact being A+. The three species have all been described as "obligate halophytes" by Chapman (1960a) and all belong to families whose members are strongly associated with saline environments. All could be described as Mediterranean species which are very near their northern limit in Norfolk and each could be said to be a strand plant. When they occur together, it is in a free draining situation where salt marsh abuts on the edge of sand dunes and here they could be said to comprise a community, albeit one which is very much part of a continuum.

Limonium bellidifolium (Matted sea lavender)

This, the rarest of the three, is one of some 200 species in a sub-cosmopolitan genus which is in fact the largest in the family *Plumbaginaceae.* It is recorded by Perring and Walters (1976) as occurring in the British Isles only on the north coast of Norfolk, South Lincolnshire and the Channel Islands. However, although Gibbons (1975) referred to it as being recorded on five occasions between 1789 and 1952 in South Lincolnshire, she believed that it had not been registered in the county since 1966. Bennett (1909) did not record the species outside Norfolk, but Perring and Walters note its occurrence to the east and the west of its present range prior to 1930 and this presents the possibility that the range has been contracting in the last 50 years. Both Butcher (1961) and Clapham, Tutin and Warburg (1962) have referred to the presence of this species on Suffolk coasts but Perring and Walters do not confirm this.

It is also recorded on north Mediterranean coasts from Gibraltar to the Black sea (Polunin 1964) and it is said there to be "rather like *L. vulgare*". This remark which is substantiated by a drawing, is of interest because it would be a most unlikely one to be responsibly offered with respect to the species in Norfolk. Moreover, Tutin, et al. (1972), after describing the species without referring to its markedly procumbent habit in Norfolk, state that "procumbent plants.....are recorded from the coast of west France and England as *L. dubyi....*; this may represent a distinct species". They go on to say, "*L. danubiale*.....from south west Ukraine is a larger variant of *(L. bellidifolium).*" There would seem to be a possibility therefore that the *Limonium* *bellidifolium* of Norfolk might be a distinct species or subspecies, or that it might represent a clinal end point. A taxonomic investigation of the present species throughout its geographic range could be an interesting exercise.

Limonium bellidifolium is a rather attractive, perennial, herbaceous, rosetted hemicryptophyte with a tap root extending straight into the substratum for as far as 20cm. There are 10 - 20 leaves in each rosette and they die when the plant flowers. Flowering stems up to 25cm in length, 5 - 20 of which are associated with each rosette, radiate from the crown and are appressed to the ground for much of their total length but they do curve upwards distally. The stem bears numerous forked branches, the lower ones among which are peculiarly and characteristically quite sterile. The upper branches bear large numbers of flowers whose gross dimensions (3 - 4mm across) and lilac colour are imparted by petals. Flowering commences in early July and continues through to late August. Clapham, Tutin and Warberg (1962) record the species as dimorphic and self incompatible with a diploid chromosome number of 18. It is likely that pollination is effected by insects although no such vectors seem to have been recorded. Little seems known about seed dispersal and germination although some suspicions based on the careful study of *L. vulgare* and *L. humile* by Boorman (1968), may be entertained. These would be that dissemination by seawater and deposition on a high tide mark is a probability although dispersal by wind may also take place. Success of germination may depend on an intricate interplay of various impinging factors especially salt and fresh water. The species has been said to be a perennial but anatomical structure of the shoots suggests that a plant living more than 5 or 6 years may be unusual.

Various authors have described the habitat of *Limonium bellidifolium* as "marsh", "normally sandy marsh", "sandy places in salt marshes", "drier parts of sandy salt marshes", "sandy margins of salt marsh" etc. It is a little strange that the word shingle does not appear in any known description yet it seems there is almost always a component of shingle in the substratum where the species is growing and that it is not in fact common to find it on pure sand. The plant indeed seems to thrive best in a free draining situation where there is a thin layer (0.5 - 1.0cm) of sand overlying a mixture of sand and shingle, especially where this is 5 - 10 cm thick and in turn overlies pure sand. It is in this underlying sand, which is almost always damp, that most of the feeding roots are to be found. An approximate evaluation of particle size in the surface sand, (this presumably being of special significance as the layer in which seedlings must first become established) has been made. Based on this it is suggested that the species seems confined to a zone where 1.5 - 7.5% (by weight) of the particles are less than 0.1mm in diameter and 50 - 65% are more than 0.25mm in diameter.

The zone occupied by the species has been delineated by Chapman 1960b) as 2.24 - 3.36 ft above I.Z.L., that is a little more than a vertical foot rather high in the intertidal region. Little reason is seen to dispute these figures although consideration of exceptional plants would probably produce wider limits. Boorman (1971) recorded transplanting *L. bellidifolium* to lower than normal regions. Death followed and was attributed "probably" to the effect of frequent submersion in sea water. Boorman concluded that the "lower limit may be determined by the height above mean tide level and thus by the number and duration of tidal submergences". Chapman (1960b) has shown that at its lowest limit, the species is submerged some 170 times per year by tides and at its upper limit 85 times. It could also be noted that the spring tides of June/July and of December/January do not reach the upper part of the zone. Some evidence has been collected which would support the implications inherent in these evaluations. These are that the plant will tolerate considerable variations in salinity ranging from hypersalinity (as evaporation concentrates salts when tides recede) to 'full' salinity during tidal immersion to very low salinity following leaching of salts by rain at times when plants are not being reached by tides. It is suggested therefore that salinity itself (and by inference other chemical factors which would be subjected to similar erratic concentration and flushing) does not strongly influence mature plants. This is not to say that an appropriate and perhaps precise juxtaposition of chemical factors might not influence germination and seedling survival.

The physical and chemical parameters of the soil which might delimit the species seems in fact to be largely unknown and could only be determined by a detailed investigation. Drainage, aeration, compaction, and percentages and decay rates of organic matter, could all be important and careful consideration would need to be given to particle size and nutrient regimes both on the surface and at the depth where feeding roots are found.

In the zone in which *Limonium bellidifolium* exists, the community is often rather open and the dominant species in normally *Suaeda vera*, although there is no suggestion of interdependence between the two. *Limonium bellidifolium* in fact seems to thrive best where *Suaeda* is growing less robustly and where its cover value is less than 50%. In such a situation the density of *Limonium* may be 60 plants/square metre with virtually no other species present. However, usually, *Puccinellia maritima, Frankenia laevis, Suaeda maritima* and less frequently *Halimoine portulacoides*, occurring together with *Suaeda vera* are to be found with, or very near to *L. bellidifolium*.

Suaeda vera (Shrubby sea blite)

Suaeda vera appears to be the more correct name (Tutin, et. al. 1964) for this member of the Chenopodiaceae also, and perhaps better known as *S. fruticosa*. It is a shrub which may be 3 - 4 feet in height and is near its northern limit on the Norfolk coast. It occurs also on south eastern coasts in the British Isles and finds its western limit in Dorset. Plants were known at Gibraltar point in 1977 but Gibbons (1975) refers to the species as having come and gone several times to and from the south Lincolnshire coast and Chapman (1947) associates its northern limit with the 61°F August isotherm which runs virtually along the north Norfolk coast. It may have also formerly occurred in Glamorgan, the Channel Islands, and possibly Yorkshire and Ayrshire (Chapman 1947). Tansley (1968) has fairly said that it tends "to be found abundantly where it occurs". Outside England it is reported from Brittany, the Atlantic coasts of France, Portugal and Spain (where it also occurs inland), and through the Mediterranean. It probably does not reach India, Afghanistan and central Asia as claimed (for *S. fruticosa*) by some authors e.g. Chapman (1947), Clapham, Tutin and Warberg (1962).

It is a virtual evergreen, but Ranwell (1972) has recounted that after the cold winter of 1962-63, plants at Blakeney Point lost all their leaves, and it is densely branched shrub with smallish cross-sectionally oval, dull green leaves. Flowers are inconspicuous axillary, greenish in colour and are present from July to September. Seeds are almost certainly water-borne and deposited on a strandline where in appropriate conditions they germinate. Usually the plants lowest in the zone occupied by *S. vera* are smaller which suggests that they do not live as long as those higher up. Anatomical examination of wood increment supports this. Where the plant is most dense it forms definite thickets in which no other plant grows.

In an impressive piece of work for its time, Oliver and Salisbury (1913) accurately described the plant's morphology and its response to accreting sand. This particular article with its several lucid illustrations has clearly provided a baseline for subsequent appraisal of the species for example by Chapman (1947) and Tansley (1965) and while it is unnecessary to recount the work again, it is appropriate to re-emphasize the role that the plant can play as a sand binder. Shoots will stand burial in sand and shingle and in fact this action stimulates the production of new branches which soon emerge above the surface. Adventitious roots will form on the buried branches and the whole composit structure serves to restrict further movement of sand. Tansley (1968) referred to it as "a very remarkable plant" and was clearly impressed by its ability to "climb" beaches. That is, as inorganic material continues to accumulate on a beach, *S. vera* continues to grow through it until it may reach the crest of the dune.

There are some special points which could be made with respect to the species in Norfolk. First, it has frequently been described as being associated with shingle. Shingle though is by no means a prerequisite. It grows well for example on the banks of marshy creeks near Wells, on compacted artificial stop banks at Burnham Overy and on semi-protected sandy beach at Holkham. Moreover there is a distinct impression that if there is a strong shingle component on the marsh/dune interface where the species is generally common, it grows less robustly (and *Limonium bellidifolium* and *Frankenia laevis* rather better), than when there is a higher proportion of sand and mud. Reference could also be made to the occasional tendency for it to be "banded" in its distribution. That is plants of several different sizes (and by inference ages) form that number of more or less distinct bands along the shore. This could be attributed to the occurrence of occasional years when seeds are deposited on a strandline in particularly favourable circumstances or are of exceptional quality.

At the top of the marsh and probably where it occurs on the sea facing dunes as well, *Suaeda vera* grows over a rather wider zone than does *Limonium bellidifolium* (0.0 - 4.0 ft above I.Z.L.). This means that at its lower limit roots would be submerged by tides on at least half the days of the year and at its upper limit by few more than equinoctial tides. Some mature plants therefore grow in a situation virtually devoid of the influences of sea-water and others in situations ranging from full to hypersalinity. Just as *Suaeda vera* seems capable of existing through a wider range of salinity than *Limonium bellidifolium* so also it seems to be associated with a wider range of soil particle size and presumably other soil characters as well. Perhaps this in part explains the wider distribution of *Suaeda vera* in the north Norfolk area.

Frankenia laevis (Sea Heath)

A member of the small family Frankeniaceae, this species has a distribution in the British Isles very similar to *Suaeda vera*, that is, somewhat irregularly on south and east coasts from Northern Norfolk to Hampshire. It is, in addition found on the Channel Islands (Perring and Walters 1976). Like the previous two species its existence on the Lincolnshire coast is somewhat tenuous but it is said by Gibbons (1975) to have appeared there in 1975. Like the others also, it occurs on Mediterranean (eastwards to Italy) and southern Atlantic coasts of Europe and in addition on certain islands to the west of North Africa.

The plant could fairly be classified as a Chamaephyte - a mat plant - and the small dark green, reddish tinged leaves and pink flowers do suggest the heath family although systematically Frankeniaceae and Ericaceae are not at all closely related. It could also fairly be described as a perennial with an extensive though essentially shallow root system. Usually, solitary, sterile, axillary flowers are produced in July and August and according to Salisbury (1952) production of fertile seed is poor in Britain. How seed is dispersed is uncertain.

It typically occurs with *Limonium bellidifolium* and *Suaeda vera* but seems to occupy a narrower zone than the other two: roughly the upper half of the *Limonium* zone and perhaps extending above it. It occurs especially in small depressions and where the proportion of shingle is high. At certain particularly shingly sites it seems to be pioneer species with *Suaeda vera* secondarily becoming established in its mats. As a mat plant with its own rather humid microenvironment immediately beneath, it is well suited to pioneer situations. Free drainage seems to be a particular requirement and as with the other two species, it must be able to tolerate at least briefly, high salinity.

Conservation

It should be to the great advantage of the three species that they exist in some abundance in the almost continuous strip of coastline reserves between Holme and Weybourne. *Limonium bellidifolium* in Britain is almost certainly confined to these reserves although fortunately it is in no real danger of becoming extinct. Even if it were so it may be argued that it is no Whooping Crane or Jarvan rhinoceros. Yet it is probably the only plant species confined to the north Norfolk reserves and if ever a regional symbol were sought, this attractive, somewhat dainty rather unusual little species would be worthy of consideration. Nevertheless without being an alarmist it would have to be said that the continued existence of this species in Norfolk is something which cannot be unequivocally guaranteed. Various events in the past 25 years emphasize that changes, which are so much a part of this particular coast, could sooner or later prove to be a threat to the species. Chapman (1960 b) for example has asserted that "*Puccinellia* and *Halimoine* have increased in dominance and *L. bellidifolium* is being suppressed since the rabbits have gone" (a consequence of the advent of myxomatosis). It may well be that this statement is not now as poignant as it was 18 years ago nor was it necessarily applicable to the region as a whole but it emphasizes that any change in an ecosystem can have unexpected consequences. Here it seems that the *removal* of the herbivores was causing *reduction* in numbers of a particular herb. And because in this case the herb was rare and confined to the region it would be possible to argue that removal of this herbivore (which in the event has been only partial) would not be an altogether desirable thing. A further thought might exercise the minds of Norfolk naturalists with respect to the plant that they might with some justification regard as their own. Where it occurs, it occupies as has been mentioned, a rather narrow band and people tend to walk not in the soft sand above nor in the squelchy mud below but precisely in this band. A subjective but conservative estimate near Gun Hill would be that 10% of the area potentially available to *Limonium bellidifolium* is hardpacked, bare, man-made track. What if and when human usage of this area doubles? trebles? increases tenfold? Other changes over the last 25 years included the 1953 storm surge which apparently removed two species from Scolt Head Island (Chapman 1960 b) and as well resulted in the "loss of peculiar flora associated with the pit" at Norton Hills. The appearance of *Spartina anglica* has also induced a change modifying, again according to Chapman "the whole pattern of the early stages of marsh formation". To reiterate, *Limonium bellidifolium* is not a threatened species but its future performance on a coast which throughout recorded history has been subject to marked changes (Steers 1960) might be watched with interest.

Even an ardent preservationist would find fewer reasons for focussing attention on *Suaeda vera* and *Frankenia laevis*. Unlike *Limonium bellidifolium* there is no suggestion that they might be genetically special in Norfolk and they are in any case found elsewhere in Britain. Moreover in the unlikely event of the peculiar marsh/dune ecotone ceasing to exist, *Suaeda vera* and less certainly *Frankenia laevis* would continue to exist in the region.

As a plant community, the one characterised by the three species is almost certainly found nowhere else in Britain and to this extent it is presumably something a little special. The degree of similarity to any plant assemblage which involves these same three species in for example the Mediterranean is an interesting though so far as is known, currently unanswered question.

As a final thought, it has been mentioned that the northern limit of *Suaeda vera* has been related to a particular August isotherm. It would be logical to apply the same constraint to the other two species. What would happen to the community if temperatures became colder? Where indeed was the community in the "mini ice age" of the early 17th century when there was ice in the north sea and the Thames Estuary was frozen in winter?

The performance of these three species and the community in which they occur, should as much as any plants, provide naturalists with food for thought, for interest and for mental stimulation, and that is probably what being a naturalist is all about.

Acknowledgements

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BIRDS OF THE CROMER FOREST BED SERIES OF THE EAST ANGLIAN PLEISTOCENE

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Summary

Specimens from the Cromer Forest Bed Series identified in the last century have been re-examined and additional material identified. The Shoveler *Spatula clypeata* and Capercaillie *Tetrao urogallus* are removed from the existing list. The list of species now includes the Cormorant *Phalacrocorax carbo* and fourteen species of waterfowl including the Mandarin Duck *Aix galericulata*, now found only in eastern Asia. There is a new species of eider duck *Somateria gravipes*. A buzzard, possibly the Common Buzzard *B. buteo*, is present, and an extinct species of junglefowl *Gallus europaeus*. Additional water birds are the Moorhen *Gallinula chloropus* and Green Sandpiper *Tringa ochropus*, and the Guillemot *Uria aalge* and Razorbill *Alca torda;* while land birds include the Eagle Owl *B. bubo* (apparently resembling the smaller southern form *B. b. ascalaphus*) and the Blackbird *Turdus merula*, Starling *Sturnus vulgaris* and Jay *Garrulus glandarius* or the ancestral forms of these. The strata from which some specimens originate is uncertain, but most are referable to the Pastonian and Cromerian warm stages, when the area had a temperate mixed oak forest as the dominant vegetation. Problems in assigning some birds to recent species arise from the existence of apparent Late Pleistocene speciation in these taxa.

Introduction

In describing the vertebrate fauna of the Cromer Forest Bed Series of the Pleistocene deposits of East Anglia, Newton (1882) listed and figured three avian carpometacarpi which he referred to — *Anser* sp., *Anas?*, and *Genus?*. In addition, with the second specimen he also referred to a distal end of a coracoid which resembled that of the Mallard *Anas platyrhynchos* (the earlier name *A. boschas* being used). Later (Newton 1891) he added to these the Cormorant *Phalacrocorax carbo*, the Shoveler *Anas clypeata* (using the generic name *Spatula)*, the Guillemot *Uria aalge* (earlier *U. troile*) and the Eagle Owl *Bubo bubo* (earlier *B. maximus* and *B. ignavus*). To this Lydekker (1891) added the Pochard *Aythya ferina* (earlier *Fuligula ferina*) and the Capercaillie *Tetrao urogallus*.

Most of this material, together with other unidentified specimens from these deposits, is in the collection of the Department of Palaeontology of the British Museum (Natural History). The Cormorant and Shoveler were in the collection of W. Barker of Birmingham and their present whereabouts is unknown; but they were figured by Newton and their identities can be checked. The Guillemot specimen has not been traced, but additional material from the same deposits confirms the presence of the specimen. The specimen and figures, together with additional material, have been studied and the earlier list of species has been revised. The additional material is mainly from collections formed in the last century by A. C. Savin and the Rev. C. Green.

Old List	**New List**
	PHALACROCORACIDAE
Phalacrocorax carbo	*Phalacrocorax carbo*
	ANATIDAE
Anser sp.	*Cygnus bewickii*
—	*Anser anser*
Anas boschas	*Anas platyrhynchos*
—	*Anas penelope*
Anas sp. ?	*Anas crecca*
—	*Netta rufina*
Fuligula ferina	*Aythya ferina*
—	*Aythya fuligula*
—	*Aix ? galericulata*
—	*Somateria gravipes* sp. nov.
—	*Melanitta nigra*
—	*Bucephala clangula*
—	*Mergus albellus*
—	*Mergus serrator*
Spatula clypeata	Anatidae ? species
	ACCIPITRIDAE
—	*Buteo ? buteo* or *B.buteo/lagopus/rufinus* superspecies.
	PHASIANIDAE
Tetrao urogallus	*Gallus europaeus*
	RALLIDAE
—	*Gallinula chloropus*
	SCOLOPACIDAE
Genus ?	*Tringa ochropus*
	ALCIDAE
Uria troile	*Uria aalge*
—	*Alca torda*
	STRIGIDAE
Bubo ignavus	*Bubo bubo*
	TURDIDAE
—	*Turdus ? merula* or *T.merula/boulboul superspecies*
	STURNIDAE
— —	*Sturnus ? vulgaris* or *S.vulgaris/unicolor* superspecies
	CORVIDAE
—	*Garrulus ? glandarius* or *Garrulus* superspecies

In the systematic list which follows the specimens have been discussed where necessary; and in the final section they have been considered in relation to the stages of the Forest Bed Series, and the ecological implications briefly examined.

Systematic List

Cormorant *Phalacrocorax carbo*. Distal end of a coracoid from West Runton, Norfolk, collected by W. Barker; shaft of a right humerus from Overstrand, Norfolk, Savin no. 715, BMNH A651. The distal end of a coracoid was not traced but is figured by Newton (1887, 1891). It is a typical cormorant coracoid of a size referable to this species. The humerus shaft is also similar in size to that of *P. carbo*. The nutrient foramen is very proximally sited on it. There is some variation in the site of the foramen in specimens examined but none is as proximal, and if this is significant it may indicate that the humerus was proportionally shorter than that of the Recent bird.

Bewick Swan *Cygnus bewickii*. Distal end of a left carpometacarpus, from East Runton, Norfolk, Savin no. 336, BMNH A645. A cervical vertebra, Savin no. 1986, BMNH A3422, and two thoracic vertebrae, Savin no. 1706, BMNH A3415, all from the Upper Freshwater Bed, West Runton, Norfolk. The distal end of carpometacarpus was referred by Newton (1882) to "*Anser* sp." but is too large for known species of that genus and more similar to those of *Cygnus* species. In size it very closely approximates to that of some specimens of *C. olor* but is closer to *C. bewickii* which it also resembles in the relative shortness of the zone of fusion of the metacarpals at the distal end. The three fragments of vertebrae are difficult to assign certainly but closely resemble those of this species.

Grey-Lag Goose *Anser anser*. Distal half of a right radius, and incomplete distal end of a left coracoid, both from the Upper Freshwater Bed, West Runton, Norfolk, Savin nos. 1611, 1987, BMNH A3406, A3402.

Mallard *Anas platyrhynchos*. Incomplete distal end of a left coracoid, from the Upper Freshwater Bed, West Runton, Norfolk, Savin no. 332, BMNH A649. Fragmentary left humerus, from East Runton, Norfolk, Savin Collection, BMNH A656. Also, from the Upper Freshwater Bed, West Runton, Norfolk, from the Savin Collection, part of five humeri, two carpometacarpi, two radii, seven caracoids, one ulna and one tibiotarsus, BMNH nos. A648, A652 (part), A3382-3, A3388-9, A3392, A3395, A3398-9, A3410, A3417, A3426, 46902.

Wigeon *Anas penelope*. Distal end of left humerus, from the Upper Freshwater Bed, West Runton, Norfolk, Savin no. 1693, BMNH A3407. Distal end of left tibiotarsus, from the same locality, Savin no. 971 (part), BMNH A3432 (part).

Teal *Anas crecca*. Left carpometacarpus lacking the unfused part of metacarpal IV, from West Runton, Norfolk, Savin BMNH A647. This is the specimen referred to by Newton (1884) as "*Anas?*".

Red-Crested Pochard *Netta rufina*. Proximal end of left ulna, from the Forest bed, Ostend, Norfolk, Green BMNH 17686 (part). Two distal ends of left coracoids, from the Upper Freshwater Bed, West Runton, Norfolk, Savin Collection nos. 386 and 1760 (part), BMNH A3411 and A3390 (part).

Pochard *Aythya ferina*. Distal end of a right tibiotarsus, from Ostend, Norfolk, Green Collection, BMNH 17686. Proximal end of a right carpometacarpus, from the Upper Freshwater Bed, West Runton, Norfolk, Savin no. 971 (part). BMNH A3432 (part). The first specimen, together with a number of other elements, was referred by Lydekker (1891) to this species but the other bones are either from different species or indeterminate.

Tufted Duck *Aythya fuligula*. Distal end of right humerus, Savin no. 1430, BMNH A3408; distal end of left tibiotarsus Savin no. 1988, BMNH A3418; and of right tibiotarsus Savin no. 739 (part), BMNH A3433; proximal end of right carpometacarpus, Savin BMNH A3432 (part); and another, Savin no. 461, BMNH A652 (part); distal end of tarsometatarsus, lacking trochleae, Savin no. 114, BMNH A5021. All from Upper Freshwater Bed, West Runton, Norfolk.

Mandarin Duck *Aix galericulata*. Distal end of a left coracoid, Savin no. 1660, BMNH A652 (part), and another less complete specimen, Savin no. 1760 (part), BMNH A3390 (part). Both from the UpperFreshwater Bed, West Runton, Norfolk. Osteologically this species and the related Wood Duck *Aix sponsa* are very similar. From the comparative material available (three specimens of each) the coracoids appeared more likely to be those of the former, with a more slender termination of the distal head.

Thick-Legged Eider *Somateria gravipes* sp. nov.

Etymology. The specific name is formed from the Latin *gravis* (= heavy) and *pes* (= a foot) in reference to the stoutness of the tarsometatarsus.

Diagnosis. Tarsometatarus similar in length to that of the Common Eider *Somateria mollissima* but the shaft in all its aspects much thicker, with well defined grooves for muscles and ligaments.

Material. Holotype a left tarsometatarsus lacking the trochlea for digit IV, A.C. Savin no. 1956, BMNH A3396. A left coracoid, A.C. Savin no. 2020, BMNH A3397, lacking the distal head and the external part of the sternal end, is tentatively referred to this species. It is similar to that of *S. mollissima* but it seems preferable not to assume the presence of two species from the present scanty material.

Occurrence. Upper Freshwater Bed, Cromerian, Middle Pleistocene; West Runton, Norfolk, England.

Description and discussion. The specimen is very similar in size to that of *S. mollissima*, and the leg bones of other eider species are similar in proportions to the latter. In proximal view the tarsometatarsus of the new species is a little stouter on the external side. In distal view it is similar to *S. mollissima* but the trochlea for digit III is a little deeper anteroposteriorly and a little narrower. The main difference is in the shaft which, from trochleae to hypotarsus, is considerably stouter, with well-defined edges to the surfaces, and noticeable grooves for muscles and ligaments. It is about one-third as wide again as that of *S. mollissima* and the flat proximal half of the external surface is about half as wide again. In general appearance it is more similar to the tarsometatarsus of the Australian Musk Duck *Biziura lobata* than to that of any eider. This may indicate that the species had an even greater ability to swim and feed underwater than do the Recent eiders.

Measurements. The measurements of a tarsometatersus of a similar-sized *S. mollissima* are given in parentheses. Length 48.7 (50.3); anteroposterior thickness of trochlea for digit two 7.2 (7.2), for digit three 8.0 (7.5); width of trochlea for digit two 3.6 (3.8), for digit three 5.0 (5.3); width and thickness of shaft 30 mm from distal end 6.1×4.6 (4.5×3.6); at 15 mm from proximal end 6.8×6.1 (5.5×4.5); projection of anterior external edge beyond anterior proximal fossa 3.6 (2.8) mm.

Common Scoter *Melanitta nigra.* Left coracoid, from the Forest Bed, Mundesley, Norfolk, Savin BMNH A650. Proximal end of a right femur, from the Forest Bed, Ostend, Norfolk, Green BMNH 17686 (part). The second specimen was a part of the material originally referred by Lydekker (1891) to *Aythya ferina.*

Goldeneye *Bucephala clangula.* Distal right tarsometatarsus lacking the trochlea for digit two, from the Upper Freshwater Bed, West Runton, Norfolk, Savin no. 614 (part), BMNH 3382 (part). Distal end of left humerus, from the same locality, Savin no. 720, BMNH A3403.

Smew *Mergus albellus.* Proximal end of a left ulna and distal end of a right radius, from the Upper Freshwater Bed, West Runton, Norfolk, Savin no. 568, BMNH A3386.

Red-Breasted Merganser *Mergus serrator.* Distal end of left humerus with shaft, from the Upper Freshwater Bed, Runton, Norfolk, Savin no. 1087, BMNH A3391. Right carpometacarpus lacking the unfused portion of matacarpal IV, from the same locality, Savin no. 771, BMNH A3393.

Anatidae? The left coracoid of a duck, from the Forest Bed, West Runton, Norfolk, originally in the collection of W. Barker, was identified by Newton and figured by him (1887, 1891) as that of the Shoveler *Spatula (=Anas) clypeata.* The original specimen has not been traced, but from the figure it appears to be the coracoid of a diving duck. In the absence of the specimen it cannot be satisfactorily identified.

Common Buzzard *Buteo ? buteo* (or *B. buteo/lagopus/rufinus* superspecies). Hind claw (terminal ungeal of digit one), from Bacton, C. Green (no. 6?), BMNH 17654. The specimen can be identified by the size and shape of the ventral prominence and the paired lateral foramina. Three Recent species of this genus occur in the Western Palaearctic, ecologically specialised and with minor osteological differences. The present species is the most similar and ecologically the most likely, but the period of speciation producing the Recent forms is unknown and the present bird might be ancestral to more than one Recent species.

European Junglefowl *Gallus europaeus.* C.J.O. Harrison 1978. A left coracoid from Ostend, Norfolk, C. Green BMNH A489. This specimen was described by Lydekker (1891) as a bone of the Capercaillie *Tetrao urogallus* and he explained away the small size by describing it as a young bird, although there is no osteological evidence of immaturity. It appears to be evidence of an extinct species of junglefowl, similar in size to the wild form of *Gallus gallus.*

Moorhen *Gallinula chloropus.* A proximal end of a right carpometacarpus, from the Upper Freshwater Bed, West Runton, Norfolk, Savin no. 114 (part), BMNH A5022.

Green Sandpiper *Tringa ochropus.* Left carpometacarpal, lacking the unfused portion of metacarpal IV, from West Runton, Savin BMNH A646. This specimen was figured by Newton (1882) merely to show the range of avian material found in the earlier studies of the Forest Bed Series, and no attempt was made to identify it. In size and shape it agrees with that of the above species.

GUILLEMOT *Uria aalge*. A shaft of a left humerus, lacking ends, from Chillesford Crag deposits, Aldeby, Norfolk, collected by Crowfoot and Dowson. Proximal end of a right radius, from Chillesford Crag deposits, Chillesford, Suffolk, presented by Dr Macfadyan, BMNH A1940. The original humerus has not been traced. It was figured by Newton (1882) and, in spite of minor discrepancies in the two views shown, appears to be of this species.

RAZORBILL *Alca torda*. Distal end of a left humerus, from Bacton, Norfolk, Savin no. 2363, BMNH A655. In Newton's interleaved copy of his "Vertebrates of the Forest Bed Series" in the Library of the Department of Palaeontology, British Museum (Natural History) there is a sketch of this bone and a note of its identification; but he did not include it in his later work.

EAGLE OWL (small race) *Bubo bubo (ascalaphus/desertorum)*. A right tarsometatarsus lacking the proximal end, from East Runton, Norfolk, Savin no. 508, BMNH A644. The trochlea for the fourth digit has been broken off and replaced again, the break being partly filled with plaster or wax, coloured to resemble the original. As a result the trochlea projects further laterally and creates a large intertrochlear notch and a more distally-projecting posterior edge. This appears to have occurred when the specimen was originally collected, since it is present in early casts without the break being indicated.

The specimen is small and the shaft is slender, resembling that of the smaller North Africa — Middle East forms. From the distal end of the tubercle for the tibialis anticus to the base of the trochlea for the third digit the bone measures 47.2 mm and the width and thickness of the shaft 30 mm from the base of the trochlea is 84 × 58 mm.

?BLACKBIRD *Turdus ? merula* (or *T. merula/boulboul* superspecies). Right humerus, from the Upper Freshwater Bed, West Runton, Norfolk, collected and presented by P. Andrews, 1976, BMNH A4957. Distal end of a left coracoid, from same locality, Savin no. 620, BMNH A3381 (part). The humeri of the likely Recent species of *Turdus* can be identified by their size and this one corresponds to those of the species.

? STARLING *Sturnus ? vulgaris*, (or *S. vulgaris/unicolor* superspecies). imperfect distal end of a left humerus, distal ends of right and left tarsometatarsi, proximal end of left carpometacarpus, from the Upper Freshwater Bed, West Runton, Norfolk, Savin no. 620, BMNH A3381 (part).

? JAY *Garrulus ? glandarius* (or *Garrulus* superspecies). Distal end of a left tibiotarsus with part of the shaft, Upper Freshwater Bed, West Runton, Norfolk, Savin no. 1638, BMNH A652. Distal end of a left tarsometatarsus lacking trochlea, from the same stratum, Savin no. 620,BMNH A3381 (part). The first specimen lacks the internal condyle but agrees with the above species in all its characters.

Discussion

For specimens collected in the 19th Century the data on the strata from which they originate tends to be inadequate. The specimens under discussion, with the exception of those from the Chillesford Crag, are said to be from the "Forest Bed" of the locality of origin. Information on the various main collecting sites and their ages has been assembled by Stuart (1974, 1975) and some information on the flora of the period is available (Stuart 1975, West 1977).

The present specimens are mainly referable to two consecutive temperate stages within the Cromer Forest Bed Series — the Pastonian and the Cromerian. These are separated by the cold Beestonian stage. In the following list indicating periods of occurrence the localities have been added.

STAGE UNCERTAIN.

Cormorant *Phalacrocorax carbo*, Red-crested Pochard *Netta rufina*, Pochard *Aythya ferina*, Common Scoter *Melanitta nigra*, European Junglefowl *Gallus europaeus*. (The cormorant is from Overstrand, Common Scoter from both Mundesley and Ostend, the others from Ostend).

PASTONIAN.

Bewick Swan Cygnus bewickii, Mallard *Anas platyrhynchos*, ? Common Buzzard *Buteo ? buteo*, Guillemot *Uria aalge*, Razorbill *Alca torda*, Eagle Owl *Bubo bubo*. (The Guillemot is from Chillesford Crag, Buzzard and Razorbill from Bacton, others from East Runton).

CROMERIAN.

Cormorant, *Phalacrocorax carbo*, Bewick Swan *Cygnus bewickii*, Grey-lag Goose *Anser anser*, Mallard *Anas platyrhynchos*, Wigeon *Ansa penelope*, Teal *Ansa crecca*, Red-crested Pochard, *Netta rufina*, Pochard *Aythya ferina*, Tufted Duck *Aythya fuligula*, Mandarin Duck *Aix galericulata*, Thick-legged Eider *Somateria gravipes*, Moorhen *Gallinula chloropus*, Green Sandpiper *Tringa ochropus*, Goldeneye *Bucephala clangula*, Smew *Mergus albellus*, Red-breasted Merganser *Mergus serrator*, ?Blackbird *Turdus ? merula*, ?Starling *Sturnus ? vulgaris*, ?Jay *Garrulus ? glandarius* (all Upper Freshwater Bed, West Runton, except for Cormorant and Green Sandpiper which are West Runton, with bed not specified).

Stuart (1975) describes the vegetation of the Upper Freshwater Beds at West Runton, which are Cromerian (zone Cr II), as that of a mixed oak forest flanking a river valley, with fens and areas of open herbaceous vegetation on the floodplain. The general picture during the early Cromerian as indicated by pollen studies (Duigan 1963) is of pine *Pinus* and birch *Betula* as the early dominant trees, gradually giving way to oak *Quercus*, elm *Ulmus*, lime *Tilia*, hazel *Corylus* and alder *Alnus*. The Pastonian has been less studied but pollen evidence shows a similar type of vegetation (West and Wilson 1966) with the addition of hornbeam *Carpinus*.

Most of the birds identified are associated at the present day with temperate conditions in this region and many with fresh water. The Grey-lag

Goose feeds by water in open places, and ducks of the genera *Anas*, *Netta* and *Aythya* are dabbling and diving species of fresh water. The Goldeneye, Smew and Merganser nest in Boreal forest regions and migrate to these parts in winter, while the Bewick Swan is a migrant from the Siberian tundra. Most of these species may occur at times on brackish waters of estuaries or coastal lagoons. The Moorhen lives on the borders of fresh waters, as does the Green Sandpiper which like some of the ducks nests in the boreal forest regions and migrates south in winter. The Cormorant is equally at home on fresh or salt water.

The Common Scoter nests on fresh water in the boreal regions but further south occurs only as a seabird, and both Razorbill and Guillemot are normally confined to salt water. The new species of eider presents a problem of interpretation. The Recent eider species are all associated with salt water seacoasts. It could be argued that the development of the leg shown in this species indicated that it had evolved as a strong swimmer, with an inference that it might be adapted for deep or rough seas. However, it has been mentioned that there is a morphological analogy with the Australian Musk Duck, a species in which similar stout tarsometatarsi are associated with feeding on inland fresh waters. Apart from the eider all other species listed for the Cromerian could occur on fresh waters.

There is an unexpected duck species; this is the Mandarin Duck which at the present day is restricted to eastern China and Japan where it is typically a bird of mixed oak forest near water. It could have occurred across Eurasia when suitable forest conditions were present. The fragmentation of forest during the glaciations must have adversely affected a number of forest species. As D. Goodwin (*pers. comm.*) suggests, there is a similar situation in the case of the Azure-winged Magpie *Cyanopica cyanea*. The latter occurs in China and Japan at present, and had it not been for the isolate population in the Iberian peninsula it might have been regarded as an eastern Asiatic endemic rather than the relics of an earlier distribution that spanned Eurasia.

Of the three Recent species of *Buteo*, the Common Buzzard *B. buteo* is the only one normally associated with forest and forest edge. The point in time at which the three species diverge is not known, and while specific separation may already have occurred by this period in the Pleistocene we do not have enough evidence to make any decisions on this. Mayhew (1977) detected evidence of erosion due to digestion by accipitrine birds of prey as opposed to owls on the teeth of small rodents from the Upper Freshwater Bed at West Runton. He believed such remains came from pellets cast by the birds and suggested buzzards and kestrals as possible raptors at this period.

We know nothing of the extinct European Junglefowl, but extrapolating from other, Recent *Gallus* species it was probably a bird of forest or forest edge. At the present day the Eagle Owl occurs through a wide range of habitats from subarctic to subtropical regions. The small, slender tarsometatarsus of the present specimen is typical in Recent times of the form found in warmer and more arid areas of North Africa and the Middle East. This is a paler and smaller bird which has been separated in the past as a species, *Bubo ascalaphus*. The size of the fossil bird does not appear to be correlated with the apparent conditions during the Pastonian as indicated by the flora. The larger and more northerly forms of the species now in existence may be examples of Bergmann's rule that within species size increases in colder regions, but these could have evolved during later glaciations. It is possible that the fossil bird is closer to an ancestral form.

The identification of the Jay is tentative, being based on incomplete specimens, but it appears to match Recent specimens closely. At present the distribution of this species is closely correlated with that of the oak, and it extensively utilises acorns for food in winter. Assuming that its habits have not changed during the intervening period it is a likely species to have occurred in a mixed oak forest. The Blackbird and Starling are widespread species of temperate conditions, the former occurring in forest and forest edge, the latter often nesting in trees but usually occurring only where there are open grassy areas nearby.

Although the last three birds have been referred to Recent species there is a taxonomic problem involved with fossil birds of this period. The three genera concerned also contain, in addition to these widely distributed species, osteologically similar isolate species with smaller populations. The Lanceolated Jay *G. lanceolatus* occurs in a limited area of the Western Himalayas and the Lidth's or Loochoo Jay *G. lidthii* in the Riu-Kiu Islands. The Grey-winged Blackbird *T. boulboul* occurs along the Himalayas and the Spotless Starling *S. unicolor* is confined to the Iberian Peninsula.

These species differ from those listed mainly in minor characters of plumage markings and colour, and do not appear to be separable osteologically from their congeners when only a few bones are available. A similar problem exists with the buzzards, *Buteo* species, of Eurasia. The close similarities and the patterns of distribution suggest a fairly recent speciation, probably during the later Pleistocene glaciations. Therefore, in referring birds from the Cromer Forest Bed Series to Recent species we cannot be certain at present that we are not dealing with ancestral forms from which these similar species evolved.

In such circumstances it can be argued that a form which existed prior to some separation and speciation in one part of its range requires a different name from the form subsequently present, even though the two may be osteologically inseparable and apparently represent a direct lineage. Currently, in ornithological studies, groups of very similar and often allopatrically distributed species of this type, which have obviously evolved from an earlier form in response to conditions of isolation and selection, are often referred to as superspecies. The term was created to assist in the study of the taxonomy and zoogeography of Recent birds but should indicate the existence of an equivalent form during the palaeontological history of the genus.

The superspecies may have a wider connotation than the context in which I have used it here. For example, the Blackbird superspecies would probably usually include the montane Ring Ousel *T. torquatus* and the North American Robin *T. migratorius*, although both are osteologically distinct in some characters from the species at present under consideration. However, in view of uncertainty about the status of the Cromer Forest Bed

Series forms, and the lack of more certain views of the probably period of speciation in these genera, I prefer to use a modified superspecies concept rather than propose new names for putative ancestral forms.

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A STUDY OF VERONICA TRIPHYLLOS L., VERONICA PRAECOX All. AND VERONICA VERNA L. AT WEETING HEATH ARABLE RESERVE, NORFOLK

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Introduction

Weeting Heath Arable Reserve (National Grid Reference TL/762882) is an area of eleven acres immediately to the east of the Weeting Heath National Nature Reserve. The Weeting-Hockwold road forms the southern boundary of the arable reserve, which slopes gently upwards to the north, where it is bordered by Belvedere Wood, a mixed coniferous/deciduous plantation. On the west it is bordered by the heathland of the N.N.R., and on the east by several rows of recently planted Scots pine seedlings and a narrow belt of gorse *(Ulex europaeus)*, broom *(Sarothamnus scoparius)* and bracken *(Pteridium aquilinum)*; this belt separates it from arable fields (see fig. 1). The land belongs to Mr. Parrott of Fengate Farm, Weeting; it was by agreement with him that the reserve was set up in 1969 with the help of Mr. Christopher Cadbury and the co-operation of the Norfolk Naturalists' Trust and the Nature Conservancy.

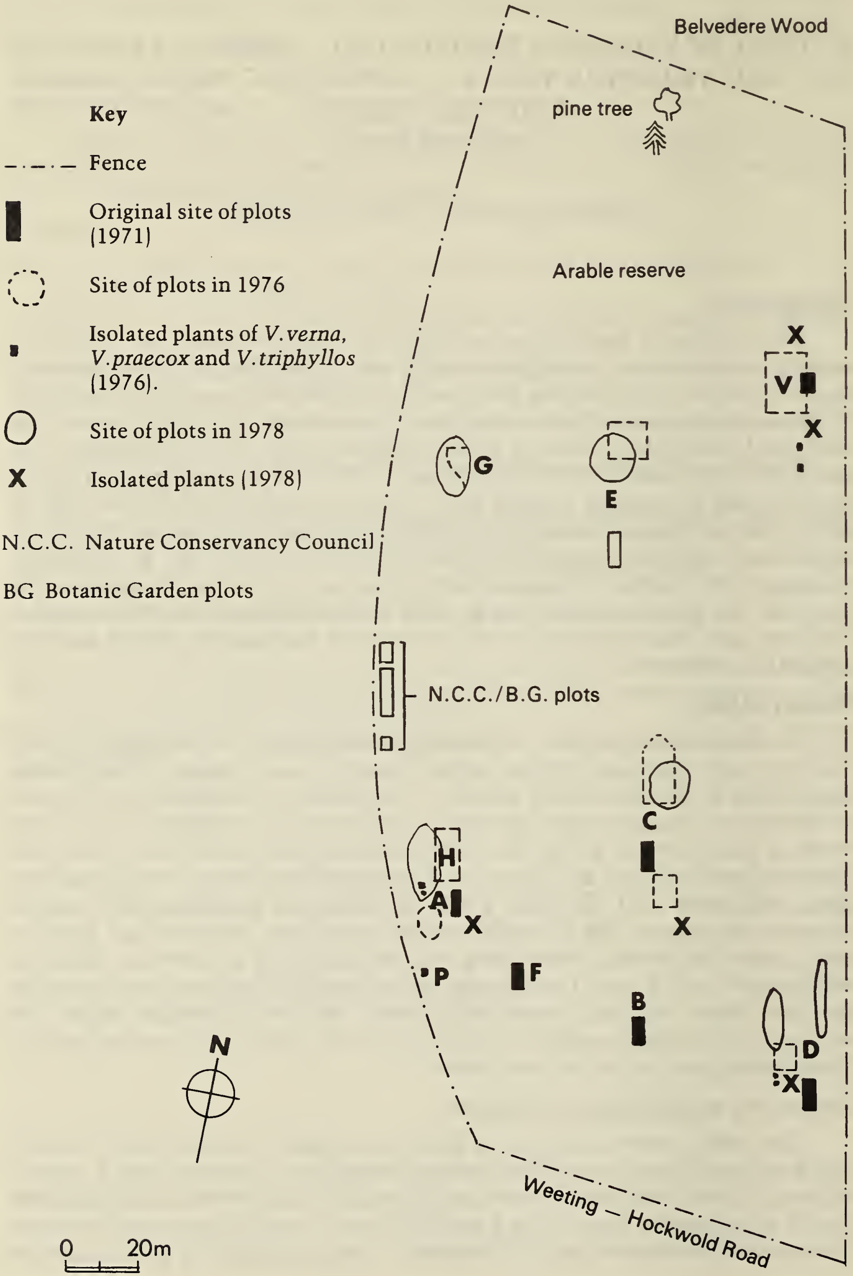
History of Site

As indicated in the paper on Weeting Heath by Mrs. G. Crompton (1974), the area now occupied by the arable reserve was covered by deciduous plantations in the nineteenth century. The period of woodland cover lasted for almost one hundred years; the area must have lost its tree cover by the first years of this century, as on the 1905 edition of the 1/2500 O.S. map the northern part is shown as "furze" and the southern part as "rough pasture, heath and moor". At this time a belt of coniferous woodland still existed between the reserve and the arable fields to the east, but this had gone by 1963, as on the Nature Conservancy map of that date it is shown as "bracken and broom", as it is now. Cereal crops were probably grown on the area during the First World War and sporadically since; the last cultivation before the setting up of the arable reserve in 1969 was in 1962, when the area was heavily limed and a good crop of rye was grown.

Reasons for establishment of Reserve

The arable reserve was set up firstly as a refuge area and study site for rare Breckland plants, especially *Veronica triphyllos*, *V. praecox* and *V. verna*. Although these three species were not known from the reserve or the adjacent area it was thought that it was a suitable area in which they would survive if introduced from elsewhere in Breckland. *Veronica triphyllos* and *V. praecox*

FIG. 1: POSITION OF PERMANENT PLOTS AT WEETING HEATH ARABLE RESERVE IN 1971, 1976 AND 1978



occur in arable fields and other areas of disturbed ground e.g. gravel pits (often old arable land). *V verna* is found in arable fields but more often now in open habitats in dry grassland. It is occasionally found in young open coniferous plantations, but this is more common on the Continent than in Britain. *V. praecox* and *V. verna* are confined to Breckland in Britian, and *V. triphyllos* is almost confined to this area. All three species, especially *V.triphyllos*, are becoming increasingly rare. It is thought that this decline has two causes (i) loss of suitable sites because of building and development on arable land (ii) recent changes in farming practice. Until recently rye was the traditional Breckland cereal crop, the autumn sowing and subsequent lack of soil disturbance providing suitable conditions for the survival of the winter annuals *V.triphyllos*, *V.praecox* and *V.verna*. The plants flower in the spring and set seed by the end of May, before the rye produces too dense a shade and well before harvest time, when the fallen seeds may be dispersed partly by the soil disturbance. Open patches in crops growing badly on the dry sandy Breckland soils were probably features of many fields and provided suitable sites for these species. Now, much spring barley is grown and many overwintering *Veronica* rosettes must be destroyed by the spring ploughing. Modern fertilisers and varieties of cereal especially suited to the sandy soils and dry Breckland climate mean not only that the poorest fields will produce a reasonable crop but also that their continuous cultivation makes economic sense. Previously many fields were only cultivated sporadically and the open but undisturbed conditions in these so-called ''brecks'' in the two or three years after ploughing must have been very favourable to many weed species, including the rare annual Breckland Veronicas. It was thus decided to recreate conditions in the arable reserve similar to those in Breckland thirty or forty years ago, in the hope that this would favour growth of *V.triphyllos*, *V.praecox* and *V.verna*. It was decided to do this by using traditional crops and by cultivating only every few years, when colonisation by weeds made a further ploughing necessary in order to provide open areas of soil for seedling establishment. Use of herbicides, another reason for the decline of many weed species, was to be avoided. Secondly, the reserve would provide habitats for insects associated with the weed species expected to colonise the area after ploughing.

Experimental Work 1969—1971

In summer 1969 the new reserve consisted of a more or less closed turf composed of grasslands B-D of Dr. Watt's classification (Watt, 1940). the more calcareous grasslands were on the west and south of the area.

The whole eleven acres was ploughed, with interruptions due to bad weather, during the period December 1969—February 1970. It was decided to leave the northern part of the reserve unsown and to observe the colonisation of this by weed species. The southern eight acres on slightly better soil was sown with spring barley (Sultan), as it was then too late to sow the traditional Breckland crop of rye as originally intended. 1 cwt 20 lbs—1 cwt 45 lbs of seed per acre was sown in the first week of April, after rolling and harrowing. 2½ cwt per acre of fertiliser (20 parts N:10 parts P:10 parts K) was put on at the same time but no lime was used although on previous cultivations of the field it was considered necessary. It was thought that the poor patchy crop which might result would favour the growth of the Veronicas to be sown in permanent plots in the field, and this did in fact happen as the barley was adversely affected by a long drought after planting and was very poor in places. The barley was harvested in the third week of August and the stubble, together with some regrowth which had occurred, left unploughed.

At the western edge of the field a strip six metres wide was left ploughed but unsown. A pilot plot (plot P in fig. 1) of size 1m × 1m containing seeds of *V.triphyllos*, *V.praecox* and *V.verna* (seed sources as for other plots, given below) was set up on 28.3.78 but no germination was recorded in this plot.

Plots were also set up in this western strip by other workers; a fenced-in plot containing *Artemisia campestris*, *Silene otites* and *Veronica spicata* was set up in 1970 by Mrs. G. Crompton and Mr. P Wright; to the north of this a demonstration plot containing *Veronica triphyllos*, *V.praecox*, *V.verna* and *Silene conica* was set up by the Nature Conservancy Council; to the south of it two small trial plots containing *Veronica triphyllos*, *V.praecox* and *V.verna* were set up by Mr. D. Donald of the Cambridge University Botanic Garden in 1977. These plots are labelled "N.C.C. and Botanic Garden plots" in Fig. 1.

Soil Survey

In Breckland the chalk is overlain by sandy drift of varying thickness; in many places a mosaic of deep acid sandy soils and shallower calcareous soils where the chalk is nearer the surface is found (Watt, 1936). In places soil stripes and polygons can be seen (Watt, Perrin and West, 1966). In 1970 and 1971 striping became evident in the pattern of weed colonisation in the unsown area at the north end of the reserve, *Reseda lutea* dominated stripes alternating with *Rumex acetosella/Holcus mollis* dominated stripes. Considerable soil heterogeneity was indicated in the reserve both by the variation in the vegetation before ploughing and by the appearance of the field after ploughing, the soil varying from dark friable material in which pieces of chalk were visible to yellowish-brown or reddish sandy soil. Small dark humus-rich areas were visible where the turves from the 1962 ploughing had been turned in. After the 1969 ploughing the turf was not completely covered in places, especially at the southern end where the taller grassland C had been.

A soil survey was carried out in March 1970 before siting the permanent plots. A sampling grid was set up and seventy-five 100g samples of the top 20cm of soil were collected; samples were collected at 15m intervals along lines 25m apart. The pH of the fresh soils was determined on the day of collection, using a pH meter. Values of 9.0 in some of the samples were probably due to lumps of calcium carbonate brought up by ploughing; it was thought that in the first year much leaching might occur and the survey was therefore repeated in November/December 1971, using the same sampling sites. Both sets of pH readings are shown in Table 1. A similar range of pH was found on both occasions (5.8—9.0 in 1970 and 6.0—8.9 in 1971), with differences of 2.0—2.4 pH units between some adjacent samples. Some disturbance of the soil had taken place during harvesting of the barley, so direct comparisons of the two readings for each sample site are of little value, but there were fewer high pH values in 1971, indicating that leaching had occurred.

The % organic content of eleven soil samples was also determined by measuring loss on ignition, and was found to be very low, ranging from 1.16—2.47%.

Permanent Plots for Veronica triphyllos, V.praecox and V.verna (see Fig. 1)

It was decided to site the plots in areas of varying soil pH and in both the sown and the unsown areas to find out if any difference in the performance of the Veronicas resulted. In fact the different conditions did not produce very great differences.

On 28.4.70 six plots were set up; plots A—D were in the barley crop and plots E and V were in the unsown ploughed area. Plots A and C were in calcareous areas, plot V was in an acid area and plots B, D and E were in intermediate to acid areas. Plot D was in a slight hollow and was damper and later more moss-grown than the other plots. The plots were sown as follows:—

Plot A: 200 seeds of *V.triphyllos* and 200 seeds of *v.praecox*
Plots B—E: 100 seeds of *V.triphyllos* and 100 seeds of *V.praecox*
Plot V: 100 + seeds of *V.verna*

A few surplus seeds of *V.praecox* and *V.triphyllos* were sown to the N.E. of plot E. Seed sources were:

V.triphyllos: collected from Green lane, Thetford, Norfolk in 1969.
V.praecox: from Broom Road, Lakenheath, Suffolk via Dr. Watt's garden in Cambridge.
V.verna: from Cherry Hill, near Tuddenham, Suffolk, via Dr. Watt's garden.

It was intended to make a comparison between the rare Breckland *Veronica* species and certain widespread species, so *V.hederifolia* and *V.arvensis* were sown in plot E and *V.hederifolia* and *V.persica* in plots A—D.

On 15.9.70 two further plots were set up, plot F in the barley crop and plot G in the unsown area; both were in calcareous soil. The plots were sown as follows:

Plot F: 100 seeds of *V.triphyllos, V.praecox* and *V.verna.*
Plot G: 100 seeds of *V.triphyllos* and *V.verna.*

Seed sources were:

V.triphyllos: collected from Green lane, Thetford, 1968 & 1969.
V.praecox: Broom Road, Lakenheath, Suffolk, via Dr. Watt's garden.
V.verna: Cherry Hill, near Tuddenham, Suffolk, via Dr. Watt's garden.

Seeds of *Veronica persica* and *V. arvensis* were also sown in both plots. the seeds of *V.persica, V.hederifolia* and *V.arvensis* were in all cases collected from Green Lane, Thetford, Norfolk in 1968.

Permanent Plots 1970—1978:—

Time of germination and flowering 1970—1971. No germination of *V.triphyllos, V.praecox* and *V.verna* was recorded in the spring and summer following planting (1970) but all three species germinated in the autumn of that year and there was some further germination in spring 1971:

V.praecox: some germination in September, most October/November 1970; some March/April and the first fortnight in May 1971. Flowered March—May 1971.
V.triphyllos: 2 Plants germinated in August, some in September, most in October/November 1970 and some in March/April 1971. Flowered March—May 1971.
V.verna: germinated in August in 1970 and 1971 with some germination in April, October and November in 1971. Flowered April—May 1971.

No *V.verna* seeds were sown in plot D but one seedling was seen there in March and April 1971; this probably came from a seed dropped during sowing of other plots.

All three species set ripe seed. In all three species there was variation from small unbranched plants 2—4cm high with only one or two flowers per plant to large well-branched plants up to 22cm high; these had up to 80 flowers and fruits per plant in *V.praecox* and up to 59 in *V.triphyllos*. The plants in the autumn sown plots were almost all very small, with one or two flowers per plant, whereas where were many more medium to large plants in the spring sown plots. In places the larger more strongly growing plants were growing up through a mat of clover and grasses e.g. *Holcus mollis*. Striking variation in size was also noticed in *V.triphyllos* and *V.praecox* at Green Lane, Thetford, often in adjacent plants.

The largest *V.persica* plant seen had 44 flowers and fruits; the largest *V.hederifolia* had 67 flowers and fruits plus developing buds.

Surprisingly the common Veronicas did not germinate in very large numbers, especially *V.arvensis*. However *V.persica* germinated in all months of the year and was in flower from February to July and in September, October and January. *V.hederifolia* germinated in September—November and March—April, and flowered from February to May and in October. These species thus seem to germinate over a wider range of conditions than the rare species, and the time of flowering and seed production is not so limited. The numbers of plants in each plot are given in Table 2.

Plants of all the *Veronica* species studied, except *V.arvensis*, were nibbled by animals, probably rabbits.

Time of germination and flowering 1971—1973: no cultivation. The site was not visited between Nov. 1971 and April 1976.

Time of germination and flowering 1974—1976: rye was grown on the whole eleven acres. Fertiliser, and possibly 2, 4 D in 1975, was put on. In 1976 the *Veronica* plots were remapped and the populations of plants estimated (see Table 2). It was found that the position of the main groups of plants had shifted slightly (see Fig. 1) because of soil disturbance following cultivation operations.

Time of germination and flowering 1977: with the help of Nature Conservancy Council staff and Mr. D. Donald the field was resurveyed and permanent wooden marker posts were put in at 50 metre intervals along the eastern and western margins of the field in order to facilitate re-finding the permanent plots.

It was thought that a combination of barley and sainfoin would favour the Breckland Veronicas, as large populations of *V.triphyllos* and *V.praecox* had been seen in other legume crops such as lucerne on occasion (e.g. at Maid's Cross Hill, Suffolk). Unfortunately bad weather delayed drilling until 4th May, and *Veronica* plants in the permanent plots were probably destroyed. No *Veronica* plants, and very few weeds of any kind, were seen in the crop on 19th May, but *Veronica verna* plants were in flower at the edge of the field near plot V and a few small plants of *V.verna* and *V.praecox* were seen in the N.C.C. and Botanic Garden plots. The barley was then about 8cm tall and the sainfoin was at the cotyledon stage. At the southern end of the reserve a two-acre strip of sainfoin and clover was sown. During the summer there was a severe drought, and the barley growth was very poor.

Time of germination and flowering 1978: It was decided to grow a combination of rye and kidney vetch. The rye was sown on 28th October 1977 and the kidney vetch on 18th April 1978. The kidney vetch was sown 1—2 inches deep using an old-fashioned drill. 50Kg of seed was sown on eight acres of the field; a strip on the western edge of the field, and the southern two acres which were carrying sainfoin and clover, were not sown with kidney vetch. The field had a top dressing of 50 units of nitrogen per acre in mid-March. The numbers of *Veronica* plants in the permanent plots were recorded in May. The rye was harvested in late August; after the rye harvest the kidney vetch was well-established. There was no flowering of the vetch in 1978 but it is hoped to crop it for seed after flowering in 1979.

Conclusions

Although the positions of the permanent plots have shifted slightly since 1971 because of soil disturbance caused by cultivation operations, it can be seen from Table 2 that the numbers of *Veronica triphyllos* and *V.praecox* in the reserve have increased. Although there were no *V.verna* plants in plot V in 1978, it is thought that this was a temporary set-back; plants were found elsewhere in the field. The arable reserve does thus appear to be a suitable site for *Veronica triphyllos*, *V.praecox* and *V.verna*, and the present management policy of re-creating conditions as under old-fashioned Breckland farming practice appears to be successful.

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Table 1: Weeting Heath Arable Reserve: Soil pH measurements in 1970 & 1971

A) MARCH 1970:—

m from W edge / *m from S edge*	*15*	*30*	*45*	*60*	*75*	*90*	*105*	*120*
300	—	7.2	—	6.5	—	—	—	—
275	—	7.5	—	7.4	—	6.0	—	—
250	—	7.1	—	6.4	—	8.9	—	—
225	—	7.5	—	5.7	—	6.1	—	—
200	—	6.4	—	8.8	—	6.1	—	—
175	—	9.0	—	8.8	—	8.4	—	7.8
150	—	8.8	—	8.9	—	8.8	—	8.7
125	8.7	7.0	8.8	9.0	8.9	8.7	7.3	6.8
100	8.9	7.0	8.9	8.2	8.9	6.9	8.6	7.3
75	8.8	8.9	8.9	7.3	8.9	8.3	8.5	7.9
50	6.9	8.8	6.7	8.8	8.5	7.2	8.2	5.8
25	7.9	8.7	7.7	8.3	6.5	8.8	8.9	—
0	8.6	8.1	6.7	6.4	7.9	6.4	—	—

b) November-December 1971:—

m from W edge *m from S edge*	*15*	*30*	*45*	*60*	*75*	*90*	*105*	*120*
300	—	—	—	—	—	—	—	—
275	—	8.0	—	—	—	6.0	—	—
250	—	6.7	—	6.4	—	—	—	—
225	—	6.5	—	7.7	—	6.1	—	—
200	—	8.3	—	7.7	—	8.3	—	—
175	—	—	—	—	—	—	—	—
150	8.7	8.3	7.5	8.9	7.3	7.7	8.5	8.6
125	—	—	—	—	—	—	—	—
100	8.6	7.3	8.8	8.9	8.5	6.9	8.9	7.8
75	8.9	8.9	7.7	8.4	8.3	7.5	7.9	6.9
50	7.2	8.8	7.5	8.3	8.5	7.4	8.5	6.6
25	6.9	8.8	7.5	6.9	6.2	7.0	8.3	6.2
0	8.2	6.9	6.3	6.4	6.7	6.3	7.9	—

Table 2: Weeting Heath Arable Reserve: Numbers of Veronica Plants in the permanent plots in 1970—1, 1976 and 1978.

A) SPRING 1971: VERONICA PRAECOX, V.TRIPHYLLOS AND V.VERNA

Plot	*Veronica praecox*	*Veronica triphyllos*	*Veronica verna*
A	40 plants flowered	1 plant flowered	—
B	—	No plants flowered but 2 unhealthy vegetative plants present Aug. 1970	
C	40 plants flowered	21 plants flowered + 1 vegetative (51 germinated).	—
D	33 plants flowered	24 plants flowered	1 seedling March—April
E	49 plants flowered + 6 vegetative	28 plants flowered	—
F	39 vegetative plants in April, some flowered April—May	5 plants flowered + 10 vegetative (55 germinated)	35 seedlings present Feb., some flowered May
G	50 seedlings present Jan, some flowered May	70 plants flowered (90 germinated)	300 vegetative plants April, some flowered May
V	—	—	22 plants flowered (50 germinated)

If many seedlings died, the number of plants which germinated is shown as well as the number which flowered.

In Oct.—Nov. 1971: *V.praecox* seedlings were present in plots B,C,D,E,G.
V.triphyllos seedlings were present in plots A,B.C,D,E,F,G.
V.verna seedlings were present in plots F,G,V.

B) 1970—1971: VERONICA PERSICA, V.HEDERIFOLIA AND V.ARVENSIS

Plot	*Veronica persica*	*Veronica hederifolia*	*Veronica arvensis*
A	No plants flowered but 4 vegetative present in April 1971	No plants (4 plants flowered + 1 seedling N. of plot in April 1971)	—
B	No plants flowered,; 3 seedlings present in November 1970	—	—
C	20 plants flowered Nov. 1970, 15 in April 1971	8 plants flowered + 6 vegetative in April 1971	—
D	25 plants in fruit Nov. 1970, 9 flowered + 1 vegetative Jan. 1971 & 13 flowered May 1971	Several plants flowered Oct. 1970; 20 vegetative Nov. 1970; 4 flowered + 7 vegetative Feb. 1971; 5 flowered April 1971	—
E	2 plants in fruit + 4 vegetative Nov. 1970; 1 plant flowered + 9 vegetative Feb. 1971; 5 plants flowered May '71	—	—
F	2 vegetative plants April 1971	—	4 vegetative plants March 1971; plants in fruit July 1971
G	—	—	A few plants in fruit July—Sept. 1971

In Oct.—Nov. 1971: *V.persica* seedlings were present in plots B,C,D,E.

c) 7—8th April 1976: Veronica praecox, V. triphyllos and V. verna

Plot	*Veronica praecox*	*Veronica triphyllos*	*Veronica verna*
A	41 seedling and vegetative plants	2 medium-sized plants, 1 flowering and 1 vegetative + 1 ?seedling	—
H	57 + seedling and vegetative plants	1 flowering plant	—
B	37 seedling and vegetative plants	52 + medium sized flowering plants	—
C	192 seedling and vegetative plants	18 medium-sized vegetative and flowering plants	—
D	61 seedling and vegetative plants	40 vegetative and flowering plants	—
E	78 + vegetative plants	9 small-medium vegetative and flowering plants	—
F	—	—	—
G	5 vegetative plants (4 small, 1 larger); ?other seedlings	23 very small vegetative and flowering plants	—
V	—	—	100—200 small seedlings, some nearly sand-covered

A group of *V. praecox* and *V. triphyllos* plants which did not appear to correspond with any of the original permanent plots was found on the western side of the field near plot A; these are recorded in the table as plot H.

D) 18—19TH MAY 1978: VERONICA PRAECOX, V.TRIPHYLLOS AND V.VERNA

Plot	*Veronica praecox*	*Veronica triphyllos*	*Veronica verna*
A & H	709 plants in flower and unripe fruit	1 plant in flower and unripe fruit	—
B	1 plant in flower and unripe fruit	1 plant in fruit	—
C	359 plants in flower and unripe fruit	5 plants in flower and unripe fruit	—
D	108 plants in flower and unripe fruit Also 11 plants nearby in strip at field edge	25 plants in flower and fruit Also 1 plant nearby in strip at field edge	15 vegetative plants nearby in strip at field edge
E	64 plants in flower and unripe fruit	3 plants in flower and fruit	—
F	1 plant in flower and unripe fruit, probably from this plot	—	—
G	237 plants in flower and unripe fruit	51 plants in flower and unripe fruit	2 vegetative plants
V	2 plants in flower and unripe fruit	—	—

2 plants of *V.praecox* were also present in the extreme S.W. corner of the field. The number of plants may have been under-estimated, particularly in plot B, because the rye was already 60—90cm tall in places, although very patchy.
Plots A and H of 1976 appear to have amalgamated.
The disappearance of *V.verna* from plot V was possibly due to cultivation operations just after germination had occurred. However *V.verna* appears to have spread to the south-eastern edge of the field near plot D. This may be because seeds were shifted by cultivation operations, although in 1971 one *V.verna* seedling was found near plot D; this was thought to have been dropped when the permanent plots were set up, and other seeds may have been dropped at the same time and lain dormant until this year.
Most of the *V.praecox* and *V.triphyllos* plants were well-branched medium to large plants, with flowers, unripe fruit or ripe fruit. The *V.verna* plants were young vegetative plants.

NORWICH BIRD-SEED MIXTURES AND THE CASUAL PLANTS OF HARFORD TIP

by NICHOLAS S. WATTS AND GEOFFREY D. WATTS

Introduction

Municipal refuse tips provide many opportunities for colonisation by native plant species, but typically they also support a wide range of casual plant species from a variety of sources. Some casuals are clearly ornamental plants derived from gardens, while others are edible species transported with refuse from the garden or with garbage, and others originate in agricultural, commercial or industrial waste. Petch and Swann (1968) connect the numbers and variety of one group of casual plants recorded from the chief tip for Norwich domestic rubbish at Harford Bridges with the large numbers of bird fanciers for which the city of Norwich has long been famed. The proof of such a relationship demands a tracing of the connecting chain and a testing of each of its links.

Thus:
(a) to investigate the number, variety and relative sales of bird-seed mixtures available in Norwich;
(b) to analyse samples of these mixtures to determine the species of plants represented in each;
(c) to determine the proportions of seeds of different species in the mixtures by weight and by number;
(d) to determine the germinative capacities of the components of the mixtures;
(e) to study cage-bird feeding preferences to establish which species of seeds are more likely to be neglected;
(f) to consider the removal and disposal of unwanted bird-seed by cage-bird owners;
(g) to observe the refuse handling procedures from house to the tipping site;
(h) to monitor the conditions for plant growth at the tip surface;
(i) to survey material recently deposited at the tip to establish the presence of casual plant species;
(j) to relate the numbers of plants and the variety of species found to the potential casual colonisers determined in (a) to (e);
(k) to survey older tip areas to establish that these casuals fail to persist and so need constant re-introduction.

Barnes (1960, 1967), Petch and Swann (1968) and Swann (1975) report surveys of refuse tip vegetation and, in general terms, relate some of the species found to their probable origins in bird-seed mixtures, thus testing links (i) and (j). This paper sets out the results of an attempt to test links (a), (b), (c), (d), (h), (j), (k). The remaining links, (e), (f) and (g), have still to be tested.

The Bird-Seed Mixtures Available

In May, 1969, visits were made to six bird-seed shops in Norwich, ranging from multiple stores to pet shops. A total of thirteen different bird-seed mixtures were purchased — five intended for budgerigars, four for canaries, two for finches, one for parrots and one for pigeons. Shopkeepers were unable or unwilling to gauge the relative popularity of mixtures in each range, or to indicate the volume of sales involved, although some indication of popularity might be drawn from the frequency with which mixtures were encountered in different shops.

Sampling, Sorting and Analysing

From each bird-seed mixture a 10-gram sample was weighed out using a laboratory balance. Each sample was hand-sorted on sheets of paper into piles of distinct species, separate piles being transferred to individual envelopes. The contents of each envelope were weighed, counted and provisionally identified.

Each seed sample contained not only the major components of the mixture but a small fraction of other material, notably 'weed' seeds, additives and inanimate material. The identification of the 'weed' seeds was considered to be particularly relevant to the study. Samples of the seeds that could be germinated were grown on in 1970 and 1971 to permit identification, and much help was given by the Official Seed Testing Station at Cambridge.

The constituents of a 10-gram sample of each of the mixtures were as follows:

Mixture A (Budgerigar)

Phalaris canariensis (Canary Grass)	4.74 g.	595 seeds
Panicum miliaceum (White Millet)	5.16 g.	789 seeds
Other:	0.10 g	
Polygonum convolvulus (Black bindweed)		2 seeds
Helianthus sp. (Sunflower)		1 seed
Solanum rostratum		1 seed
Salvia sp.		2 seeds

Mixture B (Budgerigar)

Phalaris canariensis (Canary Grass)	6.08 g.	722 seeds
Panicum miliaceum (White and Red Millet)	3.46 g.	704 seeds
Other:	0.46 g	
Lolium temulentum (Darnel)		7 seeds
Triticum aestivum (Wheat)		2 seeds
Brassica sp.		1 seed
Bupleurum lancifolium		1 seed
Centaurea diluta		1 seed
Sinapis arvensis (Charlock)		1 seed
Vaccaria pyramidata		1 seed
Unidentified		3 seeds

Mixture C (Budgerigar)

Phalaris canariensis (Canary Grass)	4.80 g.	588 seeds
Panicum miliaceum (White and Red Millet)	5.01 g.	932 seeds
Other:	0.19 g.	
Centaurea diluta		2 seeds
Lolium temulentum (Darnel)		2 seeds
Triticum aestivum (Wheat)		1 seed
Capnophyllum dichotomum		1 seed
Hibiscus trionum		1 seed
Bupleurum lancifolium		1 seed
Polygonum convolvulus (Black bindweed)		1 seed

Mixture D (Budgerigar)

Phalaris canariensis (Canary Grass)	5.04 g.	594 seeds
Panicum miliaceum (White and red Millet)	4.31 g.	877 seeds
Other:	0.65 g.	
Lolium temulentum (Darnel)		14 seeds
Triticum aestivum (Wheat)		4 seeds
Sorghum halepense (Johnson Grass)		2 seeds
Bupleurum lancifolium		1 seed
Centaurea diluta		1 seed

Mixture E (Budgerigar)

Phalaris canariensis (Canary Grass)	6.09 g.	728 seeds
Panicum miliaceum (White Millet)	2.86 g.	498 seeds
Setaria viridis (Green Bristle-Grass)	0.95 g.	303 seeds
Other:	0.10 g.	
Lolium temulentum (Darnel)		2 seeds
Medicago lupulina (Black Medick)		2 seeds
Bupleurum lancifolium		1 seed
Sorghum halepense (Johnson Grass)		1 seed
Ononis sp.		1 seed
Rapistrum rugosum		1 seed
Linum sp.		1 seed

Mixture F (Canary)

Phalaris canariensis (Canary Grass)	5.41 g.	675 seeds
Brassica napus (Rape)	1.51 g.	453 seeds
Cannabis sativa (Hemp)	1.07 g.	62 seeds
Linum usitatissimum (Linseed)	0.95 g.	163 seeds
Guizotia abyssinica (Niger)	0.83 g.	217 seeds
Other:	0.23 g.	
Dipsacus fullonum (Teasel)		3 seeds
Triticum aestivum (Wheat)		1 seed
Lolium temulentum (Darnel)		1 seed
Unknown		3 seeds

Mixture G (Canary)

Phalaris canariensis (Canary Grass)	6.87 g.	957 seeds
Brassica napus (Rape)	1.57 g.	402 seeds
Linum usitatissimum (Linseed)	0.74 g.	122 seeds
Cannabis sativa (Hemp)	0.29 g.	14 seeds
Guizotia abyssinica (Niger)	0.17 g.	39 seeds
Other:	0.36 g.	
Setaria glauca (Yellow Bristle-Grass)		1 seed
Sorghum vulgare (Sorghum)		1 seed
Unknown		2 seeds

Mixture H (Canary)

Phalaris canariensis (Canary Grass)	6.36 g.	945 seeds
Brassica napus (Rape)	1.68 g.	429 seeds
Linum usitatissimum (Linseed)	0.80 g.	132 seeds
Cannabis sativa (Hemp)	0.38 g.	25 seeds
Guizotia abyssinica (Niger)	0.14 g.	31 seeds
Other:	0.64 g.	
Alopecurus myosuroides (Black Grass)		1 seed
Triticum aestivum (Wheat)		1 seed

Mixture I (Canary and Finch)

Phalaris canariensis (Canary Grass)	4.85 g.	559 seeds
Papaver somniferum (Opium Poppy)	1.67 g.	3065 seeds
Guizatia abyssinica (Niger)	1.27 g.	354 seeds
Linum usitatissimum (Linseed)	1.09 g.	184 seeds
Brassica napus (Rape)	0.51 g.	141 seeds
Dipsacus fullonum (Teasel)	0.28 g.	80 seeds
Other:	0.33 g.	
Triticum aestivum (Wheat)		1 seed
Lolium temulentum (Darnel)		2 seeds
Centaurea diluta		1 seed
Alopecurus myosuroides (Black Grass)		1 seed

Mixture J (British Finch)

Brassica napus (Rape)	4.35 g.	966 seeds
Phalaris canariensis (Canary Grass)	2.97 g.	363 seeds
Linum usitatissimum (Linseed)	0.95 g.	155 seeds
Cannabis sativa (Hemp)	0.78 g.	41 seeds
Guizotia abyssinica (Niger)	0.61 g.	152 seeds
Other:	0.34 g.	
Lolium temulentum (Darnel)		2 seeds
Panicum miliaceum (White millet)		2 seeds
Galium aparine (Cleavers)		1 seed
Unknown		1 seed

Mixture K (Foreign Finch)

Panicum miliaceum (White and Red Millet)	4.98 g.	1062 seeds
Phalaris canariensis (Canary Grass)	2.94 g.	338 seeds
Setaria viridis (Green Bristle-Grass)	1.95 g.	831 seeds
Other:	0.13 g.	
Lolium temulentum (Darnel)		2 seeds
Sorghum halepense (Johnson Grass)		1 seed
Rapistrum rugosum		1 seed
Setaria italica (Foxtail Millet)		1 seed
Bupleurum lancifolium		1 seed

Mixture L (Parrot)

Helianthus annuus (Sunflower)	7.82 g.	90 seeds
Zea mays (Maize)	0.96 g.	4 seeds
Arachis hypogaea (Groundnut)	0.89 g.	2 seeds
Other:	0.33 g.	
Capsicum sp. (Red Pepper)		1 seed
Galium aparine (Cleavers)		1 seed
Polygonum convolvulus		1 seed
Sinapis alba (White Mustard)		1 seed

Mixture M (Pigeon)

Pisum sativum var. arvense (Maple Peas)	3.55 g.	16 seeds
Vicia faba var. equina (Tick or Horse Beans)	2.65 g.	9 seeds
Triticum aestivum (Wheat)	1.83 g.	44 seeds
Zea mays (Maize)	1.74 g.	8 seeds
Other:	0.23 g.	
Hordeum distichon (Barley)		1 seed
Avena fatua (Wild Oat)		1 seed
Galium aparine (Cleavers)		1 seed

Determining Germinative Capacity

A sample of 50 seeds of each species in each mixture was space-sown into fine sterilised garden soil in 3½'' or 5'' plastic pots on July 13th, 1969. The pots were watered, glass covered and kept in a shaded cool greenhouse. Germination was recorded at weekly intervals for four weeks.

Percentage Germination of Constituents of Mixtures

	Mixture													
Species	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**Mean**
Phalaris canariensis L.	34	90	82	78	86	44	62	36	72	86	72	—	—	67 %
Panicum miliaceum L.	70	34	76	66	72	—	—	—	—	—	54	—	—	62 %
Setaria viridis (L.) Beauv.	—	—	—	—	40	—	—	—	—	—	66	—	—	53 %
Linum usitatissimum L.	—	—	—	—	—	74	70	92	80	76	—	—	—	78 %
Guizotia abyssinica (L.f.) Cass.	—	—	—	—	—	90	58	26	78	44	—	—	—	59 %
Brassica napus L.	—	—	—	—	—	4	80	74	0	72	—	—	—	46 %
Cannabis sativa L.	—	—	—	—	—	0	0	52	—	30	—	—	—	20 %
Dipsacus fullonum L.	—	—	—	—	—	—	—	—	36	—	—	—	—	36 %
Papaver somniferum L.	—	—	—	—	—	—	—	—	0	—	—	—	—	0 %
Helianthus annuus L.	—	—	—	—	—	—	—	—	—	—	—	72	—	72 %
Zea mays L.	—	—	—	—	—	—	—	—	—	—	—	17	72	44 %
Triticum aestivum L.	—	—	—	—	—	—	—	—	—	—	—	—	80	80 %
Pisum sativum L.var arvense Poir	—	—	—	—	—	—	—	—	—	-	—	—	86	86%
Vicia faba L. var equina Pers.	—	—	—	—	—	—	—	—	—	—	—	—	98	98%
Arachis hypogaea L.	—	—	—	—	—	—	—	—	—	—	—	—	6	6%

Survey Areas

During February, 1969, three survey areas were marked out on the surface of Harford tip. Each area was a triangle of side 5 metres. Area A was sited to the east of the Tip on ground where no refuse had been deposited for at least ten years. Area B was sited to the north of the Tip on the surface of refuse deposited during the previous year, 1968. Area C was sited in the centre of the Tip on ground used for dumping several years previously and due for re-use in 1969. During February 1969 soil temperatures were taken at the surface, 15 cm. deep and 30 cm. deep at the points of the survey area triangles. The areas were observed intermittently through the year 1969, and plant species present in the areas on October 5th, 1969, were recorded.

Soil Temperatures and Snow Depth in Survey Areas, 9 February 1969

Site	*Temperature (deg. C.) at surface*	*Temperature (deg. C.) at depth of 15 cm.*	*Temperature (deg. C.) at depth of 30 cm.*	*Depth of snow*
A1	0	0	0	12 cm.
A2	0	2	2	7 cm.
A3	7	18	29	—
B1	0	0	0	4 cm.
B2	0	4	16	1 cm.
B3	14	39	46	—
C1	0	1	1	10 cm.
C2	0	0	0	7 cm.
C3	5	12	31	—

Plant Species in Survey Area A (No refuse deposited for at least ten years)

Ranunculus acris (Meadow buttercup)
Epilobium hirsutum (Gt. hairy willow-herb)
Rumex obtusifolius (Broad-leaved dock)
Senecio jacobaea (Ragwort)
Cirsium arvense (Creeping thistle)
Dactylis glomerata (Cocksfoot)
Agrostis stolonifera (Creeping bent)
Malva sylvestris (Common mallow)
Polygonum aviculare (Knotgrass)
Plantago major (Great plantain)
Cirsium vulgare (Spear thistle)
Agropyron repens (Couch grass)
Agrostis gigantea (Black bent)

Plant Species in Survey Area B (Refuse deposited during the previous year, 1968)

Capsella bursa-pastoris (Shepherd's purse)	Chenopodium album (Fat hen)
Euphorbia helioscopia (Sun spurge)	Rumex obtusifolius (Broad-leaved dock)
Urtica dioica (Stinging nettle)	Solanum nigrum (Black nightshade)
Plantago lanceolata (Ribwort plantain)	Plantago major (Great plantain)
Senecio jacobaea (Ragwort)	Senecio vulgaris (Groundsel)
Sonchus oleraceus (Sow-thistle)	Agropyron repens (Couch grass)
Poa annua (Annual meadow-grass)	
(Horticultural aliens)	
Lobularia maritima (Sweet Alison)	Solanum tuberosum (Potato)
(Bird-seed aliens)	
Panicum miliaceum (White millet) 117 plants	Phalaris canariensis (Canary grass) 78 plants
Setaria italica (Foxtail millet) 6 plants	Lolium temulentum (Darnel) 3 plants
Setaria viridis (Bristle-grass) 1 plant	Centaurea diluta (Desert knapweed) 1 plant

Plant Species in Survey Area C (Refuse deposited during the current year, 1969) (Recorded 5 October 1969)

Capsella bursa-pastoris (Shepherd's purse)	Stellaria media (Chickweed)
Chenopodium album (Fat hen)	Trifolium repens (White clover)
Anagallis arvensis (Scarlet pimpernel)	Solanum nigrum (Black nightshade)
Senecio vulgaris (Groundsel)	Matricaria matricarioides (Pineapple weed)
Picris echioides (Bristly ox-tongue)	Sonchus oleraceus (Sow-thistle)
Plantago major (Great plantain)	Poa annua (Annual meadow-grass)
Phalaris canariensis (Canary grass)	

Discussion

The series of chance events that allows a component of a packet of bird-seed to escape its many possible fates and eventually arrive within the top two or three centimetres of deposited refuse and in a benign situation seems sufficiently unlikely to happen more than rarely. The fact that botanical surveys of harford Tip regularly include records of species unlikely to have been introduced in any other way suggests otherwise. All but two or three of the species encountered in this study have been recorded from Harford Tip during the last fifteen years of its use until it was closed in 1973, and some of them are recorded regularly and in quantity.

To judge by the number and variety of bird-seed mixtures on display in the shops visited, the authors' samples were roughly representative in kind and frequency of mixtures being sold. Not surprisingly the analysis of mixtures intended for particular kinds of bird by different producers were very similar, the same species in similar proportions by weight and by seed number occurring in several related samples. Most of the chief components of the mixtures had good rates of germination.

Given the slight information about the relative sales of various mixtures (sales factor) and the average number of seeds of a given species in a 10-gram sample (frequency factor) together with the average percentage germination of the species in all samples (viability factor) it was possible to calculate a product for each species which should bear some relationship to the frequency with which these species were encountered on Harford Tip. The results of such calculations place the chief species in the following order: (1) *Phalaris canariensis* (2) *Panicum miliaceum* (3) *Brassica napus* (4) *Setaria italica* (5) *Linum usitatissimum* (6) *Guizotia abyssinica* (7) *Helianthus annuus* (8) *Triticum aestivum* (9) *Dipsacus fullonum* (10) *Cannabis sativa.* These results are in broad agreement with surveys of Harford Tip vegetation recorded here and elsewhere showing that in this class of casual plants the millets and canary grass are predominant, whereas plants of linseed and niger are uncommon, and plants of hemp and teasel are rare. The position of *Brassica napus* in the list suggests that rape plants might be expected to occur more frequently than they are reported, a circumstance which may reflect cage-bird feeding preferences or particular germination requirements among other possible explanations.

Without reference to the producer, it is not always possible to differentiate between the intended and the unintended components of a mixture. Conceivably producers may incorporate very minor components into their mixtures, but it seems more likely that species occuring in minute frequencies — one or two seeds in a 10-gram sample — are accidental inclusions entering the mixtures as seeds of weeds in the crops of the main components. Some of these 'weed' seeds occur fairly regularly in the mixtures and on Harford Tip, such as the darnel *(Lolium temulentum)* and the pale blue cornflower or desert knapweed *(Centaurea diluta).* Others which have occurred in our samples have never been recorded from Harford Tip, and it seems not unlikely that some of the wide range of casuals recorded from Harford Tip have been introduced as 'weed' seeds in bird-seed mixtures.

The controlled tipping at this site involved the deposition of refuse in a layer one to two metres deep followed by capping with a layer of soil 10 to 30 cm. deep, although the movement of vehicles over the surface inevitably mixed the top refuse and the covering soil. The first plant colonisers of this surface are species characteristic of disturbed ground and waste places introduced with the capping soil. In area C, surveyed not many weeks after tipping, the surface was largely uncolonised but carried a number of young plants, all indigenous except for a few plants of *Phalaris canariensis.* In another area sited to the west of the Tip and on refuse deposited about six months prior to the survey there were, in an area of the same size as the survey areas, 65 plants of *Panicum miliaceum* (Millet), 7 plants of *Echinochloa frumentacea* (Sanwa millet), 3 plants of *Setaria italica* (Foxtail millet), 1 plant of *Echinochloa crus-galli* (Cockspur grass) and 1 plant of *Setaria viridis* (Green bristle-grass). In area B, where refuse had been deposited between twelve and eighteen months prior to survey, there was also a good range of bird-seed casuals as well as other introduced and indigenous species. The findings in these last two areas confirm the impression previously gained by the authors that mature bird-seed casuals recorded in late summer or autumn usually originate in material deposited between the spring of that year and the previous summer.

In area A where no material had been tipped for over ten years, no casuals were found; the vegetation was closed and entirely indigenous and perennial. Earlier studies have suggested that *Phalaris canariensis* (Canary grass) sets seed in most seasons and will therefore persist for several years after introduction, but that almost all other bird-seed casuals flower too late (September—October) to ripen viable seed and so cannot persist without constant re-introduction.

A feature of refuse tips containing organic matter and insulated by a capping of soil is the relatively high temperature of the interior generated by putrefaction. In some cases this is sufficient to ignite combustible refuse giving rise to very persistent tip fires. Local heating of a less extreme kind may still be enough to prevent the growth of vegitation for a period of months or years. The soil temperature at the A3 site was still high enough to maintain an area free of both snow and vegetation more than ten years after the last refuse had been deposited. In moderation, however, the increased temperatures may provide habitats for both plants and animals of an exotic kind. The house cricket *(Acheta domestica = Gryllulus domesticus)*, from very dry parts of south-west Asia and north Africa, survives at Harford Tip in some numbers, and it is probable that soil temperatures play some part in the germination and limited persistence of casual plant introductions.

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1978 WEATHER SUMMARY

by T. B. Norgate

In order to prevent repetition, monthly details are restricted to salient weather features. Anomalies are given in the tables at the end of this report.

January. Sunshine hours amounted to 15% of the maximum possible against an average of 16%. There were 13 sunless days. It was a cold month with 22 ground frosts, the highest for a January since 1964 when 26 were recorded in central Norfolk. On Jan. 3rd the temperature in the Norwich area dropped 6C° (11F°) in under ten minutes, soon after 9.0 a.m., accompanied by thunder, lightning and some snow.

There were only 8 completely dry days, the wettest being the 23rd when almost 20mm (over ¾'') of wet snow and rain fell.

Very high barometer readings were recorded early in the month, 30.56'' (1034.9 mb.) but dropping to below 29'' at the end (982 mb.) and accompanying N & N.W. gales with hail and snow.

February. Again a cold month, the coldest February since 1969. On the 11th the ground minimum reached 18.4°C (—1°F) with snow to a depth of 150 mm (6''). It was probably the coldest night in East Anglia since before World War I. Snow remained on the ground from the 8th to the 22nd when the temperature rose rapidly. It touched a maximum of 12°C (53½°F), the warmest day since Christmas.

More than half the precipitation was snow, total amounts varying from 34mm (1⅓'') to double this on the higher ground facing the North Sea. Though there were only 7 sunless days, mostly at the beginning of the month, total amounts were about normal. (''Rainfall'' includes melted snow).

March. The month started cold and wet but ended in a ''blaze of glory'' with almost as much sunshine in the last week as in the rest of the month. Rainfall tended to be on the high side towards the Suffolk border but the pattern otherwise was irregular. The wettest day was the 20th with amounts varying from 12½ to 25 mm (½''—1''). Some of this was snow which fell on two other days.

Though on the warm side, as was March last year, maximum temperatures were very variable from 15.8°C (60.4°F) on the 11th to just below freezing on the 17th.

April. This month was even colder than March with more air frosts too, a complete reversal of the trend a few weeks earlier. It was the coldest April in East Anglia for 22 years. Rainfall was rather less than usual and included snow twice which came after a dry week at the beginning of the month.

It was a dull month too; not since 1965 have we had under 120 hours sunshine in April. Despite this there were over 10 hours bright sunshine on four days in the first half of the month.

May. All the rain was confined to the first fortnight, to be followed by an absolute drought of 19 days into June. Amounts of rain were variable in the county, down to 15 mm (.60″) in the Norwich area and up to 73 mm (nearly 3″) in West Norfolk. The range was thus under 50% to over 100% of normal.

With only two sunless days, the number of hours of bright sunshine improved throughout the month, exceeding 14 hours on four days in the last week.

Despite this the month was slightly on the cold side, clear skies being responsible for three ground frosts. The shade temperature touched 26.6°C (almost 80°F) on the 31st which turned out to be the second warmest day in the Year.

June. The month began with the hottest day of the year, 27.5°C (81½°F). But the only real warm days, i.e. above 24°C (75°F), were the first four. After this the maxima dropped below 12½°C (54½°F) two or three times by the middle of the month.

Cloudy conditions, by preventing evapouration and radiation, kept mean temperatures up to normal. But sunshine did not help and the total hours were 20% below normal and nearly as low as 1977.

Rainfall varied from about 25 mm (1″) above normal in the centre of the county to nearly double in the north west. Thunder was recorded on 4 days; a house in New Costessey was struck by lightning on the 22nd.

July. It was the coldest July for 13 years and only produced 3 days above 24°C which is less than half the usual number.

Rainfall was largely derived from thunderstorms during the last week-end of the month when a wide belt from Thetford to Sculthorpe recorded over 50 mm (2″) in one day. The writer has yet to measure this amount in 24 hours in 46 years recording.

Despite only three sunless days it was the dullest July for 10 years and only 80% of normal.

August. This was the fifth consecutive month on the cool side but marginally warmer than July. There was but one day with a maximum above 24°C (75°F) compared with an average of about six.

Rainfall amounts were erratic over the county, thanks to two or three local thunderstorms. Most fell in the first half of the month, total amounts varying from under 40 mm (1.6″) to 100 mm (4″) at Loddon.

Despite only two sunless days it was the fifth month in succession on the dull side and the dullest August since 1969, though 1972 ran it close.

September. It was marginally warmer than August whereas it would on average be 2°C cooler. There were two slight ground frosts, however, but 9 with maxima over 21°C (70°F) and more than August. Sunshine hours were on the high side for the first time since March and almost reaching the August total. On average it would expect to have 30 or 40 hours less than August.

The wind had a westerly component most days but despite this, rainfall amounts were on the low side. There were at least 12 days in the middle of the month, with hardly any rain at all. Totals were almost half the normal in the middle of the county.

October. This was the third successive October to be warmer than average, whereas sunshine was on the low side, largely due to the last week yielding only 3½ hours. Surprisingly the barometer was on the high side throughout; only once did it drop below 30" (1016 mb.), on the 17th.

As a result of anti-cyclonic conditions rainfall totals were one of the lowest on record for the county. Raveningham measured only 2.6 mm (1/10") and at least a third of the county had under 10 mm (.40").

The mean temperature was above normal, rising to a maximum of 23°C (73½°F) on the 11th. But there were 11 days when it failed to reach 13°C (55°F), the lowest being 10.3°C (50½°F) in the middle of the month. The overall mean was boosted by the absence of air frosts and only two very slight ground frosts.

November. It was appreciably warmer, drier and sunnier than usual for November which is apt to be "the odd man out". Only a few coastal and Broadland areas had over 38 mm (1½") and it was the second driest month of the year. Much of the county had half their usual rainfall and it was the driest November for over 20 years. Most of what did fall came in the second half of the month and included three snowfalls during the last few days. It did not last very long.

The mean temperature of 8.2°C (46½°F) has not been reached in November since 1968 and not exceeded for over 20 years. But the weather turned much colder during the last few days with ground and air frosts during most of the last week.

As in October the barometer remained high throughout the month, only once dropping below 30" (1,016 mb.) on the 19th. It was altogether a very pleasant month.

December. The year ended with a dull wet month and though the mean temperature was just about average, it had a "sting in its tail". The last two days had maxima below freezing, with snow, though earlier there were six days when it exceeded 10°C (50°F).

It was the wettest month of the year with something to measure on 25 days. Many parts of the county had over 100 mm (4"), including snow, some of which probably escaped measurement owing to drifting conditions. Snow fell to a depth of 100—125 mm (4"—5") and remained on the ground for several days.

The Year. Despite fluctuations in monthly temperatures and in rainfall from average, their annual means agreed very well. However, sunshine hours were 9% on the low side and it was the dullest year since 1968. This is further highlighted by the absence of hot days. There were but 7 with maxima above 25°C (77°F) and compares with a 10-year average of almost 12 days. The year 1972 may be mentioned since it had no such days and 1974 only one. The months April to August inclusive, had a deficiency of 120 hours or about 13% below normal. Such a reduction over several successive months is quite significant.

Wider discrepancies become apparent when the year's weather is studied on a seasonal basis. Winter is considered as Dec., Jan. & Feb.; Spring is March, April & May, et seq.

Thus, winter 1977/8 was only ½°C cooler than average but there was 8% more sunshine, a matter of 12 hours extra. Rainfall was a still more noticeable anomaly with an excess of 30%, nearly 50 mm (2'') in central Norfolk.

Spring was much nearer normal in all respects, only ½°C cooler, sunshine 4% down and rainfall very slightly on the high side.

Summer was much more divergent from normal, with a mean temperature a full 1°C (2°F) down, rainfall just over 25% up and the highest since 1969 but sunshine was 21% deficient. It was the lowest summer total since 1965 which only managed to record 367.5 hours compared to 441.8 in 1978.

Autumn made some amends for the miserable summer. The mean temperature was 1°C up compared to the average, sunshine hours were 8% on the high side but rainfall was 40% below normal. It was the lowest for an autumn season since 1947. These particular autumns were the only two with less than 75 mm (3'') in 46 years of measurement. Incidently, the average for this period is 192.8 mm (over 7½'').

1978 Weather

	MEAN TEMPERATURE		NO. OF AIR AND GROUND FROSTS		SUNSHINE HOURS	
	°C *1978*	°C *Avg.*	*1978*	*Avg.*	*1978*	*Avg.*
Jan.	2.4	3.6	13/22	10.4/17.6	37.7	41.9
Feb.	1.6	3.6	18/20	10.0/18.1	56.9	61.2
March	6.3	5.3	3/14	6.7/16.9	112.8	108.0
April	6.1	7.4	7/13	3.0/11.8	121.1	143.0
May	10.4	11.2	0/3	.5/4.5	187.3	189.6
June	13.7	14.0	—	.1/1.0	159.7	196.7
July	14.5	15.8	—	0/.2	137.2	183.0
Aug.	14.8	15.9	—	0/.1	144.9	180.6
Sept.	14.0	13.7	0/2	.1/1.0	166.8	149.1
Oct.	11.5	10.7	0/3	.3/5.8	93.6	100.8
Nov.	8.2	6.6	0/6	5.6/12.1	83.5	67.4
Dec.	3.9	4.0	11/16	9.1/17.3	38.0	43.3
Year	9.0	9.3	52/99	45.8/106.4	1333.8	1464.6

	Days with hail/snow		Days with thunder		Rainfall mm's	
	1978	*Avg.*	*1978*	*Avg.*	*1978*	*Avg.*
Jan.	8/2	2.0/2.7	1	.1	81.5	58.4
Feb.	9/0	1.4/3.0	—	.3	62.1	45.0
March	4/0	2.3/3.1	—	.5	50.8	42.2
April	2/0	2.3/1.9	—	1.3	44.5	39.9
May	—	.2/.2	—	2.6	31.9	41.7
June	—	.3/.3	4	2.2	72.2	43.2
July	—	—	2	2.3	65.9	57.9
Aug.	—	—	2	2.6	58.0	54.6
Sept.	—	.1/.1	—	1.8	34.2	53.6
Oct.	0/1	1.0/1.3	—	.8	8.1	62.2
Nov.	3/1	3.1/2.9	—	.6	32.1	70.1
Dec.	2/0	3.0/3.2	—	2.2	94.6	56.7
Year	28/4	24.5/19.1	9	15.1	635.9	626.1

Averages are for the last 15 years except Rainfall which is for 46 years.

T. B. Norgate
Norfolk Rainfall Organisation

TWO NEW NORFOLK ROSES

by E. L. Swann

In December 1975 a letter was received from M. J. Wigginton reporting the occurrence of a large population of a wild rose near the chalk pit in Donkey Lane, Eaton. He took it to be *R. rubiginosa* agg., and he sent material to Dr. R. Melville at Kew who determined it as the hybrid *R. agrestis* Savi x *R. canina* L. Later, in August 1976, neither the finder nor the Rev. G. Graham was able to find anything that could be *R. agrestis.* A. H. Wolley-Dod does not include this hybrid in his *British Roses (J. bot.,* 1910, 1911) and Dr. Melville makes no mention of it in his account of the roses in *Hybridization and the Flora of the British Isles* (C. A. Stace ed., 1975). This is not surprising as there are other hybrids in Norfolk not appearing in the latter work although it is possible that the hybrid was unknown until its discovery at Eaton.

The puzzle of the missing parent remained unsolved until July 1977 when E. T. Daniels wrote "We have found *R. agrestis* on the site where the hybrid occurs". Accompanied by P. G. Lawson several bushes were examined with obvious mixed characters of both *R. canina* and *R. agrestis* and "while we were pursuing our separate searches I came across a small bush with white flowers and leaves heavily glandular beneath". Material was duly confirmed by Dr. Melville as *R. agrestis* Savi; vouching material has been deposited at Kew; the Castle Museum, Norwich; and in Hb. Swann.

It is strange that the Rev. E. F. Linton who held the living at Sprowston in 1878 and during his ten years in Norfolk devoted considerable time to the flora, specialising in *Rubus, Rosa* and *Salix,* did not record either *R. agrestis* or *R. sepium* Thuill., under which latter name our rose was formerly known. This suggests it is a recent introduction.

So far as can be ascertained it is a rare species but the *Atlas of the British Flora* (1st ed., 1962) is of little help on distribution as *R. rubiginosa* L., *R. micrantha* Borrer, *R. elliptica* Tauschaand *R. agrestis* Savi are inextricably mixed under *R. rubiginosa* agg.

In view of the confusion about this species a description follows taken from Savi's original work, *Fl. Pisana* (1798), and quoted by Wolley-Dod. (l.c., 1910, 122): "Rose with germen and peduncles glabrous. Flowers subumbellate. Leaflets oval, dentate-serrate. Stem and petioles prickly. The stems rise to 8 or 10 feet, and are strong enough to support themselves, with many diffuse interlacing branches, covered with very strong curved prickles. Leaflets 3—5 or 7, oval or oval-lanceolate; dentate, with saw-like teeth, hairy and deep green above, glandular and reddish beneath. Petioles minutely prickly on the lower side. Flowers scented, in an umbel, 3 or 4 together, petals white, slightly emarginate. Peduncles and germen glabrous. The glands in this species are reddish and pedicellate, giving a reddish colour to the under surface of the leaflets, and emitting a smell. These glands are situated on the serratures of the leaflets, on the bracts, stipules and on the edges of their segments. Flowers in June; fruit, which is an inch long, and elongate-oval, ripens in September''.

The Eaton plant agrees closely with this description and Daniels remarks on salient characters, ''the very narrow leaflets which are cuneate-based, the glands so thickly peppered on the undersides of the leaflets that from a distance the whole bush has a reddish tinge'', and the small ellipsoid fruit, white flowers and glabrous styles are further similarities.

Whereas Savi's description relates to a mature plant the Eaton bush, by reason of its much smaller stature, must be a young plant and further indication of a recent introduction.

Miscellaneous Notes

Rhagium bifasciatum F.. A specimen of this 'Longhorn' beetle was found at Aylmerton, near Cromer in July 1978. This beetle is rarely found in Norfolk. Thouless records it from Brundall and Horsford at the turn of the century.

K. C. Durrant

Whilst investigating a piece of woodland at Hockham recently an infertile litchen was noted growing on the leaves and stems of a large box plant. This was the pycnidial form of *Catillaria bouteillei*, a species which normally grows on box and which is the only British lichen regularly found on leaves. This is the first Norfolk record for this species which is considered to be an uncommon species of the west and south of Britain.

P. W. Lambley

In 1978 the Museum was presented with a specimen of the rare fish burbot by Mrs E. C. Alston. It was caught by her husband, the late Rev. E. C. Alston, in about 1936 in the stream flowing out of Stanford Water. This is an additional record to those in the comprehensive paper by Malborough (J. Fish Biol., 1970). The last recorded sighting of burbot in Norfolk was in 1969 in the River Waveney.

P. W. Lambley

NOTES TO CONTRIBUTORS

1. All manuscripts submitted for publication should be sent to Dr. E. A. Ellis, Wheatfen Broad, Surlingham, Norwich.

2. Manuscripts should be typed double spaced on one side of the paper. Latin names of genera and species should be underlined. Dates should be in the form 1 January 1972. Text figures should be referred to as Fig. 1, etc.

3. All Latin names should be followed by the authority when the name is first mentioned in the text or table.

4. References should be in alphabetical order at the end of the paper, in the form of:

Bloomfield, E. N., 1905. Fauna and flora of Norfolk. Trans. Norfolk & Nor. Nat. Soc., 8. 117-37.

5. Tables should be set on separate sheets and numbered in arabic numerals.

6. Drawings should be in jet-black indian ink. Shading should be in lines or dots but not in half-tone washes.

7. Page-proofs only will be sent. They should be returned with the least possible delay, and the minimum of essential correction should be made.

8. Authors are supplied with 15 offprints gratis. Additional copies may be ordered when the proofs are returned.

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