Nature in Avon

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Bristol Naturalists' Society

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Besides many general indoor and outdoor meetings and excursions, others are specifically devoted to geology, plants, birds, mammals and invertebrates. Members may use the Society's large library.

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Editorial

It is appropriate that, in our 150th year, there should be three articles dealing with our past. There is a fascinating account of the fern prints left to the society in 1888 by Colonel Jones and rediscovered, untouched, in their original box, last year. Ray Gooding discusses the wonderful 1930s epidiascope projector presented to the BNS in memory of the great Ida Roper in 1938, which was found in a church cupboard in 2010 and which he has lovingly restored. A second article by him deals with the hundreds of glass slides created by Harry Savory, President 1954-56 that Ray has patiently scanned on to a series of CDs.

There is an important report by Tim Rich and Libby Houston on changes in the Whitebeam population in the Gully on Durdham Down. The introduction of goats a year ago to that site to control the scrub development and re-create limestone grassland is an interesting experiment, and their recent habit of stripping the bark from young Yew trees suggests that further protection may be needed if the complex evolution of Whitebeams in the Gorge is to continue. I have also summarised the main features of my Presidential address in March on a ten year phenological study on the Downs, which lays down a yardstick that can be used to measure the future impact of climate change on the native flora. There is a very detailed report by Bill Dixon on Weston Bigwood, of which he is the warden, dealing in part with the fascinating impact of the great Burns Night storm in January 1990.

There is a summary of an Otter survey in Bristol City Docks, demonstrating that if habitats are improved former wildlife can re-appear, and often without human aid. Another article details evidence of mammal populations changes derived from data gathered by the BTO Breeding Bird Survey since 1994. It shows how very simple observations by large numbers of people can reveal the processes of change that need to be known before they can be understood, and before any action can be taken in response.

Geology, in the past the Society's main area of interest and activity has in more recent years taken a bit of a back seat. A geological article by John Byles looks at the 300 million years of complex geological change than lies revealed in by a short walk up the Trym through the Blaise estate. Humanity is totally dependent upon the natural world, and the humility that geological understanding gives is a commodity in short supply.

Our last Index was published in 1996, and a simple index of authors and articles covering 1996-2011 completes the journal.

Monitoring the common Mammals of the Bristol region

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Since 1995 local observers doing the BTO's Breeding Bird Survey have been asked to record the mammals they see during their two surveys between April 1 and June 30. The survey uses randomly selected one-km squares, and requires that two parallel 1000 metre transects are walked in the early morning, recording all birds seen or heard. As the squares are random they reflect all habitat types and since 1995 there have been 692 square-years of mammal records involving 90 individual squares. Different observers spend different amounts of time doing their survey, but on average it is 84 minutes.

There are limitations to the value of this dataset. Many observers start with an enthusiastic list of mammals and then cease to record. Some squares have been recorded for only a year or two, others for seventeen (excluding 2001, the foot-and-mouth year). The total number of squares recording mammals has increased from 17 in 1995 to 60 in 2011, and many squares have been surveyed by different surveyors with different ID skills.

Most of the records have been of mammals actually seen, though the option of recording their presence from signs has been available, and used by some observers, but, as they are primarily birdwatchers, their knowledge of mammal signs is poor, and the nature of the survey means that they are not looking for them.
However the data can be used to provide evidence of distribution, population change, and a comparison between the Bristol region and England as a whole.

Distribution It is a reasonable general assumption that if a species is seen in a square once it is likely to continue to be present in that square even if not noticed subsequently. All mammals are elusive and the chance of sighting them is related to the total time spent. I have kept detailed weekly records for a decade of Squirrel sightings on Clifton Down where there is certainly a good population from the evidence of the eating of Beech mast and Hazel nuts, but the average rate at which an animal is seen is just one per hour. Less common species are likely to be encountered only once in several years of observation by the BBS. Table 1 shows the distribution of the ten most commonly recorded species in 72 one-km squares in the Bristol region which have been surveyed for three or more years. The domestic cat is included because it has been demonstrated to have a potentially significant impact on the populations of some birds, and its distribution and density are thus of ornithological significance. However it has in general not been well recorded by observers. In reality it is likely that all of these species, except the Hare in urban squares, are present in all 72 squares, and the differences are more a measure of elusiveness than distribution.

	%			%
Squirrel	85		Domestic cat	43
Rabbit	83		Badger	42
Roe Deer	79		Mole	39
Fox	68		Rat	18
Hare	51		Hedgehog	14

Table 1 The percentage distribution of ten common mammal species derived from 72 one-km squares surveyed by the BBS in the Bristol region.

Counts.

Another way of using the dataset is to sum both the counts and the evidence of presence in the 17 years since 1995 (omitting 2001). There are 692 observer-years of data, an average of 40 squares a year, though the total has increased from 17 squares in 1995 to 60 in 2011. The counts of seven species have been summed, and amount to 3554 living animals. This enables an average count per occupied square per year to be calculated. There were also 16 records of dead badgers. Table 2 lists the results. There are no surprises here, but these results would have been very different fifty years ago. Rabbits are much the most frequently seen species, and it is most unusual to come across more than one Fox.

	Sq/y	%	Count	%	Count/sq
Rabbit	368	24	2153	61	6.7
Grey Squirrel	286	18	420	12	1.7
Roe Deer	232	15	391	11	1.8
Fox	155	10	132	4	1.0
Hare	168	11	360	10	2.2
Badger	99	6	16		
Cat	106	7	84	2	
Mole	90	6			
Rat	22	1	6		
Hedgehog	26	2			

Table 2 1995-2012 sum for ten mammal species of squares and counts, also showing percentage, and average count per square.

Population change.

The dataset also permits some crude assessment of population change. This can be done either by calculating frequency of observation, or the average annual count per occupied square. Because of the fairly rapid change in the composition of the dataset in terms of the number of squares involved, and the degree of consistency in the recording by observers, many of the figures fluctuate considerably, but some clear trends are apparent. Note that a very different density figure, ie the count per square, would be obtained if the total count were divided by all the squares which reported mammals.

Rabbit.

Chart 1 shows the annual average counts, which lay between 8 and 12 from 1997 to 2004, and have hovered around four since then. Rabbits have faced a new disease in recent years, which has led to an overall fall of 37%, based on the rolling average. Nationally in the past the levels of their population have been shown to be related to Buzzard breeding success but locally Buzzard populations have expanded very rapidly since 1994, and do not seem to be correlated at all with this population estimate.

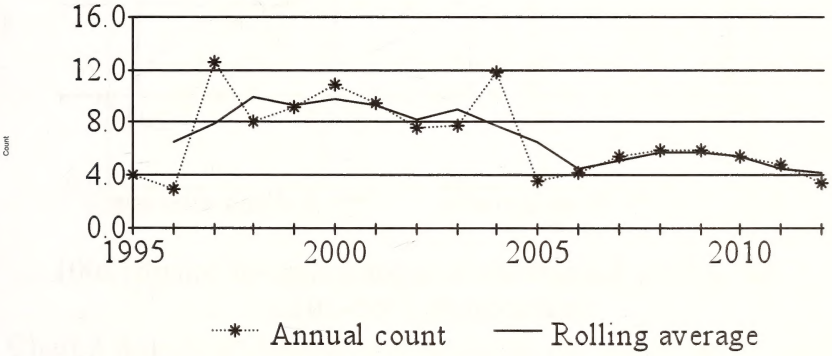

Chart 1 Rabbit. Annual average count 1995-2012 (2001 interpolated).

Grey Squirrel.

Squirrel counts per square have been remarkably constant, varying between 1.2 and 2.3. However the proportion of squares in which they have been seen has varied between 20% and 50%, though overall there has been no change. It seems unlikely that this actually represents a change in distribution, but it may represent a population change. Grey Squirrels are competitors with many bird species for nuts and seeds and share with Jays and Coal Tits the habit of caching food for the winter, and are likely to be affected by cold winters, though there is little evidence in these figures that the almost unprecedented recent run of three successive cold winters in 2008/9, 2009/10 and 2010/11 has had any impact. Squirrels are most active at the end of September and early October, and a springtime survey at its best is unlikely to pick up more than 20% of the population.

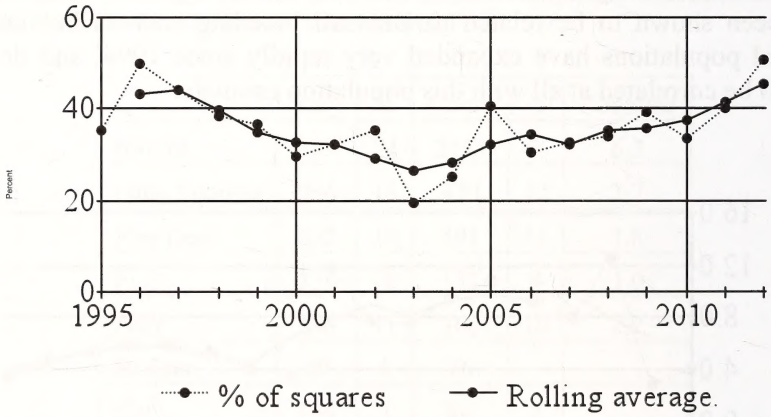

Chart 2 Grey Squirrel Annual percentage of square (2001 interpolated) 1995-2012.

Roe Deer

Roe Deer have been expanding rapidly both locally and nationally, though the figures from this survey suggest that the expansion has levelled off in the past few years. They have become less shy in recent years, and less nocturnal, partly because much of the countryside is normally disturbed by the occasional tractor, and very rarely by people. The consequence is that BBS surveyors now expect to come across Roe Deer almost anywhere, including the heart of towns. The percentage of squares in which they have been found has increased from 11% in 1997 to 49% in 2012, but not consistently. The overall rise in the average counts has been 76%. Roe Deer are now altering the structure of woodland vegetation in some areas of the country, which is having a significant impact on some bird populations.

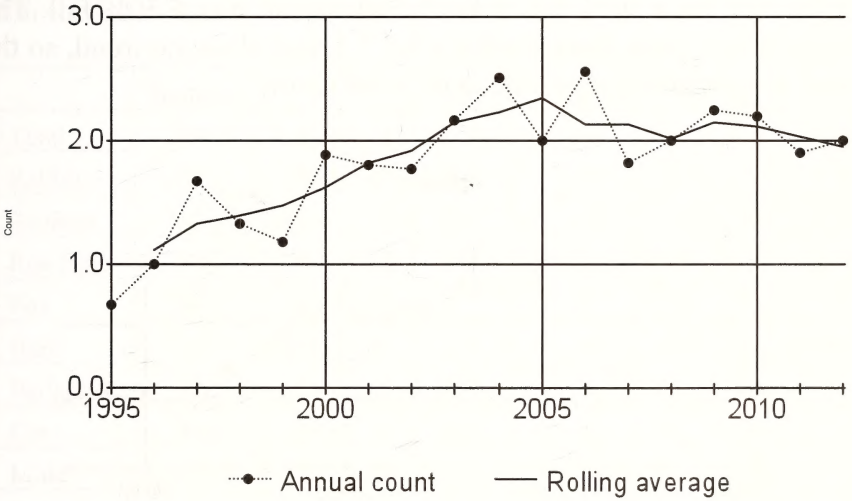

Chart 3 Roe Deer. Annual average count per square and a rolling three year average. 2001 values interpolated.

Fox

In urban areas Fox numbers collapsed in the mid 1990s as this survey began, but the figures from this survey do not reflect that in any way, partly because the sample contains few urban squares. Foxes remain very wary animals in the wild, and although they are clearly in fact very widespread having been seen at some point in 68% of the squares, both counts and annual percentages fluctuate wildly from year to year with no trend. The annual percentage figure has varied from 10% to 30% without trend.

Hare

In the early years of the survey records of the presence of Hares increased rapidly, but this may merely have been related to the increase in the number of participating squares. Since 1999 the figure remained fairly constant at around 35% until 2006, since when there has been a sharp drop. The overall fall since 1995, measured by the average, has been 30%, but from the maximum it is a 50% fall. The average counts have fluctuated around 2.2, and show no trend, so the figures suggest a real contraction of distribution.

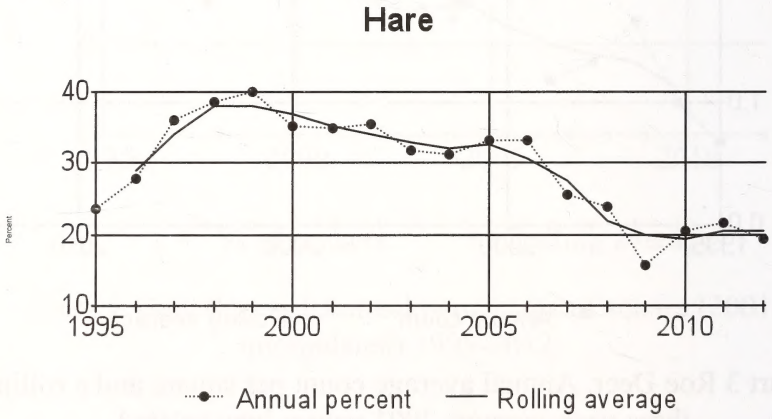

Chart 4 Hare. Annual percentage of squares (2001 interpolated) 1995-2012

Badger, Domestic Cat and Mole.

Unfortunately these three species are recorded so rarely that they are not at present effectively monitored by this survey. Moles are extremely persistent in suitable areas, and I have records of sites in Bristol occupied for at least forty years. Molehills are easiest to see in winter when vegetation is low, and can readily be missed even as early as April unless looked for. Badger setts are very obvious if they are on the line of the transect, but other fairly obvious signs are more easily missed by casual observation. There were unsurprisingly no live sightings, but 16 dead animals were seen. Road kills are the most obvious evidence of presence, but most transects follow footpaths where possible. Domestic cats have probably been seen but not recorded by many observers.

National comparisons

The annual BBS report produced by the BTO summarise the mammal data and Table 3 shows the annual data for 2011 compared with the Bristol data for the same year

	National					Avon			
Total	2407	Count	%	No/Sq		60	Count	%	No/sq
Rabbit	1587	13591	66	8.6		31	151	52	4.9
Squirrel	921	1833	38	2.0		24	33	40	1.4
Roe Deer	566	987	24	1.7		21	40	35	1.9
Fox	562	403	23	0.7		7	5	12	0.7
Hare	735	2475	31	3.4		13	32	22	2.5
Badger	290	21	12	0.1		8		13	
Cat	326	504	14	1.5		5		8	
Mole	499		21			8		13	
Hedgehog	76	8	3	0.1		1		2	

Table 3 National and Avon data for nine common species.

The table demonstrates that in general terms the national and local results are very similar in terms of both apparent distribution and the numbers seen though Roe Deer are marginally commoner, and rabbits less common.

Table 4 shows the difference in trends since 1995. These are trends based on counts, not distribution. The local decline in Rabbits, probably caused by haemorrhagic disease, and Hares is very similar to the national figure. There has been a significant national decline in Fox numbers, but the local figure of a 29% decline is based on distribution not counts. There is no sign of the national increase in Grey Squirrels locally, but Roe Deer appear to be increasing faster than nationally.

	Trend UK	Trend Avon
	95-11	95-11
Rabbit	-46	-37
Grey Squirrel	53	1
Roe Deer	58	76
Fox	-24	
Hare	-6	-10

Conclusion

I hope that this methodology can be extended and the number of observers involved widened to create a more precise method of measuring mammal populations in future.

Otters in Bristol Docks

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The information below summarises the findings of a series of surveys carried out by Phil Quinn. The surveys were commissioned by Bristol City Council's Greener Places Team as part of their work on the Bristol Biodiversity Action Plan. This summary has been approved for publication by Phil Quinn and Bristol City Council, due to wide public interest in this topic.

The first report of Otters in the City docks was in 2009, and it followed earlier evidence of otters from both the River Avon and the River Frome. A full survey of the City Docks was first conducted in October 2010, when evidence of otter was found at nine sites. This evidence was further supported by photographic evidence captured, by a camera trap in the spring of 2011.

Otters are territorial, and mark their territory with spraints at specific sites. A dog Otter can travel thirty km a night, marking his territory all the way. The survey covered the whole City Docks estate from the Cumberland Basin, through the heart of the city to the junction with the Feeder Canal near Temple Meads, and along the Feeder Canal to Netham Lock, a total distance of some seven kilometres of waterway, much of it intensively used.

In October 2011, the original survey was repeated, and included the investigation of all sites where spraint had previously been found, such as under bridges or on ledges. At seven sites there were accumulations of spraint, some very fresh, others clearly dating back some time. The sites were spread all along the Dock area from close to Netham Lock in the East through to the harbour arena area in the vicinity of the SS Great Britain.

Whilst carrying out the survey, Phil was also provided with a photo of an otter, taken from a houseboat near the River Frome outlet at the Centre. It is not commonly understood that the River Frome still flows underground from Newfoundland Road near the end of the M32 through the heart of the city, nor that it still links with the underground course of the castle moat near Broadmead. This complex underground system gives Otters ample opportunity to lie up safely during the day.

Apart from the access from the River Frome, Otters could gain access to the system from the River Avon upstream of Netham Lock, either by using the river bank, though this would involve a road crossing, or by waiting for those occasions when both lock gates are open to top up the harbour with fresh water following losses by vessels leaving Cumberland Basin. They could also gain access from the tidal New Cut, especially at high tides, via Bathurst Basin and the old Lock gates which were filled in 1940 to avoid the Docks being emptied by bombing the lock gates. Another access point at high tides is the unused south lock gate to Cumberland Basin.

The City Docks support a healthy fish population, derived largely from the River Avon, and the presence of both fishermen and Cormorants is good evidence of that. The national increase in Otters has resulted largely from a ban on the use of chlorinatated hydrocarbon pesticides in 1963. These poisons were concentrated up the food chain, so that species at the top, such as Otters and Peregrine Falcons, were almost driven to extinction. As water quality has improved so Otters have returned.

It is not clear how many different animals are involved, which would require DNA analysis, but it is thought there may be up to four. Otters are fully protected under UK and European law, and are the subject of both UK and Bristol Biodiversity Action Plans. The Bristol BAP seeks to establish and monitor the extent and range of the otter population within Bristol; to maintain and enhance the population; and to raise awareness about it. The Docks survey report will be used by the council to help identify wildlife enhancement opportunities within the docks estate as well as to steer management regimes.

Any sightings should be reported to the Bristol Regional Environment Record Centre (records@brerc.org.uk) or to Becky Coffin (becky.coffin@bristol.gov.uk.)

Weather Report for 2011

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Data sources

The BNS began publishing weather data in 1872 with G. F. Burder's paper on rainfall in Clifton since 1853, and this led me to search for temperature data back to that date. From 1920 until its closure in 2002 the Long Ashton Research Station provided the published data, and since then I have used the **Times** daily reports for Bristol, although since 2000 I have also used my own rain gauge. There is an excellent website at www.afour.demon.co.uk which has traced records from some other sources back to 1853, and I have used these to fill in the gaps. A long series of reports is crucial for an understanding of the continuous processes of climate change, which is normally defined as the average for the previous thirty years. I use the term "long-term average" to mean the average back to 1853. The term "since records began" is often used without a clear date reference, and this can create confusion. Most meteorologists use the mean daily temperature as the basis, but many sources only quote the daily maximum and so I have used this data throughout.

The year that has just passed, 2011, was another exceptional one. It had the highest April and November temperatures since 1853, and the second highest (the first was for 1921) annual temperature at 15.5°C. The thirty-year average, the normal definition of climate, reached 14.0°C for the first time since 1962. It was over 14.0°C from 1949 to 1962, and the highest ever was 14.05°C in 1950. Rainfall was 50mm (three weeks worth) below normal but the thirty-year average has reached 963mm, higher than the previous maximum in 1938 of 959mm. The long term average is just 900mm. April was exceptionally dry, with just four millimetres of rain falling. There have been six previous years with single digit April rainfall - the most recent was in 1984. In the past century such events have occurred on average every 24 years.

Year	2002	03	04	05	06	07	08	09	10	2011
Av. Max °C	14.3	15	14.3	14.4	14.7	14.5	13.7	14.6	14.2	15.5
Ten year Av. °C	14	14.2	14.2	14.2	14.4	14.4	14.3	14.3	14.3	14.4
Rainfall *mm*	1058	758	945	896	952	1107	1150	986	747	847
Ten year Av. *mm*	995	963	954	956	974	997	1005	993	943	945

Table 1 Average maximum temperature and rainfall. The average rows are for the ten years up to and including the year in question.

Seasons

Winter (December 2010 to February 2011) Average temperature was 6.8°C, the third below average winter in a row, which is unusual. It was caused by the exceptional cold in December 2010 as the temperature in February was above average. Rainfall, at 72mm per month, was just below average. A total of 41 frost nights (October to April) was recorded, the last on March 19th. There were 34 nights cold enough to create ice, and 23 days with lying snow, all in December. The winter cold began on Nov. 24th, and only ended on Dec. 27th. Two brief cold snaps were also noted in January.

Spring (March to May) Average temperature was 16.1°C, the second warmest since 1853 (the record was set in 1893) caused by a heat wave at the end of April.

This had a profound effect on plants. Rainfall at 21mm per month was drier than average, and it was the second dry spring in a row and the driest since 1990.

Summer (June to August) Average temperature at 20.0°C was spot on the long term average, but it was the fourth wet summer in a row, with 90mm of rain per month.

Autumn (September to November) Average temperature at 16.8°C was the highest ever recorded. October had the fourth highest temperature for this month since 1853, and November the highest. Rainfall was below average.

Seasonal Comparisons To put the 2011 average temperatures into perspective, Table 2 shows the seasonal temperature extremes with their years, the average since 1853, and the difference between 2011 and the long-term average.

	2011	Minimum	Maximum	Av., since 1853	Difference
Winter	**6.8°**	1917-2.5	1920-10.6	7.5°	-0.7°
Spring	**16.1°**	1887-10.4	1893-16.6	13.0°	3.1°
Summer	**20.0°**	1883-18.0	1976-23.9	20.2°	-0.2°
Autumn	**16.8°**	1915-10.6	1959-16.8	14.0°	2.8°
Annual	**15.5°**	1892-12.1	1921-15.6	13.6°	1.9°

Table 2 2011 seasonal average temperature compared with minimum, maximum and average since 1853.

	2011	Minimum	Maximum	Av. since 1853	Difference
Winter	72	1964-21	1995-154	79	-7
Spring	21	1893-17	1981-107	60	-39
Summer	90	1995-11	1879-140	74	16
Autumn	68	1978-26	1935-173	87	-19
Annual	71	1864-49	1882-104	75	-4

Table 3 Seasonal annual rainfall compared with the minimum and maximum and average since 1853.

Monthly percentage deviation in 2011 from the average since 1853

Temperature February, April, October and November were warmer than normal.

Rainfall March, April, May, October and November were drier than normal, and January, June and December were wetter.

	Temperature	Rainfall			Temperature	Rainfall
Jan	-5	55		Jul	1	21
Feb	33	8		Aug	-3	6
Mar	22	-75		Sep	9	10
Apr	47	-93		Oct	23	-43
May	6	-29		Nov	32	-29
Jun	0	48		Dec	25	31

Table 4 Monthly percentage deviations in 2011 from the norm

Monthly Summaries for 2011

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Av.
Temp °C	6.9	10.1	12.2	18.7	17.3	19.3	21.0	19.7	19.6	17.3	13.5	9.8	15.5
Rain mm	130	67	15	4	44	92	87	90	87	54	62	115	71

Table 5 2011 Monthly average temperatures and total rainfall

January The first two weeks were cool, and very wet from 11th to 17th. Winds switched to the North on 17th, and high pressure took charge with five days of frost from 18th to 22nd and again from 28th to 31st. The winds stayed in the North or East, and it remained largely dry. There were 17 sunless days, and eleven frosty nights.

February The month began with SW winds and a warm spell, reaching 15°C on 11th, but staying dry and overcast. There was a cooler spell of SE winds round a Baltic high in the third week, and a warmer final week. There were 17 sunless days, and three frosty nights.

March The first week was cold and dry with NE winds, but southerly winds from 10th caused temperatures to rise to 16°C on 15th and the SE winds round high pressure produced 19°C on 25th, and remained above 15°C for the rest of the month. Only six sunless days, but it remained very dry.

April The first ten days were dominated by high pressure, very light winds, and bright sunshine that saw temperatures reach 22°C on 9th and 10th. It was slightly cooler from the 12th to the 16th then a new warm spell with very light winds saw a temperature of 26°C on 21st.There were only seven sunless days and the average sunshine was 2.1 hours a day greater than normal and effectively no rain fell.

May Temperatures remained high, at around 18°C throughout the month, and sunshine was almost continuous; there were just two wet days.

June The maximum temperature was on 3rd (25°C), the sun continued to shine, with only six sunless days, although total sunshine hours were normal, and all of the month's rain came on two days. Winds were generally light and westerly.

July Temperatures were around 20°C throughout but 26°C on 4th. Although there were only four sunless days, sunshine was 1.1 hours per day less than the recent average. There were two wet spells from 6th to 9th and 16th to 20th. Winds were generally light westerly.

August Warmest at the start with 24°C, by the end temperatures were down to 18°C. Only seven sunless days, but total sunshine was 2.1 hours a day lower than average. There was significant rain on five days. Westerly winds predominated throughout.

September The westerly pattern continued with three wet spells from 5th to 10th, 17th to 21st and 25th to 26th. Temperatures were around 18°C until 26th when an abrupt warm spell saw 29°C on 29th, the warmest day of the year, with cloudless skies. There were only seven sunless days, but below average sunshine.

October The month began with the temperature at 28°C, and it remained warm until 18th when it fell to 12°C but the last week was warmer. Few sunless days but sunshine was average, and there were just two seriously wet days.

November Temperatures remained above the long-term average of 10.0°C throughout the month. Winds were southerly throughout with low pressure in the West Atlantic, and a high over the Baltic and Russia. There were no frosts, and 21 days were rainless.

December Winds switched to the West and North-west with a significant storm on the 8th, and strong winds on eight other days. There was a cold spell from 14th to 19th but it remained the warmest December since 1994 and 50*mm* of rain fell in two days on 13th and 14th. There were just four frost nights.

Weather Extremes

The table below gives figures for extreme annual events over the past decade, enabling the abnormal events of 2011 to be put in perspective. There seems to be no pattern in these figures, except for the number of days per year without sun which has increased from about 70 to about 100. It is also interesting to note that, contrary to common perception, two days in every three had no rain at all.

		02	03	04	05	06	07	08	09	10	2011
Hottest day	°C	26	32	28	30	35	27	28	28	26	29
Coldest day	°C	0	1	3	0	0	2	2	-1	-5	1
Wettest day	*mm*	60	45	45	47	39	40	35	36	36	40
Max sun hours	Hr.	15	15.1	13.9	14.8	14.7	14.1	14.9	14.7	15.6	14.7
Longest dry spell	Days				14	22	24	16	20	24	23
Longest wet spell	Days				7	11	8	8	8	7	5
Frost, nights	Days	14	49	30	32	33	25	44	42	76	22
Snow days	Days	0	0	6	2	2	2	1	19	33	0
Storms	Days				1	3	6	4	1	1	1
Days hotter than 25°C	days	3	22	13	14	27	1	7	5	3	14
days colder than 5°C	days	17	25	15	26	39	18	14	37	60	13
Days with at least 10hr sun	days	30	42	19	38	36	45	29	49	46	44
Days with no sun	days	78	56	90	89	107	99	95	95	106	104
Days with no rain	days		263	231	248	234	238	228	265	269	253

The Moulding of the Bigwood.

A botanical review of the ecological history of Weston Bigwood, in the Gordano Valley.

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Introduction

Weston Bigwood (ST455750) is a 38 hectare woodland remnant situated in the county of North Somerset (previously Avon) and lies between the towns of Portishead and Clevedon. The wood straddles the northern limestone ridge of the Gordano Valley between the village of Northweston at it's easternmost point and is delimited westwards by Valley road, some half a mile before the village of Weston in Gordano

Weston Bigwood became one of the earlier reserves of the Avon Wildlife Trust in 1985, the Trust being given a fifteen year lease on the management rights of the wood by the owners, Amy Roadstone (now Hanson) who owned the western end of the wood to the first set of boundary stones and Bristol City Council who owned the area to the east of the stones. In 2000 the Trust managed to buy the wood using Heritage Lottery funding and local donations. The wood had already been designated as an S.S.S.I. by the then Nature Conservancy Council in 1971, primarily as a remnant of ancient woodland containing many classic ancient woodland indicators but especially because of the abundance of the relatively rare Small Leaved Lime (*Tilia cordata*) which is itself an ancient woodland indicator. The geology of the site is complex (see fig. 1), but is primarily of carboniferous limestone. The woodland was managed as coppice with standards until approximately the late 1940's. since which time the coppicing regime has been abandoned . The wood is classified as w8d Fraxinus-Acer campestre-Mercurialis woodland, Hedera helix subc.

Geological Evolution

The rocks of Weston Bigwood were laid down under the seas in the Lower Carboniferous at about 200 million years ago as the calcarious shells of dead corals and other creatures formed layers of limestone at the bottom of the sea. At the end of the Carboniferous era the Armorican uplift affected the whole of Europe creating creating the Alps and other ranges, and the Gordano ridge was created as part of this movement. The ridge were probably originally much higher but have stood the test of time well. The hard limestone was probably overlaid with sediments and other softer rocks from time to time and would have been host to various flora regimes. Various species of flora present before the last ice age e.g. Norway Spruce (Picea abies) and Siver Fir (Abies alba) did not return to Britain. The current Weston Bigwood flora has been grown up since the last (Wurm) glaciation about ten thousand years ago.

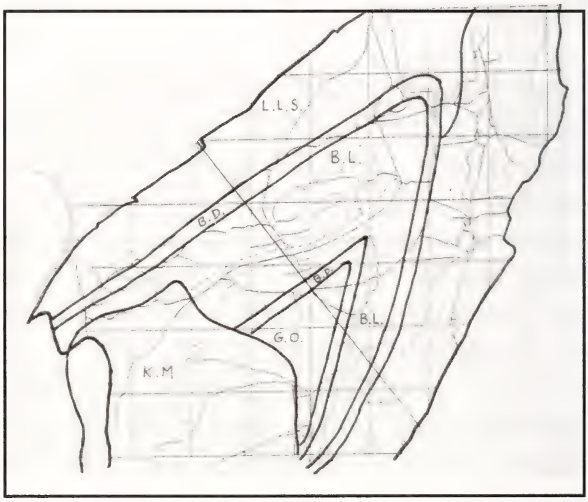

Figure 1 – The geology of Weston Bigwood

Key to rock types. - North is towards top of page
LLS – Lower limestone Shale
BD – Blackrock Dolomite
BL – Blackrock Limestone
GO – Gulley Oolite
KM – Keuper Marl

The development of the flora

The current flora and their distribution within the wood have undoubtedly been moulded by five major episodes in it's recent history.

1 The end of the Wurm glaciation.

Dates used here are in years b efore the present (BP) and are approximate in that different authors quote slightly different timescales for the various time zones.

The last UK glaciation (the Wurm) ended at about 10,000 years ago. Although this latest ice episode did not bring ice to the south west of England it did create tundra conditions like those within the arctic circle today. This had the effect of dramatically replacing any previously existing flora with a typical tundra flora. Dense woodland as seen now in pockets must have formed later as conditions warmed. Evidence of this succession in the Gordano Valley (Weston Bigwood implied) may be obtained by looking at peat bore analysis in the Gordano Valley (Jefferies, 1955). The tree pollen found in this study will in part at least have come from the hillsides that surround the valley.

Pollen data clearly shows that the hillsides during the late glacial period (10000-9000 BP) were a mixture of grasses and herbs with birch and a little pine. Birch, oak and pine were present in the valley during the Boreal period (9000-8000BP) and towards the late Boreal replaced the herb rich flora. During the early Boreal there is a rapid increase in hazel. By the Atlantic period (8000-5000BP) conditions became much wetter and most of the trees in the valley floor were swamped. Pollen counts suggest that Alder quickly colonised the valley during the early Atlantic, afterwards showing a gradual decline as the climate changed and Betula and Quercus replaced it. Herbaceous pollen appeared at the end of the Atlantic period which may represent forest clearance. Pollen levels for Elm are similar to other parts of Britain at this time.

The impact of the opening of the English Channel.
As the climate warmed (Atlantic period 8000-5000BP) early pioneers of Juniper, Birch and Pine were largely replaced as other tree species spread north and west to the UK from warmer refuges in South Europe predominately the Italian and Iberian peninsulas and South East Europe (the Balkans) where they had retreated during the ice-age. Britain was still connected to the continent by a low bridge of land allowing uninterrupted march north of the most successful species. Oak, Elm, Hazel, Cherry, Wild Service and other Sorbus species spread from the south, while the Balkans supplied Small-leaved Lime and Beech. The Balkan species were later reaching Britain and some only just beat the opening of the English Channel at about 8500BP. The arrival of man and forest clearance began at about 4000BP. After the 'climatic maximum'of the Atlantic period, the climate in the UK cooled significantly halting the northward colonisation of less hardy tree species and in particular the Small-leaved Lime. By BC1200 (3200BP) the modern tree structure was more or less complete.
Beech and Hornbeam never reached Weston Bigwood. Small-leaved Lime and Wild Service Tree are now rarely found naturally outside ancient woodland as they have lost the ability to colonise new woodlands. In the case of Lime it is unable to set seed in today's climate as the pollen tube requires about 20 consecutive days of mid twenties centigrade to grow and fertilise the egg. Both species can survive by vegetative regeneration. Lime roots well from fallen branches and also when blown down some of the elastic roots remain in the soil, the tree remains alive, and shoots and roots form along the now prostrate trunk. Good examples of this are seen in Weston Bigwood. Wild Service suckers extremely well and sets seed but maybe the seeds are not transported or able to grow in new woodland.

2. The Mediaeval Era

Medieval man's treatment of woodland, which included coppice with standards, partitioning, grazing animals, and selective encouragement of certain species have further moulded the flora and their distribution within Weston Bigwood.

In medieval times woodland was a vital resource and used for building, fencing, firewood, and fodder. One important management method was coppicing. This involved cutting trees to the ground, which would then regenerate, enabling a repeat crop after a set period.. The classic type is termed coppice with standards, the standards being Oak which were allowed to grow to maturity for about a century before being cut for timber for major building construction. Coppicing created much lighter conditions within woodland, which increased flora and fauna diversity.

The detailed history of the use of Weston Bigwood is uncertain but it was extensively managed for many centuries. There is evidence of several ditches and banks, necessary to keep deer out of newly coppiced areas, and a number of boundary stones. There are also a series of ridges and bumps and in one area there is a semi-circle of stones which may be the remains of an animal pen or shelter, and there are reports of saw-pits and rough dwellings being present in the past. There is a map of a survey of Portishead taken in 1741 (held by Bristol City Council Archive Office) which details the wood as consisting of many small partitions. Figure 2 is a representation of this map to show the compartments present in 1741. Many of the names associated with the compartments were well-to-do gentry, thus highlighting the importance of woodland at this time. The map below is aligned North (top) to South with Valley Road skirting the Western edge.

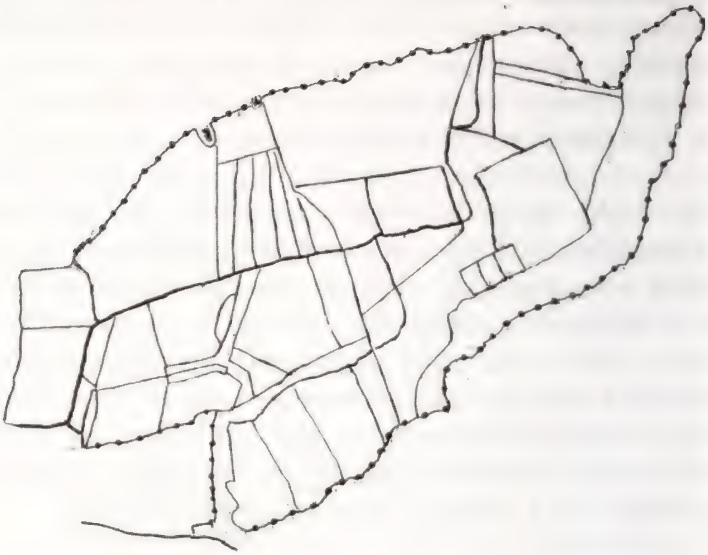

Figure 2 – Diagrammatic representation Weston Bigwood owners/compartments (from a survey of Portishead in 1741)

Key
Dotted line – Wood boundary
Thick line – Path through the wood
Thinner lines – Individual owners delimits

Evidence that the wood was much more open when actively coppiced may be found in 'The Bristol Flora' written by John White in 1912. The following are quotations from his book.
Fly Orchid. 'six plants together in the Big Wood'
Greater Butterfly Orchid. 'Nightingale Valley and Weston Big Wood'
Cow Wheat. 'Weston Big Wood'
Nettle Leaved Bellflower. 'Woods along the ridge above Weston in Gordano'
Upright Cudweed. 'in a wood between Portishead and Weston in Gordano' (Weston Bigwood ?)
Wood Vetch. 'about the woodland extending to Weston in Gordano'
Hairy St. Johns Wort. 'Between Portishead and Weston in Gordano' woodland inferred.
Columbine. 'in the Big Wood, Weston in Gordano'

All of these plants require more open woodland than has been seen in recent decades in Weston Bigwood.

3. Inaccessibility.
Woodland in England had reduced from 15% of the land area (Domesday) to 5.4% by 1895 (Mathews, 1987). After the development of canals, which cheapened the price of coal throughout the land during the industrial changes of the eighteenth century, the need for wood for fuel reduced and some woodlands were converted to arable farmland. The inaccessible nature of Weston Bigwood with steep sides both north and south and very shallow soil at least on the plateau area, probably saved it.

4. Abandonment.
Research by Dixon (1998 unpublished PhD) performing incremental core analysis on the overgrown Small-leaved Lime coppice indicates that coppicing in the plateau area was abandoned at about the end of world war two, but had been abandoned in the southern (lower) part of the wood earlier. The effect as seen by the 1990's was that the wood was generally very dark with overgrown coppice and little obvious ground flora. Many species of ground flora hitherto recorded had been lost or at least suppressed.

5. The Burn's day storm.
On the 23rd January 1990 an ill-defined and shallow low pressure was developing off the Eastern seaboard of the USA. By midday on the 24th it had been joined by another system and the pressure had dropped to 992 mbars with satellite images indicating an explosive system developing. This particular cloud/front formation (called a baroclinic leaf) reliably predicts a storm of force 10 or greater. Early on the 25th the low tracked eastwards over Northern Ireland with a remarkable further drop in pressure of 16mb in three hours down to 952 mbar. During the morning of the 25th the wood was battered from WSW with gusts (Bristol Channel data) of up to 67 km/hr. As the front rapidly moved north east during the afternoon an even faster rise in pressure resulted in a second wave of strong winds this time hitting the wood from the WNW direction. The strongest gust from this direction at 76 km/hr and evidence of tree fall direction and the areas affected strongly indicates that the greatest damage was done in this period.

Although this storm appears major it is important only in the context of the structure of the wood now. Similar great storms must have occurred in the past and had similar effects (prior to the advent of coppicing). This follows the classical theory of Patch Dynamics where patches regenerate potentially with different species to those areas undamaged.

Further major storms create their own patches which are likely to be different to the younger previous patches. Once the wood was coppiced such storms may have had only a limited effect. About 20 areas of damage large enough to be considered as patches were created during the storm., Some 500 to 600 boles were felled (representing 300 to 400 root plates) and caused about 10% canopy loss.

The existing Flora

The combination of these five historical factors have left the wood with a rich and diverse flora.

The wood consists of standard trees of Pedunculate Oak (*Quercus robur)* and a few Sessile Oak (*Quercus petraea*) or hybrids between the two species, with old coppice mainly of Small Leaved Lime (*Tilia cordata*) and Ash (*Fraxinus excelsior*). Survey data from the late 1980's showed that these three species each represented about 30% of the canopy. In addition there are smaller numbers of Whitebeam (*Sorbus aria*), Cherry (*Prunus avium*), Crab Apple (*Malus sylvestris*), Field Maple (*Acer campestre*) and Wild Service Tree (*Sorbus torminalis*), most of which are old coppice as well as quite a lot of Wych Elm (*Ulmus glabra*) most of which is at present part of the subcanopy. Distribution surveys have been conducted on most species of tree in the wood.

Other trees recorded from the wood include a few Sycamore (*Acer pseudoplatanus*) and a single Beech (*Fagus sylvatica*) which was presumably planted. A few Turkey Oak (*Quercus cerris*), and a single Holm Oak (*Quercus ilex*) are found at the edge of the old quarry. Reference to *Sorbus spp.* in Nature in Avon (Proceedings of the Bristol Naturalist's Society 1991) is as follows; *Sorbus x vagensis* (Wilmott) - 3 trees in Weston Bigwood were lost in the 1990 storm but should regenerate by suckers; *Sorbus eminens* (E. F. Warb.) - present in the old quarried area (Willis, 1991).

Interestingly a small specimen of Sorbus eminens was discovered at the edge of the ride near where it is joined by the valley road path in about 2008. In a later edition of the Nature in Avon some doubt was expressed to the actual species of Whitebeam present in the wood and this needs to be clarified. In the vicinity of the ride there are some Goat Willow (*Salix cinerea*) and the introduced *Buddleja davidii* also thrives here.

The shrub layer is typically Hazel (*Corylus avellana*), Hawthorn (*Crataegus monogyna*) with some Spindle (*Euonymous europaeus*), Holly (*Ilex aquifolium*), Wayfaring Tree (*Viburnum lantana*), Yew (*Taxus baccata*) and in the more open areas Dogwood (*Cornus sanguinea*) and Guelder Rose (*Viburnum opulus*). Sub-canopy Maple, Ash, Wych Elm and Crab also form part of the shrub layer while waiting for a canopy gap to appear at which time they may grow to join the canopy. Holly, Hawthorn and Hazel also occasionally reach the canopy in the wood.

The ground flora is variously dominated by Wood Anemone (*Anemone nemorosa*), Dog's Mercury (*Mercurialis perennis*), Bramble (*Rubus fruticosus* agg.), Bluebell (*Hyacinthoides non-scripta*), Ivy (*Hedera helix*) and includes rarer species such as Herb Paris (*Paris quadrifolia*), Birds Nest Orchid (*Neottia nidus-avis*) and local species such as Goldilocks (*Ranunculus auricomus*) and the limestone thicket specialist Purple Gromwell (*Lithospermum purpurocaeruleum*). Other typical ancient woodland indicator species include Sweet Woodruff (*Galium odoratum*), Madder (*Rubia peregrina*), Wood Spurge (*Euphorbia amygdaloides*), Yellow Archangel (*Lamiastrum galeobdolon*), Pignut (*Conopodium majus*), Sanicle (*Saniculum vulgare*), Barren Strawberry (*Potentilla sterilis*), Hairy Woodrush (*Luzula pilosa*), Wood Melick (*Melica uniflora*), Wood Millet (*Milium effusum*) and Wood sedge (*Carex sylvatica*). Other sedges indicative of ancient woodland but which prefer moister soils are absent. Weston Bigwood is a dry wood being well drained by the limestone on which much of the wood is situated.

The present structure

Looking at the wood it is easy to see that it is classic but overgrown coppice with standards, the standard trees being almost entirely of Oak but with one or two Ash. The coppice trees have now joined the canopy but can still be identified by being multi-trunked. Some of the oldest coppiced limes have formed 'fairy rings' with the original central trunk now rotted away and each coppice pole forming a discreet tree. The cutting of a ride through three quarters of the wood in 1987, and numerous gaps created by the 1990 storm have created a much more open woodland in places, with much dead and lying timber and a more diverse ground flora possibly reflecting times when the wood was actively coppiced. Recent management has seen the creation of four coppice coups in the south west area of the wood continuing the 'light' diversity within the wood as the canopy gaps created by the storm close. These events have produced a more varied ground flora including the reappearance of some of White's 'lost' species. In particular Nettle Leaved Bellflower, Hairy St Johns Wort and Columbine have reappeared in the ride after an absence of more than ninety years, and Wood Vetch has appeared along the path on the plateau. There have been up to three Greater Butterfly Orchid in the ride.

Some woodland species not quoted by White have appeared in recent years. These include Tutsan which is a native of ancient woodland. Some species such as Cow Wheat and Fly Orchid have not (yet) returned. And of course these open areas have attracted lots of 'non wood' flora usually transient on recently disturbed areas such as scrapes where timber has been moved, tractor tyres marks and bare areas under recently removed Bramble. Some of the more interesting include garden escapes including Hollyhock and Bleeding Heart.

It is probable that historic management of the wood is responsible for the surprising distribution of some of the trees described below under 'Main wood and Plateau' and may at least in part be due to it's medieval compartment structure. The main ditch and bank delimits the medieval eastern end of the wood which is still recognisable by the trees and ground flora present on each side. Thus most of the central plateau was kept free from grazing animals and is coppice with standards. Outside this ditch and bank to the east of the wood there is a classic 'Woodland Pasture' structure indicating past grazing in this area (this is described in more detail later).

The main wood and plateau

Detailed analysis of the distribution of canopy trees within the wood reveals more about the wood's true character and past. In particular the Small-leaved Lime occurs in discreet discontinuous stands, often dominant where it occurs, and near the north west edge the wood it is the only coppice tree present. It is absent from part of the plateau and much of the eastern part of the wood. Although the delimitation of the Lime does not match the 1741 compartments, the strikingly linear edge of it's distribution in the north west of the wood is strong evidence of human intervention. In the south eastern part of the wood at the base of the plateau the Limes are much bigger and here coppicing appears to have been abandoned considerably earlier. There are standard Oak more or less throughout the wood and also a few standard Ash. In one area roughly matching a plot on the 1741 map of an area of 40 to 50 metres square consists almost entirely of coppice Oak and this may have been used by an Oak tanner. Some other plots must have favoured Lime which may have been used to stoke surrounding lime kilns or used as fodder or to make ropes. Some plots by inference from their names may have been maintained as 'field' areas and others as un-coppiced woodland, for example 'wood at Sparley's Splott'. The distribution of Wild Service Tree is interesting in that it is scattered throughout the wood except the eastern end and does not occur beyond the major ditch and bank system that delimits the 'wood pasture' .

The Wood Pasture

The Eastern end of the medieval wood is delimited by a major ditch and bank system and comprises mainly of standards with little old coppice. Here the under-storey has a much larger proportion of Hawthorn compared to Hazel than the rest of the wood and also contains a few large Holly trees. This appears to have been wood pasture in which only the standards would have survived and only prickly or unpalatable un-grazed under-story could grow. No Lime or Wild Service Trees occur in this area but there are a few Whitebeam. Of the ground flora a little Herb Paris occurs in the wood pasture but less commonly than in most other parts of the wood. In contrast the area to the west of this ditch and bank system is more traditional coppice with standards with under-storey predominately of Hazel but with several other sub-canopy species present. The inference is that the area to the East of the main ditch and bank is secondary woodland not present in medieval times.

Other plant species.

The woodland flora also shows a discontinuity of distribution for some species. Rather surprisingly there is only one small patch of Early Purple Orchid (*Orchis mascula*) just at the north western edge of the plateau. Similarly Town Hall Clock (*Adoxa moschatellina*) only occured around one of the main badger setts although it appears to have died out there. The Goldilocks Buttercup (R*anunculus auricomus*) is only found on the eastern part of the plateau to the east of the main ditch and bank and then almost entirely along the edges of paths. Other species such as Twayblade (*Listera ovata*), Herb Paris, Spurge Laurel (*Daphne laureola*), and most of the other ancient woodland indicator species are distributed in most parts of the wood both on the Limestone and over more acidic rocks. A few species characteristic of more acidic soils do occur at the eastern end of the wood, namely Ransoms (*Allium ursinum*) and Wood Sorrel (*Oxalis acetosella*).

The ride, which is mown annually to preserve a low sward with intermediate scrub grading into the canopy (alternate sides are cut in alternate years), has become floristically rich with a number of limestone grassland species colonising as well as open woodland species. Meadow species that have appeared here include Yellow Wort (*Blackstonia perfoliata*), Centaury (*Centaurium erythraea*), Vervain (*Verbena officinalis*), Red Bartsia (*Odontites verna*), Cowslip (*Primula veris*) etc. with over 200 species of plant in total recorded from the ride. The majority of the canopy gaps created by the 1990 storm and the ride became rapidly covered with a dense cover of Bramble, suppressing the woodland flora. As the canopy closes over these gaps the Bramble dies back and the woodland herbs are reappearing (but not necessarily the same in species and distribution).

Management

Since the Avon Wildlife took over the wood in 1985 there has been a management plan, but its realisation was at first not well coordinated. When I became voluntary warden I was able to give stability to the management and since then the voluntary team have had considerable input into the policies. Woodlands are pretty resilient and management needed is often minimal. In Weston Bigwood there are three main activities.

In 1987 a 10 metre wide ride was cut into the south west half of the wood to about two thirds through following the route of a path noted in medieval times. This concentrated where people would walk and allowed more light for flora and butterflies including the now declining Silver-washed Fritillary. Weston Bigwood is a 'Bramble' wood and the opened up ride becomes a Bramble patch in about two years. Therefore the ride needs to be cut every couple of years. A diverse flora is maintained by cutting different parts of the ride in two or three year rotation.

Over the last few years a section of the south west part of the wood including mainly areas severely damaged in the Burn's day storm have been coppiced in a four coup rotation, the latest being formed in February 2012. We have been monitoring the coppice coups with two metre quadrats each Spring to see if the regeneration flora is any different to that before the coppicing took place.

Other management includes keeping paths open, maintaining the steps and reporting fallen trees.

Monitoring

In the late 1980's I formed a team of volunteers. It seemed a good idea to involve them in scientific survey and monitoring and this became of greater interest after the Burn's day storm in 1990 as the structure of the wood was changed dramatically. The storm also triggered a seven year study of how ancient woodland regenerates leading to the award of my PhD in 1998.

Original surveys included a Breeding Bird census which was carried out first by Pete Evans and then Simon Wilson and currently by Geoff Harris. Results over the years have shown that changes in the woodland structure have not dramatically affected bird populations with the exception of Marsh Tit. Prior to the storm there were regularly two or three pairs, but there have been none since. Nationally this species is declining for reasons unknown.

An intriguing and novel method of tree surveying was devised by the late Noel Moreton. In order to simplify area sampling of trees he proposed a circular quadrat composed of a rope radiating from a central point usually a tree. The sampler would complete a circle using the rope as radius counting the trees encountered within. Over a couple of years over 60 such quadrats were done allowing us to accurately estimate the canopy composition which was pretty much a third each of Lime, Ash and Oak

There have been surveys of the numbers of Sorbus and Wild Service trees and of Norway Maple and Sycamore. Fixed Point photographs were taken for several years as the canopy gaps closed.
Rare and specialised flora was monitored, the methods depending on the type of distribution and plant numbers. For example early surveys of Herb Paris revealed that this species is abundant in the wood. Therefore we concentrated on two or three colonies. This species generally forms discreet colonies which are really one body connected by underground rhizomes.

Goldilocks and Purple Gromwell occur at low density and in dense colonies so a measure of the length, and breadth of each is taken. Plants with low numbers are counted e.g. Birds Nest Orchid, and Early Purple Orchid.

General results of surveys.
Coppice quadrat analysis.
The method was to count the species in three two metre square areas within each coppice coups during each spring. The results as expected were a rapid build up of bramble, followed by a return to woodland flora as the coppice grows and shades out the Bramble.
Herb Paris.
Three long standing colonies have been recorded, one for nearly 20 years. Results show that there is a greater ratio of flowering spikes as light increases. One patch has moved some two metres over a decade in response to partial closing ofc the canopy. As light has fallen this colony has diminished by two thirds. Another small colony of 30 spikes had apparently vanished by 2001 but one or two plants have since reappeared. It will be interesting to see what would happen if this site becomes lighter.
Goldilocks
Colonies mapped and measured for length and maximum width.

Early Purple Orchid
The number of flowering spikes are counted. Currently we know of one colony just off the northern path plus a few by the extension of the ride towards the southwest entrance gates
Purple Gromwell
Every 2 years or so the roadside colony is measured for length and maximum width. Visual recollection before measuring was started indicates that this patch is increasing in length.
Broad-leaved Helleborine
Each year the plants are counted and mapped
Birds-nest Orchid
This is done as an ad hoc survey – If you see one log it on the map.
Wild Service Tree.
A count of mature trees and saplings was done in the 1980's.
Whitebeams
These have never been fully counted, or fully identified.
Plant survey of the Ride
This is done yearly as a one off headcount of all species present in the ride. Usually late May is best to get most species.
Butterfly monitoring
Butterfly Transect
Individual species monitoring e.g. Silver Washed Fritillary

The Future

Now that the wood has reverted to natural processes of regeneration there is the possibility of change in the composition of the canopy. Evidence of an increase in the amount of Ash and a decrease in Oak and Birch can be seen from study of two older gaps (30 and 10 years before the 1990 storm). In the 30 year old gap Birch and Oak are being replaced with Ash, while in a ten year old gap a large Oak is being replaced by Ash and Elm. The amount of Oak present in the wood in the past was probably maintained because of the high value of the mature timber.

What of the future? At present the Avon Wildlife Trust is allowing natural processes of woodland regeneration to take place. This consists of leaving dead timber and trees to rot naturally and allowing gaps to regenerate to canopy themselves. The regeneration of gaps demonstrates the classic example of patch dynamics. The 20 or so gaps formed by the 1990 storm will possibly fill with a different canopy mix than was present prior to the storm. The next great storm will create another series of gaps which will probably involve parts of the wood not affected by the 1990 storm. Thus a mosaic of patches in different stages of regeneration and with different canopy trees may be visible in a hundred or so years.

Overgrown coppice of course is not the same as 'natural' woodland and the multi-stooled trunks cause denser shade and may become unstable and split outwards. Regeneration of gaps formed by the 1990 and future storms will gradually redress this balance.
There is a further consideration. For centuries woods such as Weston Bigwood have been artificially kept open by coppicing with a corresponding distinct and evolving flora and fauna. There are some who feel that some sort of coppicing regime should be maintained, although others feel that some woods should be restored to high forest status comparable to that prior to man's colonisation of Britain. To maintain light diversity within the wood, over the last several years four coppice coups have been cut in in the south west area of the wood and will be recut on a rotational basis, thus maintaining both types of woodland. The coppice coups occupy about a tenth of the wood.
In conclusion Weston Bigwood is a vitally important woodland both as ancient woodland but also as a model for scientific study.

Blaise Castle Estate

Geological Time Travel in a Land of Giants

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Blaise Castle Estate is a magnificent Grade II listed parkland. Jane Austen wrote in *Northangar Abbey*: "Kingsweston! Aye and Blaize Castle too…The finest place in England – worth going fifty miles at any time to see." Here though, Thorpe is somewhat deceitful in his persuasion of the reluctant Catherine to join the excursion from Bath. Even so, Blaise is justly renowned for its picturesque landscape, making it a popular attraction to this day.

Blaise is set mainly onto the Carboniferous Limestone ridge of Kings Weston Hill and Castle Hill, on the western outskirts of Bristol. This dramatic and scenic incised plateau area is a microcosm of the solid geology of the Bristol district. The changing environment and evolution of the landscape can be traced from its sedimentary rock units in the section dating from the late Devonian period, *c*360 Ma. Tectonic forces and thrust faults that shaped the region are evident from the folded strata of the Westbury Anticline along with steeply-dipping, overturned and shattered beds in the northern limb of the anticline. Finally, a drainage system etched its channels through the covering sediments and into the Carboniferous rocks to form the spectacular, steep-sided, densely-wooded Henbury gorge. This is a recent sculpting of the landscape, also seen in similar features across the region, from the nearby Avon Gorge to Burrington Coombe and Cheddar Gorge in the Mendip Hills.

The Blaise Castle Estate/Kings Weston Ridge RIGS extends from Henbury, ST62788 westward along the northern limb of the Westbury Anticline as far as Shirehampton, ST530774 and southwest to Coombe Dingle, ST558773 including the River Trym valley from Coombe Farm, ST563776 to Sea Mills Lane, ST 555766. The site is important for education and research into the palaeo-environment of the region, periglacial landscapes and stream action.

Its rich variety of rock units along with their twisted and contorted structures make for a challenging lithology and stratigraphy. It's an area of extraordinary natural beauty, complex geological structure, with some remarkable exposures.

A walk through geological time starts in Coombe Dingle by the River Trym, at the base of the succession in the late Devonian, *c*360 Ma. From the confluence of the Trym and Hazel Brook at ST559775 the course of Hazel Brook is followed northward into the shady gorge and a gentle ascent to the top of the early Carboniferous, *c*330 Ma and the giant's footprints on Castle Hill. From nearby Lover's Leap, and then from the legendary giant Goram's Chair opposite, the full panorama of Blaise and the gorge can be admired.

The massive and thick-bedded river cliffs of conglomerate at the Coombe Dingle entrance rest on the Upper Old Red Sandstone of the Portishead Formation. These ten m high cliffs of Triassic age were formed *c*206 to 248 Ma from the debris of shattered and scoured uplands in Carboniferous and Permian times. Debris collecting in the valleys and wadis below were cemented into the Mercia Mudstone Marginal Facies (dolomitic conglomerate) along shorelines, wedged between and against the limbs of the Westbury Anticline, forming the present day bedrock.

The angular unconformity where the Triassic breccia overlies what appear to be vertical beds of Devonian old red sandstone is exposed at ground level to the left of the path *c*150m from the Coombe Dingle entrance. A similar unconformity, but with a conglomerate of different origin, is exposed on a far greater scale at Kilkenny Bay, Portishead. At Blaise, the Upper Old Red Sandstone continues along the wooded slopes beyond the Trym floodplain, on the south side of the Trym valley, heading east to Westbury-on-Trym. These rocks were formed by rivers depositing sand and gravels into river channels, *c*354 to 364 Ma.

After a few metres along the path the base of the Avon Group is reached marking a change from fluvial and deltaic to marine environments, *c*344 to 354 Ma. Down-slope to the river confluence outlines a small area for the Shirehampton Formation. Surface rock samples show light-grey, medium-grain, crinoidal limestone, possibly formed in a warm shallow sea or lagoons. Across the Hazel Brook weir footbridge and close to the river bank marks the boundary with a thin bed above the Shirehampton Formation. Rock samples show a distinct reddening of finer grained, sparsely fossiliferous limestone and red-brown, siltstone that together may reveal the Bryozoa Bed.

From the main path above the footbridge, an unmade path forks left and leads after *c* 100m into woodland and to an outcrop of the Maesbury Mudstone Formation, at the top of the Avon Group. Penny Well has its source *c* 20m farther along the path, at ST558778. The spring also marks a termination of a one km fault line SW - NE, to where Hazel Brook enters the gorge near Henbury Church. Penny Well feeds into Hazel Brook a few metres from the bridge south of the lily pond. At this point of the succession the base of the Pembroke Limestone Group has been crossed and the main path passes the pond through the Black Rock Limestone Sub-Group, rocks again formed in a warm, shallow, carbonate sea.

A small disused quarry to the right of the path next to the lily pond has been used to extract limestone. North of the pond, by the next bridge, the path meets a shear rock face of Black Rock Limestone beds dipping 86° NE, climbing away to the east, disappearing into dark woods, upwards to the precipitous Potter's Point. As the path winds its way towards the Beech Cathedral the succession passes up through the Black Rock Dolomitic Limestone. A few metres up the slope, between the beeches, the distinctive white weathered rock of the Gully Oolite Formation crops out.

Coming off the bend, and overlying the Gully Oolite in the succession, the brown mudstones found in the bank prove the presence of the Clifton Down Mudstone Formation. The appearance along the path of scree deposits marks the boundary with the Clifton Down Limestone Formation and a change in the palaeo-environment to more open seas. A vertical limestone cliff butts up against the path by the next pond, Tarn Lake (the Giant's Soap Dish). Above the tree canopy and to the right are the soaring limestone twin towers of Goram's Chair. On the opposite side of the gorge the limestone cliffs, their beds dipping 30° E, line up to buttress Castle Hill, screes piled high at their bases.

The uppermost formations of succession are reached at the bridge near Stratford Mill. The paths to Blaise Castle and Rhododendron Walk lead to good exposures of the Oxwich Head Formation (previously the Hotwells Limestone Formation) and the Cromhall Sandstone Formation. A flight of steps leads up to the giant's footprints, in an outcrop of the Oxwich Head Limestone Formation. The feature has the appearance of a limestone pavement. These are usually formed on horizontal beds by slightly acidic conditions dissolving the limestone around cracks, such as bedding planes and joints. They are sometimes associated with glaciation. It's unusual to find them in southern Britain.

Proof of the top of the succession is more reliable in some exciting outcrops along Rhododendron Walk. Rocks more recognisable of the Cromhall Sandstone Formation crop out in places up to the Rustic Lodge. Oxwich Head Limestone crops out along the path to the gatehouse at Henbury Hill, and before Henbury Lodge the bank leads up to the site of the former Henbury Hill Quarry, reclaimed for the 14th Green at Henbury Golf Course on Coombe Hill.

Rhododendron Walk makes a dogleg at the Rustic Lodge where rocks of the Oxwich Head Limestone crop out in the bank. They show recognisable coarse, grey, ooidal and crinoidal limestones that represent high-energy marine deposits expected in open shelf environments.

The path through the rhododendrons runs along the rim of the gorge on Coombe Hill and leads to Goram's Chair. From one of the cliff towers there is a commanding view across the gorge to Kings Weston Hill, Echo Gate and Castle Hill. It overlooks the steepest part of the gorge, plunging 60m to the bottom. The Severn Estuary and South Wales can be seen over the col at Echo Gate on a clear day.

A local legend says that the giant brothers Goram and Vincent diverted the River Avon, each digging a ravine, Goram at Henbury and Vincent at Clifton. More natural explanations for the origin of the Henbury gorge and the Avon Gorge have been hotly debated from the early 19th century almost until the present day (Bradshaw 1965).

Hazel Brook makes a curious *c*90° turn south in the Crow Lane Open Space, ST568796 and flows in a straight line across the Triassic dolomitic conglomerate plain to where it enters the gorge near to Henbury Church. It follows the straight line of the Henbury Fault along the strike through beds of the Cromhall Sandstone Formation to beyond the bridge at Stratford Mill. From here the brook diverges from the fault line, taking a more westerly course before turning towards the south again below Goram's Chair, following the gorge, crossing the Henbury Fault near Penny Well.

An alternative course for a river would have been the more direct and easier westerly route across softer Triassic and Jurassic rocks to Hallen. It has been suggested that glacial diversion of the river created a new route that breached the Carboniferous rocks at Henbury, (Hawkins 1977). Evidence in the form of gravels and till found in the Bristol district has been interpreted as glacial deposits (Colborne et al 1973). But there has been no evidence found so far that ice reached as far as the Hallen gap, ST559795.

The plateau of Kings Weston Hill and Coombe Hill, *c*100m OD, is the result of river or marine erosion, when the steeply-dipping and faulted Carboniferous strata were planed flat. An erosion surface at a similar height in Pembrokeshire is estimated to be Pliocene in age, *c*5 – 2 Ma. This has led to the proposal, that if the Kings Weston Hill erosion surface is Pliocene, it would have been more extensive, cutting across the hard Carboniferous rocks and adjacent softer Triassic and Jurassic strata that had buried the earlier landscape. During the following 2 million years of the Quaternary, this *c*100m hard Carboniferous surface would have been gradually incised by its drainage system, and softer rocks worn down faster. The Carboniferous rocks being more resistant remained, producing the typical Carboniferous Limestone landscape seen today.

Cheddar Gorge is thought to have been formed in the periglacial, tundra environment of the last glaciation by seasonal meltwater flowing off snowfields and over the surface of the bedrock made impermeable by permafrost. In the last glacial period during the Devensian stage, *c*118,000 to 10,000 years BP, the ice sheet advanced to South Wales. The Bristol district was in the grip of a permafrost and it's reasonable to suppose that frost action and seasonal melts over frozen ground could have rapidly enlarged the Henbury gorge, in a similar process to Cheddar.

To conclude, it has been possible to map the succession and trace the changing palaeo-environment from the rocks of Henbury gorge. The precise origin of the gorge remains uncertain. However, the balance of evidence found so far suggests that it's the result of processes observed in the formation of similar features in the region.

Acknowledgements
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References
Bradshaw, R. 1965. The Avon Gorge, Proceedings of the Bristol Naturalists' Society, Vol. 31, Part 2, pp 203-220.
Colborne, G.J., Gilbertson, D.D., Hawkins, A.B. 1973. Temporary Drift Exposures on the Failand Ridge, Proceedings of the Bristol Naturalists' Society, Vol. 33, pp 91-97.
Hawkins, A.B. 1971. Some Gorges of the Bristol District,Proceedings of the Bristol Naturalists' Society, Vol. 32, Part 2, pp 167-185.
Hawkins, A.B. 1977. The Quaternary of the North Somerset Area, Geological Excursions in the Bristol District.

Population dynamics of Common Whitebeam (*Sorbus aria* (L.) Crantz, Rosaceae) in the Gully, Avon Gorge

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SUMMARY

A survey of the Whitebeams (*Sorbus*) on the north side of the Gully, Avon Gorge was carried out in 1996 and repeated in 2010. The data are used to assess the population biology of *S. aria*, to review the effects of recent conservation management and to suggest implications for conservation of Whitebeams in the future. The average increase in girth of *S. aria* was 0.58 cm per year and 0.19 m increase in height per year. Nearly all trees should flower from when they are about 20 years old. About 8% of *S. aria* trees were damaged during conservation work. Careful planning will be needed to ensure that sufficient *S. aria* plants are available to pollinate the rare pseudogamic and apomictic species of Whitebeam in the future; new recruitment will be required in 10 years so that there will be trees of reproductive age in 30 years time.

INTRODUCTION

Following the accidental coppicing and subsequent loss of two of the few (<10; Nethercott 1998) known Wilmott's Whitebeams (*Sorbus wilmottiana*) during conservation management work in the Avon Gorge in 1995, English Nature (now Natural England) commissioned Tim Rich and Libby Houston to survey Whitebeams in the Gully in 1996.

The aim of the survey was to assess the distribution and abundance of Whitebeams on the north side of the Gully so that they could be conserved during further scrub and secondary woodland clearance (Rich & Houston 1996). During the survey, two trees of an unknown species of Whitebeam were found (now described as *S. whiteana*) which stimulated our recent work on *Sorbus* (Chester *et al.* 2007; Houston *et al.* 2008; Rich & Houston 2004, 2006; Rich *et al.* 2009, 2010, Robertson *et al.* 2010). The Avon Gorge is now considered to be the most important site for Whitebeams in Britain and is probably the most diverse site in the world with at least 21 *Sorbus* taxa including seven Avon Gorge endemics (Rich *et al.* 2010).

The Gully (also known as Walcombe Slade) is a small, steep, west-facing, dry valley which descends from the Clifton and Durdham Downs plateau to the River Avon. There are a few Carboniferous Limestone outcrops and fairly extensive limestone screes, with cliffs at Black Rock Quarry on the north side and those of Gully Quarry or New Quarry on the south side. Historically the north side of the Gully was largely open grassland with rare grassland plants such as *Carex humilis* (Lovatt 1982) into which alien pine trees had been planted around 1870. After the 1930s, the Gully became increasingly covered in secondary woodland and scrub. By 1996 it was mainly secondary woodland and scrub with small open areas on the north side at 'the outcrop' (well known for its rare plants such as *Allium sphaerocephalon*) and down the Black Rock Quarry edge, with a larger grassy and open scrub area on the south side. Conservation management initially concentrated on extending existing open areas through small scale works (e.g. Houston 1998; Houston *et al.* 2002). Large woodland areas were cleared in 2006. Although care was taken to conserve Whitebeams during this major clearance work, a few were accidentally cut down, some were damaged by other trees during felling (including one *S. whiteana*), and some subsequently fell or bent over as the supporting canopy around them had been removed (cf. Figure 22 of Rich *et al.* 2010).

The extensive regrowth of brambles and scrub on the eutrophic soils which had developed under the secondary woodland was at first controlled manually before grazing by goats was proposed as a longer term solution by Bristol City Council. The Gully was fenced in 2010 and goats were introduced in 2011.

We expressed concern about conservation of the Whitebeams related to the goat grazing proposals on two grounds. First, we were concerned that the rare species would be browsed as the evidence from Cheddar Gorge showed that smaller Whitebeams were selectively targeted by goats (Smith & Bullock 1993; Houston *et al.* 2009, cf Figure 23 of Rich *et al.* 2010; Wheatley 2009); this concern was partly addressed for existing trees by significantly reducing the area to be enclosed and by providing protective fencing for the rare Whitebeams which was put in place before the goats were introduced. Second, that due to the unusual reproductive method in the rare Whitebeams, sufficient mature common Whitebeam (*S. aria*) trees might not be left to allow the rare species to be pollinated (Ludwig *et al.*, data in preparation). The rare Whitebeams are apomictic (i.e. they are direct clonal copies of the mother) and pseudogamous (i.e. pollination is required to set seed even though the pollen does not contribute to the genetic make-up of that seed (Robertson *et al.* 2010)). It was hoped that the larger *S. aria* trees would not be affected by the goats so these were left unprotected, but a small enclosure c. 15 m x 15 m was erected on the south side of the Gully to allow for some regeneration. As no information was available on the population biology of *S. aria* or information on how many should be retained to promote seeding of the rare Whitebeams, in 2008 we set up a PhD project for Shanna Ludwig to research this; unfortunately Bristol City Council and Natural England went ahead with the goat grazing proposal anyway.

One of the first parts of the PhD project was to map the distribution of the Whitebeam trees in the Gully so that the spatial relationship between the rare apomictic species such as *S. wilmottiana* and their pollinating trees of *S. aria* could be assessed. This provided the opportunity to assess changes in Whitebeam populations between the Rich & Houston (1996) survey and that of 2010 which is reported here.

There are several updates to the original 1996 survey report (Rich & Houston 1996) worth noting which have resulted from our increased knowledge of individual trees and *Sorbus* taxonomy in the Gully since 1996. The heavily shaded sapling no. 58 was recorded as *S. bristoliensis* in 1996 but is now known to be *S. wilmottiana*. Another *S. wilmottiana* is now known, which was probably overlooked as shaded *S. aria* in 1996. One tree of *S. bristoliensis* was over-looked in 1996. The trees recorded as possible *S. wilmottiana* and as *S. eminens* are now known to be *S. aria*. Another *S. eminens*-like plant (tree 88 of Rich & Houston 1996) has been found to be triploid and needs further investigation. The two (not three) trees of the new species recorded as "JWWhite" are now named as *S. whiteana*.

METHODS

Rich & Houston (1996) surveyed the Gully, Black Rock Quarry and Sea Walls in September 1996. The woodland was searched as systematically as possible mainly by working in approximate 20 m strips up and down the slopes, which was often difficult in the dense woodland. For each whitebeam or group of whitebeams, a sketch map was drawn showing their approximate location in relation to local features such as paths, rocky outcrops or large trees. Notes were made on the girth (circumference at breast height measured with a tape measure; cm), height (estimated by eye to nearest metre), the form (maiden or coppice) and reproductive status (presence of fruit).

Seedlings were ignored but saplings over 0.2 m were recorded. The survey number was written on the stem with marker pen to avoid duplication. Trees were named in the field, or vouchers were taken for further consideration and deposited at the National Museum of Wales, Cardiff (**NMW**; accession number V97.34).

Using the maps of Rich & Houston (1996), the area was resurveyed by S. Ludwig and T. Rich in May 2010 with a few subsequent checks in 2011. Notes were again made on height, girth, form and reproductive status (presence of buds or flowers). Locations were noted with a Garmin eTrex GPS but no sketch maps were made. Some trees had individual permanent labels attached in 2010 to ensure the same individuals could be re-identified with certainty in the future and also to provide names for education and conservation management purposes. Houston *et al.* (2008) found that height estimates made by different observers varied by an average of 0·67 m (range 0–1 m) and girth measurements by an average of 3 cm (range 1–4 cm); these errors will apply to our survey data too but are small relative to the large sample sizes.

In 2010, care was taken to see if trees recorded in 1996 could be recognised individually again. This often proved difficult due to the extensive clearance work which had resulted in loss of trees used on sketch maps to locate Whitebeams and overgrowth of some of the minor paths. Some trees could be checked morphologically from their leaf shapes against the vouchers collected in 1996.

Whitebeams are known to vary in flowering and fruiting from year to year (Rich *et al.* 2010). 1996 and 2010 were both good years with high reproductive performance, and it is assumed that reproductive status assessed from the fruiting status noted in 1996 and the presence of buds or flowers in 2010 is comparable.

RESULTS

Population sizes

In 1996, excluding planted and dead trees and including corrections, 309 trees and saplings were recorded, 298 of which were *S. aria* with 5 *S. bristoliensis*, 2 *S. latifolia* group (one of which may have been *S. croceocarpa*), 1 *S. porrigentiformis,* 2 *S. whiteana* and 1 *S. wilmottiana*. In 2010, 299 trees and saplings were recorded in total, 284 of which were *S. aria*, 8 *S. bristoliensis*, 1 *S. croceocarpa*, 1 *S. latifolia*, 1 *S. porrigentiformis,* 2 *S. whiteana* and 2 *S. wilmottiana*. The addition of 1 *S. wilmottiana* was due to misidentification of trees in dense shade in 1996, and 3 *S. bristoliensis* was from regeneration.

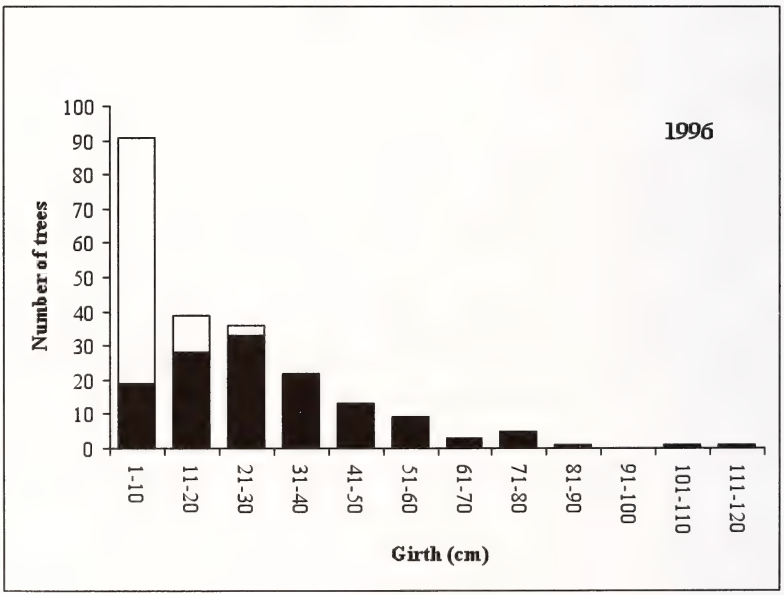
152 *S. aria* trees (51% of the population) present in 1996 were reasonably confidently relocated, of which 12 (4%) had been damaged during the conservation work (thus about 8% overall). 146 trees recorded in 1996 could not be clearly re-identified in 2010 and conversely 126 trees found in 2010 could not be clearly related to trees present in 1996; as some of the latter are reasonable-sized trees which must have been present in 1996 the main difficulty was matching the two surveys.

Five *S. aria* trees present in 1996 (1.7%) had certainly been lost (cause unknown); as the fate of only 51% of the population can be ascertained it is likely that the mortality rate is double this, i.e. about 3.4%. 20 trees (7%) were found in 2010 which were certainly not present in 1996. Overall there was 10.4% turnover in the population over the 13 year growth period between the surveys, suggesting about 0.8% loss and recruitment of the population per year.

Growth and reproduction

Trees increase in girth annually by the production of new growth rings, so girth can be a good proxy measure of age of a trunk without having to count tree rings from cores or sections and avoids damaging trees (cf. Houston *et al.* 2009). Tree height can also be a proxy for age, as the taller a tree is, the older it is likely to be. The relationship between height and age can be affected by coppicing or the environment, for example old trees on exposed dry limestone rocks are short compared to young slender trees struggling to reach the canopy in dense woodland. Height and girth are highly correlated in both 1996 ($r=0.814$, $p<<0.001$) and 2010 ($r=0.815$, $p<<0.001$).

Bar charts showing the number of *S. aria* individuals of girth classes for the 1996 and 2010 surveys are shown in Figure 1. The bar charts show there are fewer trees in successive size classes as might be expected with natural mortality in age-structured populations. Trees with larger girths were more likely to be reproducing.



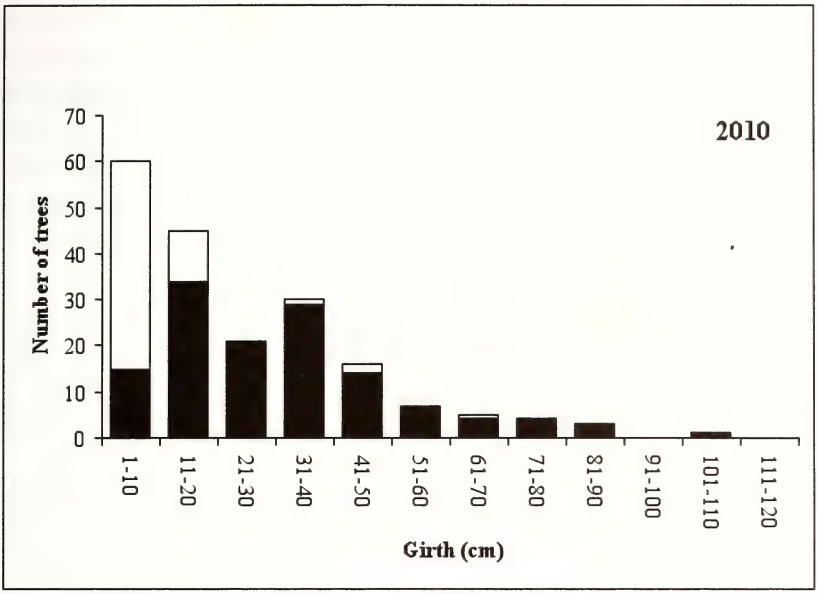
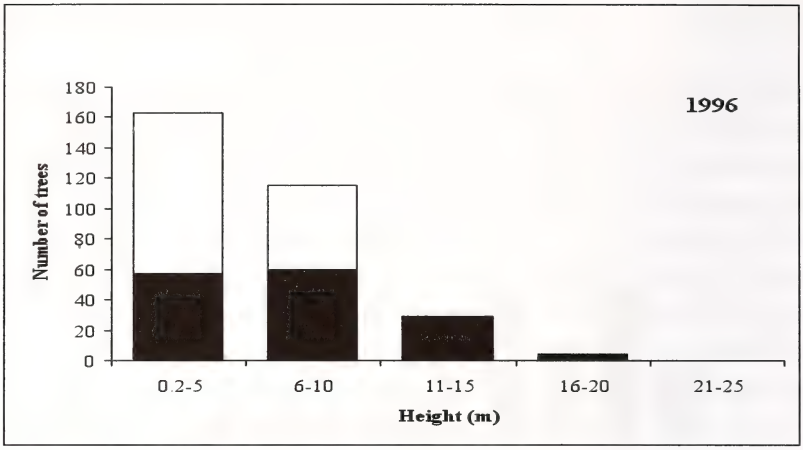


Figure 1. Bar charts showing the numbers of *S. aria* individuals of each girth class for 1996 (n=221) and 2010 (n=192) surveys, subdivided as to whether trees were fruiting (1996) or had buds/were flowering (2010) ■ or were vegetative □.

Bar charts showing the number of *S. aria* individuals of the different height classes for the 1996 and 2010 surveys are shown in Figure 2. Both charts show relatively large numbers of short trees with decreasing numbers of tall trees, and that most vegetative trees are short.



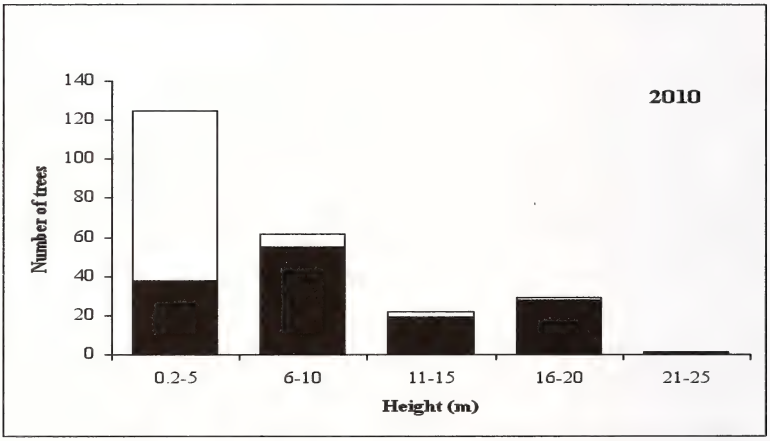


Figure 2. Bar charts showing the numbers of *S. aria* individuals of each height class for 1996 (n=311) and 2010 (n=239) surveys, subdivided as to whether trees were fruiting (1996) or had buds/were flowering (2010) ■ or were vegetative □.

Comparison of growth from two surveys

By selecting the trees for which reliable data were recorded for girth and height in both surveys, estimates of growth between the two surveys can be obtained.

For the 83 *S. aria* with girth measurements for both surveys, the mean girth in 1996 was 22.5 cm (±22.3 cm s.d.) and in 2010 was 30.0 cm (±23.9 cm s.d.). The mean increase in girth was 7.6 cm (±5.4 cm s.d.), which over the 13 seasons of growth gives an average increase in girth of 0.58 cm per year.

For the 97 *S. aria* with height measurements for both surveys, the mean height in 1996 was 5.85 m (±4.64 m s.d.) and in 2010 was 8.32 m (±5.64 m s.d.). The mean increase in height was 2.46 m (±2.23 m s.d.), which over the 13 seasons of growth gives an average increase in height of 0.19 m per year.

Age of first flowering

To estimate the age at which *S. aria* may first flower using the growth data, the data for maidens were examined (note that the plant has to get to more than 1.3 m tall to have a girth recorded, estimated as taking 7 years). In 1996, the smallest maiden with fruit was 2 m tall with a girth of 5 cm, giving a possible age of 11 years from the height alone, and at least 16 years from the girth. In 2010, the smallest maiden with buds was 3 m tall with a girth of 3 cm, giving a possible age of 16 years from the height alone, and at least 13 years from the girth. Coppiced trees arise from older trees with more reserves in the rootstock; they may therefore flower at a smaller size – two coppiced trees flowered at 1 m tall. 95% of the maidens with fruit or buds have a height of 4 m or more and a girth of 8.5 cm or more; thus nearly all trees should be flowering from about 20 years old.

DISCUSSION

The population size of *Sorbus* in the Gully has remained similar between 1996 and 2010 with only small changes in the numbers of *S. aria* and little change in the rare species. About 8% of *S. aria* trees and one individual of *S. whiteana* were damaged during conservation work.

Despite the difficulties of relocating individual trees from the 1996 survey due to the wide scale clearances in the Gully, much useful data about *S. aria* population biology has been obtained. Since 1996 there has been a low mortality rate and equally little regeneration; seedlings are frequent in some years but few of them establish. The average increase in girth is 0.58 cm per year and 0.19 m in height per year. Nearly all trees will first flower from the age of about 20 years.

The estimated population turnover rate of 0.8% suggests that the whole population will be replaced every 125 years under current conditions. As goat grazing is likely to prevent any regeneration within the fenced area, a 3.4% annual mortality rate would lead to loss of *S. aria* in 29.4 years. Hence in order to maintain the *S. aria* populations required to pollinate the rare Whitebeams, new recruitment will be needed in 10 years to provide trees of reproductive age in 30 years time. The small enclosure on the south side of the Gully alone is unlikely to provide sufficient recruitment to allow for pollination of all the rare Whitebeams in the future. The 2010 data will be used to monitor the effects of goat grazing and the *S. aria* population dynamics under an untested grazing regime.

Some comparative population data for *S. bristoliensis* are available in Houston *et al.* (2008) which may show some differences between species and habitats. Overall, the population age structure is similar; 23 of the 81 trees mapped by R. V. Russell in 1979 could not be refound in 2004-5, suggesting an annual loss of about 1.2% per year though the population was found to be increasing overall with significant recruitment into open ground.

The smallest tree with fruit was 3 m tall with a girth of 12·5 cm. The average increase in girth of *S. bristoliensis* across all sites was 0.96 cm per year, approximately two thirds as much again as in *S. aria,* but for the four trees in the Gully alone was 0.56 cm per year which is very similar. Counts of *S. bristoliensis* bud scars suggested that saplings took 15 years to reach the height at which girth could be recorded, suggesting the estimate of seven years in *S. aria* above may be an underestimate.

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REFERENCES

Chester, M., Cowan, R. S., Fay, M. F. & Rich, T. C. G. (2007). Parentage of endemic *Sorbus* L. (Rosaceae) species in the British Isles – evidence from plastid DNA. *Botanical Journal of the Linnean Society* **154**: 291-304.

Houston, L. (1998). *Report on works carried out on Gully outcrop, Avon Gorge (Clifton side), between 11 and 16 February 1998.* Unpublished report to English Nature/Bristol City Council.

Houston, L., Tillotson, A. & Charles, C. (2002). *Avon Gorge, Clifton side. Surveys and minor works 2001.* Unpublished report to Avon Gorge and Downs Wildlife Project.

Houston, L., Robertson, A. & Rich, T. C. G. (2008). The distribution, population size and growth of the rare English endemic *Sorbus bristoliensis* A. J. Wilmott, Bristol Whitebeam (Rosaceae). *Watsonia* **27**: 37-49.

Houston, L., Robertson, A., Jones, K., Smith, S. C. C., Hiscock, S. J. & Rich, T. C. G. (2009). An account of the Whitebeams (*Sorbus* L., Rosaceae) of Cheddar Gorge, England, with description of three new species. *Watsonia* **27**: 283-300.

Lovatt, C. M. (1982). *The history, ecology and status of the rare plants and the vegetation of the Avon Gorge, Bristol*. PhD thesis, University of Bristol.
Nethercott, P. J. M. (1998). Conservation status of *Sorbus* in the Avon Gorge, in Jackson, A. & Flanagan, M., eds., *The conservation status of* Sorbus *in the UK*. pp. 40–43. Royal Botanic Gardens, Kew.
Rich, T. C. G. & Houston, L. (1996). *Sorbus* survey of the Gully, Avon Gorge. September 1996. Unpublished contract report to English Nature (11 October 1996).
Rich, T. C. G. & Houston, L. (2004). The distribution and population sizes of the rare English endemic *Sorbus wilmottiana* E. F. Warburg, Wilmott's Whitebeam (Rosaceae). *Watsonia* **25**: 185-191.
Rich, T. C. G. & Houston, L. (2006). *Sorbus whiteana* (Rosaceae), a new endemic tree from Britain. *Watsonia* **26**: 1-7.
Rich, T. C. G., Harris, S. A. & Hiscock, S. J. (2009). Five new *Sorbus* (Rosaceae) taxa from the Avon Gorge, England. *Watsonia* **27**: 217-228.
Rich, T. C. G., Houston, L., Robertson, A. & Proctor, M. C. F. (2010). *Whitebeams, Rowans and Service Trees of Britain and Ireland. A monograph of British and Irish* Sorbus *L.* Botanical Society of the British Isles in association with National Museum Wales. London.
Robertson, A., Rich, T. C. G., Allen, A. M., Houston, L., Roberts, C., Bridle, J. R., Harris, S. A. & Hiscock, S. J. (2010). Hybridization and polyploidy as drivers of continuing evolution and speciation in *Sorbus* L. (Rosaceae). *Molecular Ecology* **19**: 1675-1690.
Smith, J. E. & Bullock, D. J. (1993). A note on the summer feeding behaviour and habitat use of free-ranging goats (*Capra*) in the Cheddar Gorge SSSI. *Journal of Zoology, London* **231**: 683-688.
Wheatley, H. R. (2009). Are feral goats (*Capra*) and Soay sheep (*Ovis aries*) having an impact on tree species in Cheddar Gorge, in particular towards rare Whitebeams (*Sorbus* spp.)? Unpublished BSc. Conservation Biology thesis, University of the West of England.

Bristol and District Invertebrate Report 2011

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INTRODUCTION

The winter of 2010/2011 was the second relatively cold winter in a row. Prior to this, we had experienced a considerable period of mild winters which, it is thought, had led to the noticeable changes to our local invertebrate fauna with the invasion of many insect species previously known only from further south. It might therefore be expected that two cold winters might impact upon these new populations in an adverse way. The spring and summer of 2011 was a chance to look specifically to see if these populations had crashed or were in trouble. Although only anecdotal impressions were gained over the year, it would seem that there was no obvious impact and most new colonists seemed unaffected. If correct, the reasons for this can only be guessed at. Is it that an impact will only take place with sustained periods of cold winters or that these particular cold spells in the last two winters came at a time in the life cycles of these species which did not affect survival rates?

Another climate related feature of 2011 was at least the fourth poor summer in a row. April was a very warm and very dry month but the summer months were cool and damp. The warm spring, rather than the cold winter, seemed to impact upon insect populations. In particular, dragonflies appeared in numbers early on but then were in very low numbers for the rest of the season. Also, the impression was gained that insects of open meadows, such as the various common grass bugs, seemed to suffer from the dry conditions and be in low numbers during the spring.

Immigration of insects was confined to a small number of sudden influxes associated with appropriate weather patterns of strong southerly winds. These were centred around the beginning of April, when Saharan sand was deposited in places, the first week of June, early July and the last week of September/first week of October which saw unseasonably high temperatures. All four events saw unusual moth species for our region recorded, notably the Silver-striped Hawk in April, the Portland Riband Wave and Rannoch Looper in June, the Small Marbled in July and Dewick's Plusia and Pale-lemon Sallow in the autumn. (The latter is a resident species in the British Isles but not in our region.) Aside from these waves of immigration numbers of the more usually reported species eg Clouded Yellow Butterfly, Humming-bird Hawk Moth, Silver Y Moth and so on were very low.

As suggested above, new colonists, or those resident species which have expanded their range recently, seemed to consolidate their position. As examples, the Hornet, Scarlet Tiger Moth and Small Ranunculus Moth have remained very much in evidence across the whole region and the hoverfly *Volucella inanis* continued to be reported in the late summer from locations in Bristol. Encouraging was the news of a second locality south of Bristol for the Narrow-bordered Bee Hawk Moth and a locality for a breeding colony of the Marsh Fritillary Butterfly, a species which had been thought to be locally extinct. The L-album Wainscot Moth seems to have become very well established on our coastline of North Somerset. The Bristol 'Bioblitz' was held this year at the Tyntesfield National Trust estate and it proved very fruitful, turning up a new site for the diminutive bee fly *Bombylius canescens* amongst other good records. Otherwise, there have been a number of new species to our region recorded but perhaps most surprising was the discovery of a live example of the longhorn beetle *Stenygrimun quadrinotatum*, a first for the British Isles and native to the Far East.

Scientific nomenclature follows that used by the National Biodiversity Network website (www.nbn.org.uk).

My thanks to all who have submitted records directly to the Society (particularly to Paul Chadwick, Jon Mortin, Andy Pym, Mandy Lievers, John Martin, Richard Bland, Paul Bowyer, Neale Jordan-Mellersh, Nigel Milbourne, Bob Fleetwood, Tony Cotterell, Rhian Rowson, John Aldridge, Dave Nevitt, David Agassiz, Tim Knowles, Alan Bone, Martin Evans, Roger Palmer and John Burton) the Bristol Regional Environmental Records Centre (BRERC), Clevedon Moth Group, Bristol & District Moth Group and to the Bristol Wildlife E-group. The importance of receiving, not just the records picked out here, but those of perhaps less noteworthy species cannot be understated in terms of monitoring the ever changing status of the invertebrate fauna.

Species of note in 2011

INSECTA
Hemiptera (true bugs)
Rhyparochromus pini (Linnaeus) The Gully, Avon Gorge, Bristol (vice county 34) ST564746 9 April 2011 and 21 August 2011 Ray Barnett, one swept on each occasion. (Confirmed as this species rather than the similar *R. vulgaris* recently arrived in the London area.) A localised usually coastal species.
Arocatus longiceps Stal College Green, Bristol (vice county 34) ST582 786 17 October 2011 Jon Mortin, one adult on London Plane Tree. First noted in this country outside the Natural History Museum, London in 2007, this is the first record from the Bristol region. Native to the Eastern Mediterranean.

Lepidoptera (butterflies)

Marsh Fritillary *Euphydryas aurinia* (Rottemburg) Bath & NE Somerset (vice county 6) ST55 2011 Nigel Milbourne, larval web seen early in the year followed by adults in summer. The only known colony in the region currently.

Lepidoptera (micro-moths)

Adela croesella (Scopoli) Tyntesfield NT Estate, North Somerset (vice county 6) ST5071 21 May 2011 det. Ray Barnett. A local species seldom recorded.

Coleophora saliconiae Heinemann & Wocke Severn Beach, South Gloucestershire (vice county 6) ST58 29 September 2011 Guy Meredith. The second record for our region of this species whose larvae feed on *Salicornia*.

Telechrysis tripuncta (Haworth) Tyntesfield NT Estate, North Somerset (vice county 6) ST5071 21 May 2011 det. Ray Barnett. Apparently the first record since the 19th century for our region.

Aphelia viburnana (Denis & Schiffermüller) Weston-super-Mare, North Somerset (vice county 6) ST36 1 July 2011 Paul Chapman. A species of bogs, the first confirmed record for the Bristol region.

Lepidoptera (macro-moths)

Five-spot Burnet *Zygaena trifolii* (Esp.) Max Bog, North Somerset (vice county 6) ST4157 23 June 2011 John Martin, several imagines and cocoons. Very rare in the region where the similar Narrow-bordered Five-spot Burnet and Six-spot Burnet are the commoner species.

Portland Ribbon Wave *Idaea degeneraria* (Hübner) Mangotsfield, South Gloucestershire (vice county 34) ST67 2 June 2011 Denise Whittle, one in garden moth trap photographed.

Rannoch Looper *Itame brunneata* (Thunberg) Mangotsfield, South Gloucestershire (vice county 34) ST67 6 June 2011 Denise Whittle, one in garden moth trap photographed.

Chevron *Eulithis testata* (Linnaeus) Weston Moor, North Somerset (vice county 6) ST4473 29 July 2011 Paul Chapman.

Narrow-bordered Bee Hawk Moth *Hemaris tityus* (Linnaeus) Bath & NE Somerset (vice county 6) ST 5 2011 Nigel Milbourne.
Silver-striped Hawk Moth *Hippotion celerio* (Linnaeus) Walton Common, North Somerset ST4273 (vice-county 6) 5 May 2011 Paul Chapman
Jersey Tiger *Euplagia quadripunctaria* (Poda) Weston Moor, North Somerset (vice county 6) ST4473 29 July 2011 Paul Chapman. Keynsham, Bath & NE Somerset (vice county 6) ST6 6 August 2011 John Aldridge.
White Colon *Sideridis albicolon* (Hübner) Sand Bay, North Somerset (vice county 6) ST36 29 May 2011 Paul Bowyer, in good numbers.
L-album Wainscot *Mythimna l-album* (Linnaeus) Weston-super-Mare, North Somerset (vice county 6) ST36 2011 Bob Fleetwood.
Pale-lemon Sallow *Xanthia ocellaris* (Borkhausen) Dundry, Bristol (vice county 6) ST5 6 3 October 2011, Dave Nevitt.
Silky Wainscot *Chilodes maritimus* (Tauscher) Weston-super-Mare, North Somerset (vice county 6) ST36 2011 Paul Bowyer.
Dewick's Plusia *Macdunnoughia confusa* (Stephens) Weston-super-Mare, North Somerset (vice county 6) ST36 1 October 2011 David Agassiz.
Small Marbled *Eublemma parva* (Hübner) Weston-super-Mare, North Somerset (vice county 6) ST36 · 26 June 2011 Paul Bowyer. Clevedon, North Somerset (vice county 6) ST47 11 July 2011, Bob Fleetwood.
Beautiful Snout *Hypena crassalis* (Fabricius) Tyntesfield NT Estate, North Somerset (vice county 6) ST5071 20 May 2011 Bristol & District Moth Group.
Buttoned Snout *Hypena rostralis* (Linnaeus) Keynsham, Bath & NE Somerset (vice county 6) ST66 August 2011 Roger Palmer.

Coleoptera (beetles)

Ophonus ardosiacus Luts. Hawkfield Road, former sports pitch, Bristol (vice county 6) ST588679 15 August 2011 Jon Mortin, det. Mark Telfer. 3rd record for BRERC area and a very local species in Somerset and Gloucestershire..

Ophonus puncticeps Steph. Hawkfield Road, former sports pitch, Bristol (vice county 6) ST588679 15 August 2011 Jon Mortin. A very local species in our region.

Harpalus rubripes (Dufts.) Hawkfield Road, former sports pitch, Bristol (vice county 6) ST588679 15 August 2011 Jon Mortin, det. Mark Telfer. 3rd record for BRERC area, a very localised ground beetle.

Dytiscus circumflexus Fabricius Blagdon Lake, Bath & NE Somerset (vice county 6) ST55 1 August 2011 Nigel Milbourne and Alan Bone. Very local on the Somerset Levels and other sites.

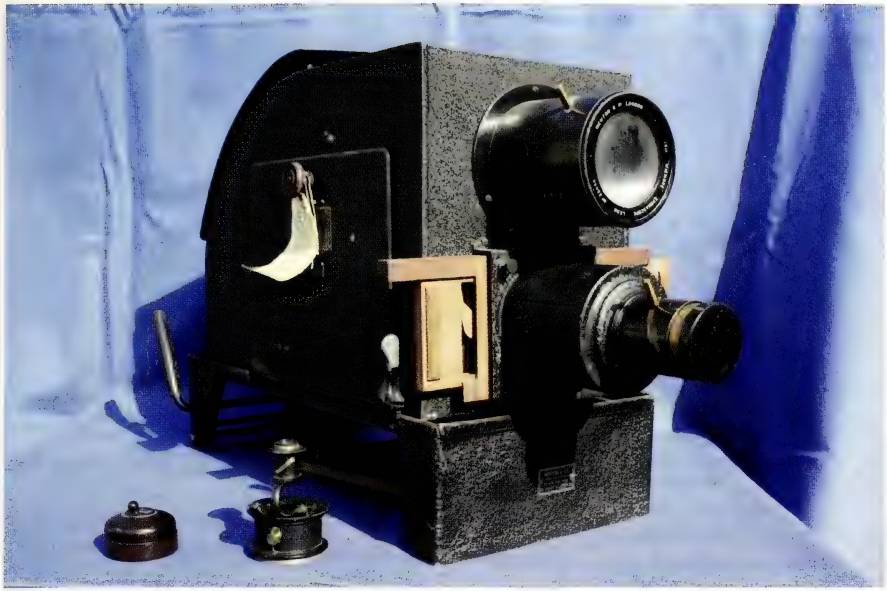
Stenagostus rhombeus (Olivier) Blagdon Lake, Bath & NE Somerset (vice county 6) ST55 1 August 2011 Nigel Milbourne and Alan Bone. A very large click beetle whose larvae breed in rotting trees.

Adonis Ladybird *Hippodamia variegata* (Goeze) Hawkfield Road, former sports pitch, Bristol (vice county 6) ST588679 2 July 2011 Jon Mortin. 5th record for BRERC area. Apparently increasing.

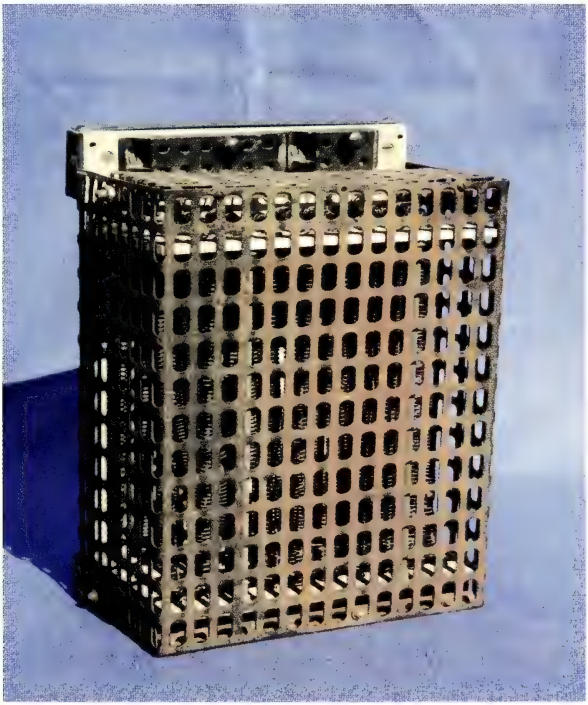
Stenygrinum quadrinotatum Bates Stoke Bishop, Bristol (vice county 34) ST5576 5 July 2011 Martin Evans det. Max Barclay. The first record for the British Isles, thought to have been imported as a larva in wood purchased from the pet trade. (Barnett, 2011.)

Larinus planus (Fabricius) Portbury Wharf AWT Reserve, North Somerset (vice county 6) ST4876 14 May 2011, Ray Barnett. A local species associated with thistle.

Microplontus campestris (Gyll.) Hawkfield Road, former sports pitch, Bristol (vice county 6) ST588679 7 June 2011 Jon Mortin. 1st record for BRERC area. Very local on Ox-eye Daisy.



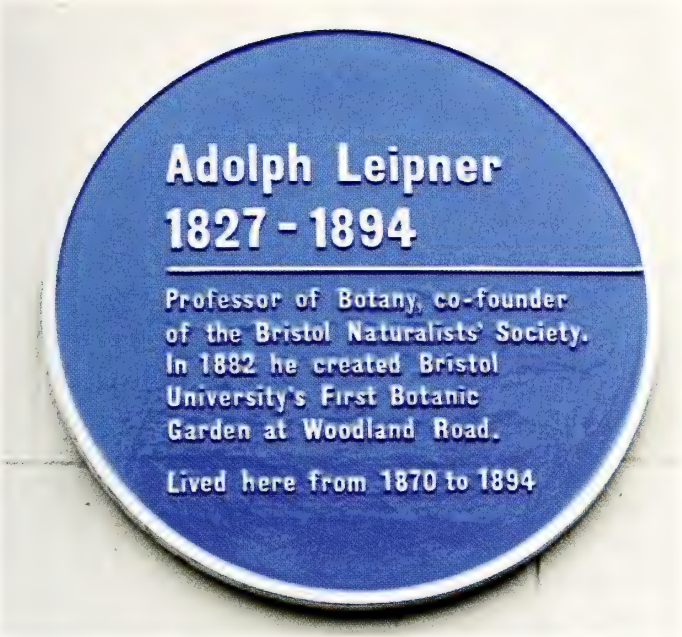
Roper memorial epidiascope See Page 76



Transformer for the epidiascope see page 80

Harry Savory and his Goshawk See page 84

Colonel Jones See page 68



The plaque on 47 Hampton Road, Redland where our founder lived.

Pictures from an Exhibition

To celebrate 150 years we held a successful photographic exhibition in Henleaze on April 14th, and there follows a selection from it.

Whitebeam bud. R Bland

Usnea florida J Lea-Jones

Green-veined White mudfest M Webster

Sawwort M Webster

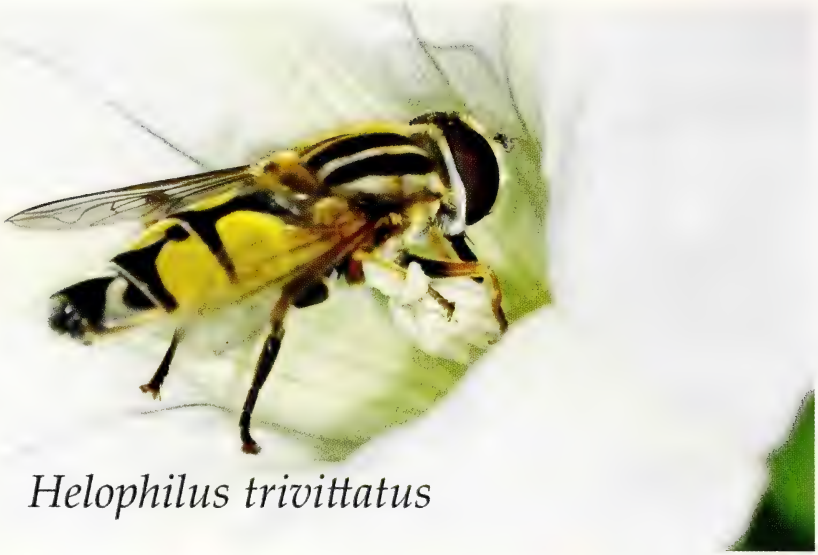
Wych Elm seeds R Bland

Silver Birch R Bland

Stagshorn R Muston

Burnet Moth JP Green

Plume Moth M Webster



Helophilus trivittatus

Tony Cottrell

Green Carpet Moth M Webster

Hymenoptera (bees, wasps and ants)

Zarea fasciata (Linnaeus) Cornwall Road, Bishopston, Bristol (vice county 34) ST585757 12 July 2011 James Barnett. Rarely see but distinctive sawfly.

Rhyssa persuasoria (Linnaeus) Arnos Vale Cemetery, Bristol (vice county 6) ST6071 4 June 2011 Ray Barnett, one female investigating a Yew tree trunk. This exceptionally large ichneumon is more usually associated with coniferous stands where the larvae are parasitoids on 'horntail' sawflies. In this location perhaps cerambycid beetle larvae are the more likely hosts of the parasitoid.

Lissonota setosa (Geoff.) The Gully, Avon Gorge, Bristol (vice county 34) ST564746 21 August 2011 Ray Barnett, one female caught on the wing. A large species, but smaller than the previous species.

Lasioglossum minutissimum (Kirby) The Gully, Avon Gorge, Bristol (vice county 34) ST563746 3 December 2011 Jon Mortin. Few records in our region.

Colletes hederae (Schm. & West.) Bishop's Knoll, nature reserve, Bristol (vice county 34) ST553752 11 September 2011 Jon Mortin, one photographed. A recent arrival to the British isles but now well established and to be looked for in the autumn on ivy flowers.

Bombus hypnorum (Linnaeus) Berkley Square, Clifton, Bristol (vice county 34) ST580731 April 2011 a nest reported, Rhian Rowson. Royal Fort Gardens, Clifton, Bristol (vice county 34) ST583 734 24 May 2011 Jon Mortin, 10 seen. Hawkfield Road, former sports pitch, Bristol (vice county 6) ST588 679 7 June 2011 Jon Mortin. Chew Valley School, North Somerset (vice county 6) ST569 624 7 September 2011 Jon Mortin. Another new arrival in the British Isles which has become established throughout our region.

Diptera (true flies)

Bombylius canescens Mikan Tyntesfield NT Estate, North Somerset (vice county 6) ST5071 21 May 2011 Tim Corner (det. Ray Barnett). A very local species of small beefly.

Herina germinationis (Rossi) Chew Valley School grassland, North Somerset (vice county 6) ST569623 15 June 2011 Jon Mortin, det. Stephane Lebrun. Poorly recorded in the region.

Minettia inusta (Meig.) Clifton Down, Bristol (vice county 34) ST570746 24 May 2011 Jon Mortin, det. Stephane Lebrun, one photographed. Few records in the region.

Minettia plumicornis (Fall.) Old Sneed Park, Bristol (vice county 34) ST554755 25 May 2011, Jon Mortin, det. Steven Falk, one adult photographed. Poorly recorded locally.

Siphona geniculata (DeG.) The Gully, Avon Gorge, Bristol (vice county 34) ST563746 3 December 2011 Jon Mortin, det. Chris Raper. Few local records.

Graphomya maculata Chew Valley Lake, North Somerset (vice county 6) ST581605 1 September 2011 Jon Mortin, det. Paul Beuk, 4th record for the BRERC area.

Gymnocheta viridis (Fall.) Old Sneed Park, Bristol (vice county 34) ST553755 3 April 2011, Jon Mortin, det. Matt Smith. Few local records.

Volucella inanis (L.) Bishop's Knoll, nature reserve, Bristol (vice county 34) ST553752 11 September 2011 Jon Mortin, one adult. River Avon path, Sea Mills, Bristol (vice county 34) ST550754 11 September 2011 Jon Mortin, one adult. A species which has increased considerably in recent years after expanding from its stronghold in SE England.

Mollusca

Irish Yellow Slug *Limacus maculatus* (Kal.) The Gully, Avon Gorge, Bristol (vice county 34) ST563746 19 May 2011 Jon Mortin. 1st record for the BRERC area. Not necessarily rare but under recorded.

Reference

Barnett, R.J. 2011 *Stenygrinum quadrinotatum* Bates 1873 (Cerambycidae: Cerambycinae: Callidiopini) imported into the British Isles. The Coleopterist Vol.: 20 pt. 3.

Colonel Jones and the Nature Prints of the Varieties of the British Ferns

by Michael Hayward, Liverpool
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Between May 1876 and December 1890 Col. Jones of Clifton produced a series of around 300 large format nature prints illustrating the latest finds of Varieties of the British ferns. He aimed to produce 48 sets of which perhaps 44 or 45 were distributed to subscribers. These prints and the text sheets that accompanied them provide a valuable record of the fern collecting and fern breeding that was going on in this period and an invaluable reference source of the Victorian fern varieties. The BNS holds two sets of these prints in its library, an unbound extended set presented to the society by Col. Jones and a bound subscriber's set of prints.

Arthur Mowbray Jones, 1826-1889, was an infantryman, brought up in Bristol and educated at Bishop's College. He purchased his first commission as an ensign in the 75th Regiment in Madras in 1846. At the start of the Crimean war he resigned his commission in India, returned home and joined the West Yorkshire militia, but did not see active service in the Crimea. His regiment was disbanded at the end of that war and he had a short break from military service, attending Cirencester Agricultural College and Durham University (Lowe, 1895). In November 1860 he joined his final regiment, the 1st Volunteer Battalion of the Gloucester Regiment, rising to be its commanding officer with the rank of Lieutenant Colonel. He retired from the army in 1882.

Colonel Jones married Clara Belinda Martin-Atkins, 19 years his junior, in 1864. They had three children. Clara died of a throat tumour in 1876 and his unmarried sister moved into the household. Jones named one of his favourite lady ferns, *Athyrium filix-femina* 'Clarissima' after his late wife.

At the beginning of the nineteenth century, expensively imported exotic ferns, chiefly from the West Indies and the Americas, were prized possessions in the heated conservatories of the wealthy. At the end of the 18th century John Lindsay, a surgeon in the West Indies, described how to propagate ferns from spores and the Victorian fern craze had its beginnings (Whittingham, 2012). The 1820 catalogue of the London nursery, Loddiges, lists 36 exotic ferns for hot houses, 2 ferns for the conservatory and 31 ferns as hardy perennials, 21 of which are British species. 60 years later the catalogue of W. & J. Birkenhead of Sale lists over 1000 varieties of ferns. In Charles Kingsley's opinion, it was Gilbert White's publication of *The Natural History and Antiquities of Selbourne* in 1789 that made the study of nature respectable, particularly amongst the middle classes. The rapid expansion of the railways allowed collectors to increase their horizons from just their immediate locality. In this atmosphere the 1st British Pteridological Society was born.

Founded in the early 1870's, the only contemporary record that we have of this short lived society is in the form of a 16 page publication *Occasional Paper No. 1* of 1876 (Hayward, 2008), which was sent out with a folded nature print of three *Polystichum* varieties. The paper lists the officers and committee members of the society, predominately wealthy or professional individuals. Col. Jones had developed an interest in ferns after his return from India and was the secretary of this society, under whose auspices the first of the fern nature prints were produced. Rather ominously, the office of President of the society is listed as vacant and it appears that no one was willing to take on the responsibilities as the society folded shortly after that publication.

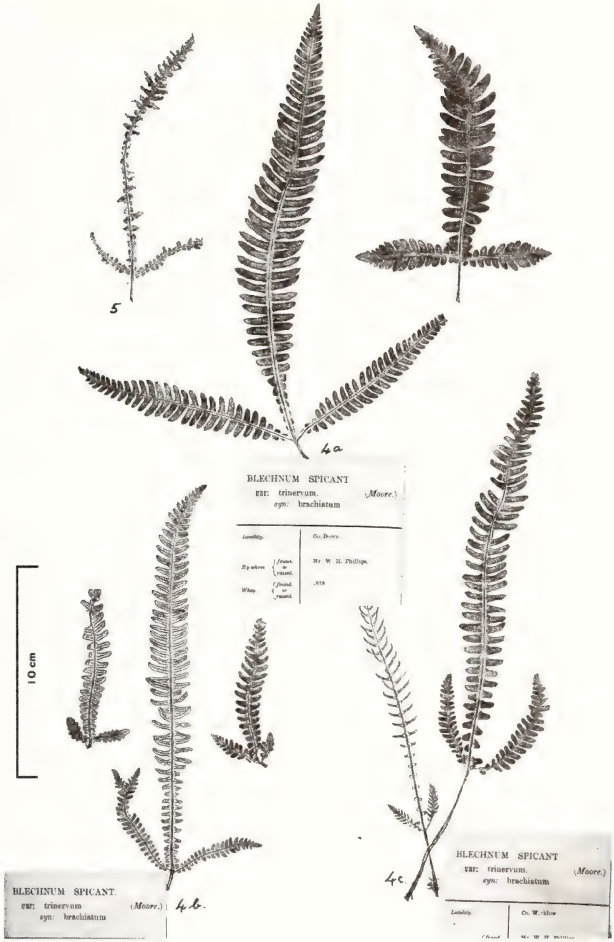
The original idea for producing fern nature prints was that of Rev. Charles Padley (1823-1887), an extremely wealthy bachelor who had inherited Bulwell Hall near Nottingham when his father died in 1856. He had no clerical responsibilities and had spent much of his life in Devon, studying ferns, and was regarded by his peers as the leading expert on the shield ferns (*Polystichums*). He sold the Bulwell estate in 1864 and moved to Beaconfield House, near Plymouth. He started to produce extravagant displays of ferns at flower shows. At the Devon and Exeter show of 1865 he shared a tent 200 ft. long with the Veitch nursery, filling one half of the tent with his ferns! By 1868 he had to sell Beaconfield house with all of its fittings, including his Rubens, Canellettos and other old masters, renting Cliffden House in Teignmouth for a while. He managed to spend or lose the whole of his inherited fortune and was forced to take up a clerical appointment in 1874 as Rector of Enville in Staffordshire. He was declared bankrupt in 1876.

Charles Padley had intended to write a book on *Polystichums*, illustrated with nature prints. He arranged for his young gardener, Thomas Smith (1844-1924) to go to London to be taught how to make them. We have records of Smith living in Teignmoth at the same time as Padley. When Padley was forced through his financial straits to give up this project, Col. Jones employed Smith for his own project. Smith moved to Clevedon Hall Lodge, then to an address in Henby Hill. After a short spell working in London (probably for a nursery) he retired to Westbury-on-Trym. Thomas Smith was responsible for the actual production of the prints at the start of Col. Jones project. Eventually he became too busy with his gardening work, so taught Col. Jones and his daughters how to make the prints. We do not know at what stage Smith dropped out of the project and cannot distinguish between prints made by Smith from those made by Jones or his daughters.

Thomas Smith had acquired Charles Padley's herbarium and this was passed on, through his nursery contacts, eventually to the present British Pteridological Society (BPS). Padley's herbarium sheets are now housed with the R.H.S. herbarium at Wisley (Ackers, 2008).
Although the production of a series of prints of the fern varieties was approved by the 1st BPS before its demise, it was solely due to the organisation and tenacity of Col. Jones that the project came to fruition, although it often fell behind schedule. Trial prints were made on a variety of paper. The issued prints are on a uniform thick wove paper with a sheet size of 470 x 285 mm (larger than A3). Jones requested that fern fronds be sent to him 'in the green'. They would have been briefly pressed, then inked on both sides with black printer's ink. The fronds were then arranged on one side of a large sheet of paper which was then folded in half to enclose the inked specimens. The paper was probably dampened. Pressure was then applied by rubbing all over by hand (not with a press, as was recently suggested). Each frond was used to produce a number of pairs of prints. When the ink was dry, the paper was split. There are no noticeable difference between the prints from the top and the under surface of the frond, even with fertile fronds, the sporangia showing on both halves, indicating that considerable pressure was applied during the rubbing. The prints sent to subscribers were labelled with a number at the bottom of the page which corresponded with the variety number on the text sheet which was sent with them. Subscribers were expected to be able to recognise the actual species.

Each series of prints was sent out with a memorandum sheet, which gave an overall view of the make-up of that series, and text sheets giving details of the individual varieties. A considerable amount of work must have gone into assembling this data and designing the sheets. The first series did not have a specific theme, but with the subsequent series Jones tried to show, with varying degrees of success, how a particular type of variety might affect the different species of ferns, even though comparing a Lady Fern variety with a Hart's Tongue variety is rather like comparing chalk with cheese.
The subscribers were charged 3/- per dozen prints. The prints were sent to subscribers unfolded in six series, from May 1876 to December 1880.

A section of one of Jones' text sheets is shown to illustrate the manner in which he set out the data that he had gathered about the ferns. Much of the information on these text sheets is not available elsewhere in the horticultural literature. As the project progressed, the information that Jones provided on the sheets steadily increased and the layout became increasingly convoluted but is a mine of information on these Victorian fern varieties.



The prints that Jones sent to his subscribers were labelled with a pencilled number at the bottom of the sheet which corresponded with the numbering of that variety on his text sheet. It was up to the recipients to complete the labelling. Some wrote the names of the varieties on the sheets, others cut up the text sheets and glued strips to their prints. With Series 6, Jones sent out a set of printed labels that had been prepared for subscribers by William Carbonell of Usk and some of the surviving sets have had these labels attached.

The individual prints are sometimes referred to by numbers that were ascribed to them when *Index Londinensis* was prepared at Kew. Carbonell had bound his set of prints, arranged by species rather than in the order in which they were issued, and this volume is in the library at Kew. Numbers were added to the pages at the time *Index Londinensis* was prepared, probably by Stapf. They are a convenient reference but are not Jones' own numbers *(Index Londinensis* is a comprehensive listing of all known botanical illustrations of flowers and ferns up to 1920). Carbonell had included 16 extra prints in his bound set which can cause confusion to the unwary. In all 12 surviving sets of prints have been traced, including the two in the BNS library, two at Kew, two in the Guildhall library, one at the Royal Botanic Gardens, Edinburgh and one at Leicester University. A small number of sets are in private hands.
In 1938, Col. Jones' daughter presented several thousand of her father's spare and unissued prints to the BPS. The last two of his spare sets are currently being collated and bound and the mass of unissued prints, some with the varietal names unknown, are being researched.

Col. Jones presented an extended set of his prints to the BNS sometime between his lectures to the Society in 1888 and his death in 1889. The prints are unlabelled, apart from his usual pencil mark in the centre of the bottom margin and are still in series order, each series being held in a flimsy paper wrapper. The memoranda sheets and text-block sheets are included with each series.

The Jones presentation set in the BNS library contains many more prints than were usually sent to subscribers. For example, Series I starts with 3 *Polypodiums* usually sent to subscribers on either 1 or 2 sheets. Here there are 6 sheets of the *Polypodiums*, the usual varieties but in multiple different combinations, 1, 2 or 3 to a sheet.

As well as including many alternate variants of his prints, Jones also includes a number of extra prints, not listed in the text-blocks, labelled 'Padley', 'Wills', 'Axminster', etc. and positioned adjacent to closest issued prints. All of the prints are in excellent condition. The set is still housed in the box in which they were delivered by Colonel Jones, a wooden box originally for 'KEEN'S MUSTARD'.

In addition to the presentation set, there is a bound set of the prints in the BNS library. This is cased in a black half calf and grey buckram Victorian binding. The prints have been bound with extensions to each sheet and the volume opens flat for examination, with a page size of 305 x 490 mm and an overall thickness of 60 mm.
There are two inscriptions in this volume, *'Edward T. Biggs'*, presumably an early owner of the volume, and *'Bristol Naturalists Society / Presented by Miss J. Shaw / May 1933'*.

No details of Edward T Biggs have been traced in either the BNS archives or the BPS archives. His signature is undated so he may not have been the original owner of the volume. Miss J. Shaw is also unidentified but a Miss T. Shaw was a temporary librarian of the BNS around this time, which may be relevant. The prints have been arranged by species, starting with the *Polystichums*. The text-blocks have been cut up and pasted onto sheets to form an index for the volume. All of the original text is included on these sheets. Memoranda sheets 2, 3, 5 & 6 are then included(1 & 4 missing), followed by the prints. No labels are pasted to the prints, the varietal names being written on the prints in black ink in a rounded Victorian script, uniform throughout the set. There is slight foxing of the first and last few prints of the set and along the upper margins but the set is in overall very pleasing condition.

Col. Jones set out to illustrate the most recently discovered varieties of ferns, particularly ones that his subscribers might not yet have had the opportunity to see. Many of the prints are of very attractive varieties but a significant proportion would now be considered as unremarkable and a few are quite freakish. The most represented species of fern illustrated in the series are the *Polystichums* (Shield Ferns) with 109 varieties, *Athyriums* (Lady Fern), 50 varieties and *Scolopendriums* (Hart's Tongue Ferns), 48 varieties. The origins of the collected varieties reflect the underlying distribution of the species, the *Polystichums* coming predominately from Devon, Dorset and Somerset. Only small numbers of ferns had been collected in Wales, Scotland and Ireland.75 of the varieties had been raised from spores by a small number of enthusiasts, including Col. Jones. A detailed technical description of the prints, their background, history and the surviving sets of prints will be found in the BPS publication, *The Jones Nature Prints and the Victorian Fern Cult* (in press, 2012) and an extended set of high resolution images of the prints in the BPS archive can be examined at www.jonesnatureprints.co.uk.

My grateful thanks are due to Jim Webster for showing me the prints in the BNS library.

References.....

Ackers, G, 2008 The British Pteridological Society's Herbarium. *Pteridologist*. 5 [1]:53-61

Hayward, M., 2008 Occasional Paper No 1 of the British Pteridological Society, 1875 (facsimile with introduction). *BPS Special Publication No 10.* London: BPS

Hayward, M., 2008 The First BPS, then and now. *Pteridologist* 5 [1]:51-52

Hayward, M,. (in press), *The Jones Nature Prints and the Victorian Fern Cult:* London: BPS

Jones, A. M., 1888 Varieties of ferns in the Bristol district. *Proc Bristol Nat. Soc. 5:216-228*

Jones, A. M., 1888 The crossing of ferns. *Proc Bristol Nat. Soc.* 5:339-354

Lowe, E. J., 1895 *Fern Growing, pp172-176,* London:John C. Nimmo

Stapf, O., 1929-31 *Index Londinensis.* Oxford, Clarendon Press

Whittingham, S., 2012 Fern Fever: The story of Pteridomania. London: Francis Lincoln

The Roper Memorial Epidiascope

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Introduction.

As a sequel to Harry Savory's slides, in September 2010 I was informed by the BNS secretary that an old epidiascope belonging to the BNS had been found. It was now in his possession and he wondered if it was possible to get it working again. After inspecting it I thought it should be possible, so on 7th September 2010 I collected the epidiascope and took it home with me for the purpose of renovating it.

Description.

The epidiascope consisted of the following items.

The main body of the unit contained 3 silver-coated reflectors, behind and to each side of the bulb, plus a silver-coated mirror located above the bulb. The bulb was quite large with an overall length of 127mm; 110vAC 500W with a screw fitting. There was a Bakelite connector at the back of the unit for the power supply cable which was connected internally to the bulb socket which was angled at 45^0. An old two-core twisted electric cable originally led from this external connection. The cable included a ceramic switch and would have been connected to a very primitive transformer located in the epidiascope's wooden storage box. At the front of the main body was a large lens with adjustable focus and a dust cap which would be used when the unit functions as an epidiascope.

A lever on the side of the unit moved one of the reflectors according to whether it's being used as an epidiascope or for projection of glass slides. A glass plate was located in the base of the unit covering a large square hole for when used as an epidiascope which would protect a book or paper from the heat generated by the bulb.

At the front there was also provision to install the lens for projection of slides on to a tube below the epidiascope lens and locate the wooden slide holder. One side of the unit contained a fairly large door which acted as an access panel to the bulb and reflectors. On that panel were two brass plates stating that it was a "Wigmore" epidiascope, model "W", record number 4882, manufactured by Newton & Co, London W1. A card label was attached to the knob which opens the access panel, providing advice on how to keep the mirror clean. Ventilation was by convection and the large square hole in the top was shielded by a curved plate located on 4 pillars one inch above the top of the unit. The back was fitted with a convenient handle and an earth point.

A metal base frame, on which the main unit would be placed, contained a platform which would hold a document that could be raised up to the square hole in the base of the main unit when used as an epidiascope. A lever raises and lowers the platform.
A lens that can be attached to the front of the main unit by a push fit on to the front tube. The lens had a small brass lever for adjusting the focus. The lens itself was screwed to a four inch diameter tube which provided the push fit on to the front tube of the main unit. The lens also had a dust cap.
A small lens and microscope slide holder which could be used separately as a microscope or could be screwed to the lens adaptor tube for projection of microscope slides. This item also contained provision for adjusting the focus.
A wooden holder for the $3^1/_4$ inch glass slides when used for projection. This fitted into a slot behind the tube which held the lens at the front of the main unit. It was capable of holding two slides so that a slide could be changed while the other was projected, thereby maintaining continuity of the slide show.

Everything was stored in a large wooden box which measures $27^1/_4$ inches long by 19 inches high and 19 inches wide. The box alone weighed 14kg (31lb) and the total weight amounted to 22kg (49lb). The box contained a rather primitive form of transformer which consisted of what looked like a multitude of heater elements (coiled wires) located in asbestos blocks. At the top of this assembly was a plate indicating input voltages ranging from 200 to 250 volts AC and the bulb voltage of 100 / 110 / C. (C = common, ie the blue return wire). The whole assembly was held in a stiff wire mesh allowing for ventilation as it radiated heat when power was applied.
There was also an envelope contained the Roper memorial name plate, several rusty wood screws were lying at the bottom of the box and a few staples that were probably used to secure the power cable to the box. There was also a broken key which might have been for securing the lid of the box. The top surface of the box was rather messy and seemed to have been used as a work table and splashed with white paint.

Condition & Work done.
With the epidiascope at home my initial reaction was that it was in rather good condition considering its age and long period of storage.
The mirror and the three reflectors were in good condition and only required a gentle wipe with a camera lens cloth. The condenser surfaces behind the position where the wooden slide changer was located and both surfaces of the epidiascope lens were carefully cleaned and appeared to be in good order. It was noted that a small brass part was missing from the lever for adjusting the focus of the epidiascope lens.

Obviously it had been mislaid many years ago and its loss does not significantly affect its operation The bulb (110v 500W) was inspected and it appeared to be capable of working. I was unable to test it at the time as it required 110 volts.

A nut was missing from one of the support screws that secured the ventilation cover, so was replaced. Minor damage to the paintwork of the epidiascope body was touched up with matt black paint. The glass plate at the base of the unit, which would protect projected literature from internal heat from the bulb, only required a good wash. However, when handling the epidiascope assembly, care needed to be taken as there was nothing to stop that glass from sliding out from one side, so that was made secure.

The external wiring was totally unsuitable for further use as it consisted of the old brown cotton covered wire, so was replaced with modern mains cable. The internal wiring was coated with a heat resistant material and appeared to be OK. However, a heat resisting sleeve was added to those two wires for additional safety.

The base unit for the epidiascope worked perfectly and only required a good clean. The parts that permitted focus of the slide projection lens were found to be seized. After freeing the seized parts the slide projection lens was dismantled in order to clean the brass tube. On doing so I discovered that a lock nut was rattling about inside the tube between the front and rear lenses, so was relocated. The nut had obviously been free floating for a long time as it had chipped away the matt black paint inside the tube, so the inside of the lens tube was repainted matt black with blackboard paint. The outer brass surface was polished, together with the inner surface of its mating part. Both lenses were thoroughly cleaned and the whole projection lens finally reassembled. The large diameter tube for attaching the lens to the epidiascope unit required no attention other than a wipe over to remove dust. The microscope unit required little attention beyond cleaning its lenses. The microscope unit could also be fitted to the tube and installed to project microscope slides.

The Roper Memorial name plate was polished so it became much easier to read and was reattached to the front of the box. The top of the box was rather messy so it was sandpapered clean and repainted to match the sides.

The device located in the wooden box, which was originally used to change the mains voltage to a voltage suitable for the projector bulb (110v), consisted of a series of wire coils rather like thick electric fire elements. It provided a range of input voltages between 200v to 250v with an output voltage of 110v and was assembled in thick blocks of asbestos. The whole unit was covered with an open wire mesh. With regard to today's emphasis on health and safety regulations it was considered unwise to use this item. When tested it radiated a colossal amount of heat, as expected, thereby confirming my opinion that it would not be safe to use again.

Clearly a modern transformer would be required to get the epidiascope working again. The next step was to investigate the availability of a suitable power supply that would convert the mains 240v to110v with a power output sufficient to power the 500W bulb. From the Internet it was found that several units were available costing in the region of £100. However, I eventually managed to acquire a step-down voltage converter. 240v – 110v 800W for £50. This unit had been manufactured so that electrical items made in the USA, requiring 110v, could be used in the UK. Consequently it was also necessary to obtain a UK to USA 3 pin plug adaptor, which was easier to find than a USA 3 pin plug. This unit is also fairly heavy at 8kg (18lb).

Test Results.

When refurbishment of the epidiascope was complete it was set up in my garage for a test run to verify that the bulb still worked. With the modern new transformer and a borrowed $3^1/_4$ inch glass slide, I successfully projected it on to the screen thereby proving that it was back in full working order.

Clearly the epidiascope did not match the quality achieved with a digital projector but in a really dark room the result was quite good. Should anything happen to the bulb, however, it is no longer possible to obtain a replacement, as bulbs with tungsten filaments are no longer manufactured. After scouring the internet on several occasions, the old stocks of tungsten filament bulbs being sold off were either not powerful enough (less than 500W) or much too large to fit inside the epidiascope. Should the old bulb fail then it would be possible to change the existing screw fitting for the bulb and replace it with a fitting for a modern projector bulb, but it would also be necessary to provide a cooling fan for the new type of bulb. While the internal parts would not be entirely original, externally it would still be the same.

Before the epidiascope could be used for a public presentation it would be necessary to obtain a certificate verifying that it is electrically safe.

Miss Ida Roper.

From the BNS Proceedings it was discovered that Miss Ida Roper died on June 8th 1935 and that money had been collected for the Ida Roper Memorial Fund. The following year a sub-committee reported "As a memorial to Miss Ida Roper an Epidiascope has been purchased, and an addition is being made to the library". At the AGM in 1938 the retiring President, Mr G.E.J. McMurtrie, presented it to the Society. She was President of the Society in 1913 and served as Secretary and Editor during the years 1916 to 1935.

The Roper Memorial Epidiascope was part of the static display at the Society's 150th Anniversary Exhibition on April 14th 2012 and attracted a lot of attention.

References.

E-mail from Roger Symes 17 Sept 2010 "Data concerning Miss Ida Roper"

BNS Proceedings for 1936 and 1938

Harry Savory's glass slides.

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Introduction.

I visited the Library of the Bristol Naturalists in January 2009 to accompany my wife Pam whose turn it was to be on duty. To pass the time I looked at what the library had to offer and discovered some interesting small wooden boxes. It was their shape that attracted attention as they were long and narrow. I couldn't resist the temptation to open one of them to see what it contained and was surprised to find that it was full of $3^{1}/_{4}$ inch square glass slides. Together with the wooden boxes were many more cardboard ones, each with an interesting title such as "Lundy 1934" and "Birdlife in Holland". Most of the slides were photographs of birds taken by Harry Savory. I asked Pam if she knew anything about these slides and she informed me that they had been there for some time and that the library committee didn't really know what to do with them. As archive material they were heavy and took up a lot of space. My immediate reaction was to suggest that they should be scanned and recorded on CD before considering disposal. Thus the slides could be seen by anyone interested via a digital projector, particularly as a lantern slide projector was not available. To prove that it could be done I took the liberty of borrowing a small selection of the slides to take home. These I scanned and transferred to a CD, which Pam later presented to the library committee with my suggestion that they should all be scanned. The library committee approved the proposal and I was authorised to take the slides home for scanning. It required two trips to transport two very heavy cases full of the boxed slides.

Scanning procedure.
An Epson flatbed scanner was used with a cardboard mask, which was used to position the slides correctly in the centre of the scanner. Prior to scanning each glass slide required cleaning, as best I could, to remove fungus and fingerprints together with a greasy layer, which from its smell I suspect originated from tobacco smoke. Some slides were in rather poor condition due to moisture and fungal growth between the cover glass and a few were cracked. Many of the Lundy slides were not individually identified so they were grouped as found in their boxes. Where explanatory details were provided, such as location and date, these were recorded verbatim. Several of the slides were clearly marked for cropping (oval or circular) so they were scanned as found. There was much duplication.

Each slide took more than 5 minutes to complete, (prepare / scan / identify), so it took about 2 hours to cover a pack of 15. Each slide was scanned at 200dpi to maximise the number of slides that could be recorded on a CD and to keep the scanning time to a reasonable duration. In retrospect a DVD would have been a more appropriate recording material but I just didn't think of it at the time; however that could still be arranged. Among the slides were a few half plate negatives and some very old photo prints, all of which were scanned. The photograph of Harry Savory with his Goshawk was from one of the glass negatives. The total number of slides scanned was 1004, which amounted to at least 140 hours scanning time plus arranging and copying to a flash drive for a preview and finally to 4 CD's. The scanning was finally completed at the end of May 2009. The majority of the glass slides were from the collection by J.H. Savory. However, the collection also included slides from photographs by R.P. Gait, P.H. James and a person with the initials MLD, who was later identified as Mabel L. Davis. The oldest slide that was scanned was dated 1906 and the oldest photograph dated 1898. The copyright slides indicated that Harry Savory had received the required permission to photograph them. The most awkward part of the job was transporting the very heavy boxes of slides from the library to home and back.

Harry Savory.

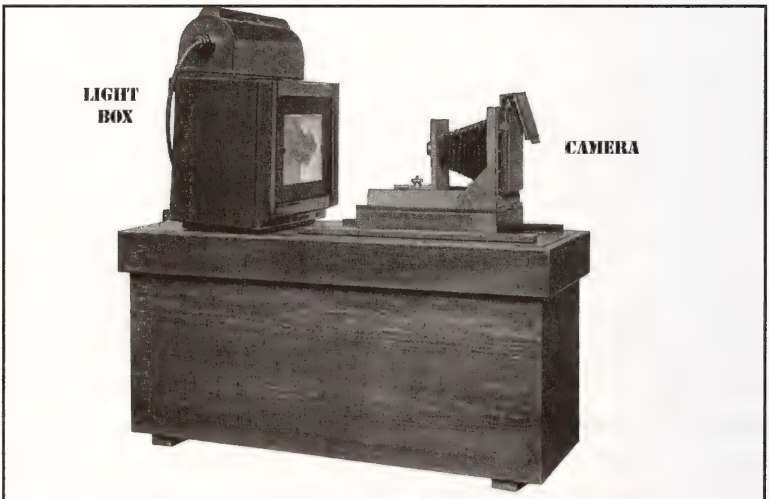
Harry Savory joined the Bristol Naturalists Society in 1914 but became otherwise engaged with World War One. He didn't rejoin the Society until 1931 and began a long and valuable association with the ornithology section for which he was President for many years. He was Vice President of the parent society on two occasions and President during the years 1954 and 1955. He represented the Society on the foundation of the Steep Holm Trust for which he was both secretary and chairman. He was also largely instrumental in the formation of a junior section of the Society and was elected as an honorary member of the Society in 1962. He was a keen supporter of the Lundy Field Society and joined the Wildfowl Trust soon after its inception; he was also a founder member of the newly formed Gloucester Trust for Nature Conservation. The exploration of Mendip caves was one of his earlier pursuits and he became a pioneer of cave photography. He then took up Falconry and bird photography, with several visits to Lundy and the island of Texel in Holland. When he died on June 25th 1962 the society lost a great personality and loyal supporter.

Method of producing a glass slide.

As a keen photographer I was interested to know what equipment Harry Savory used. My first impression was that the slides had been produced from a plate camera. I used one myself many years ago. However, it dawned on me that there was not a plate camera that used $3^1/_4$ inch square plates. The smallest was quarter plate which measured $3^1/_4$ x $4^1/_4$ inches. Furthermore the camera would have produced them as negatives rather than positives. Following that realization I did a bit of research from some of my old photography books dating back to 1949. From one of them I discovered how lantern slides were actually produced.

Glass lantern slides came in three sizes but the most popular British size was $3^1/_4$ inches square. The slide consisted of a thin glass plate coated on one side with a bromide or chloride emulsion, specially made for positive lantern slides. It was understood that Harry Savory's camera was probably whole plate (ie it used $6^1/_2$ x $8^1/_2$ inch glass plates) with a rising front and swinging back, possibly also with an f6.4 lens with a velvet cap as shutter. So what puzzled me most was how he transferred the original picture from the whole plate negative, such that it could be contained on a $3^1/_4$ inch square positive lantern slide.

So I reasoned that to produce the lantern slide a method of reduction was required, as a contact print was clearly out of the question. I then discovered that lantern slides could be made from glass negatives which were not the same size as the glass lantern slides. This could be achieved by either projection printing, which involved a rather complicated set-up and a lens of short focal length, or by the reduction method using his whole plate camera. The latter would be much simpler and is illustrated in the following diagram.



EQUIPMENT FOR MAKING GLASS SLIDES BY REDUCTION.

The whole plate negative was illuminated in the light-box on the left (known as an Ilford Number 4 Lamp House). Thus when making his lantern slides, using his whole plate camera, it would be an easy matter to make a carrier for the $3^1/_4$ inch lantern slide. This carrier could be made from thin cardboard for use in a single metal plate holder. Attached to the back of the camera the lantern slide was then exposed for the required duration via the camera lens. After exposure, the slide was developed and fixed resulting in a positive image of the illuminated negative. When dry it was mounted between two glass cover plates with the edges sealed with adhesive tape. Any form of masking required was also contained within the cover plates. A white marker was placed on the appropriate outer surface to indicate the viewing side. I suspect that this was the most likely method adopted by Harry Savory for producing his lantern slides, as it was certainly the easiest and he had several identical copies as spares.

Arrangement of slides on CD's

CD. 1.	**SIZE. Meg**	**No. of Pictures**
LUNDY. 1950.	609	132

CD. 2.	**SIZE. Meg**	**No. of Pictures**
LUNDY. 1934.	277.0	211
LUNDY. (By P.H. James).	37.4	11
STEEPHOLM.	38.4	12
SCILLIES.	87.3	33
PEMBROKE ISLANDS.	29.5	9
RIVER AVON & LOCAL.	65.0	23
SOMERSET & EXMOOR.	18.3	26
SEVERN.	57.4	19
NEW GROUNDS. (Slimbridge).	18.6	29

CD. 3.	SIZE. Meg	No. of Pictures
BIRDS. (Boxes D-E-F).	74.0	96
BIRD HABITATS.	67.5	26
BIRDLIFE IN HOLLAND. (Boxes 2 & 3).	96.8	111
PLACES & PEOPLE IN HOLLAND.	13.6	19
ASSORTMENT IN LEATHER BOX.	33.0	43
BIRD LEGENDS.	120.0	12
BIRD LORE.	227.0	59
ANCIENT BRITAIN.	46.5	18

CD. 4.	SIZE. Meg	No. of Pictures
COPYRIGHT.	403.0	49
THORBURN.	25.3	23
PRESENTATION NOTES.	6.2	6
BLACK & WHITE PRINTS.	24.7	7
SEPIA PRINTS.	7.6	2
DOCUMENT – COLOURING SLIDES.	7.3	6
MISCELLANEOUS. (From illustrations).	32.1	12
HALF PLATE NEGATIVES.	29.4	9

Slides related to caving.

The boxes of Harry Savory's slides contained many that were associated with his caving activities. As these were considered to be unrelated to natural history and more appropriate to a caving club, it was decided not to scan them. Recently that decision was reversed, so I was authorised to scan the remaining slides related to caving for addition to the library archives.

Wells museum and the University of Bristol Speleological Society were understood to hold many of Harry Savory's slides and negatives relating to his caving activities. Harry Savory's son, John, edited a book from many of his photographs, entitled "A man Deep in Mendip - The Caving Diaries of Harry Savory 1910-1021" in 1989, a copy of which was in the BNS Library. From that book it was discovered that, as well as the whole plate camera, Harry must also have possessed a half plate camera, as both are recorded as being used in the Mendip caves.

References.

"The Ilford manual of Photography" 4th Edition 1949.
"BNS Proceedings Volume 1962" Harry Savory obituary.
"e-mail from Roger Symes". 18-6-2009 Details of Harry's camera.
"A Man Deep in Mendip – The Caving Diaries of Harry Savory1910-1921" Edited by John Savory 1989.

Plant reactions to temperature change; a ten year study on Clifton Down 2002-2011

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Phenology, the science of when things happen, was created by Rev. Gilbert White whose "Nature's Calendar", published as part of his Letters, gives the earliest flowering date of plants in his parish of Selborne over the twenty years 1760-1780. At Marlborough Rev. Thomas Preston published a more thorough twenty year study, 1865-1885, giving the annual first flowering date for all plant species in the area, and calculating the average, together with detailed weather records. The Royal Meteorological Society became interested and in 1875 he became the national organiser of their phenological endeavours, which continued until 1947. Unhappily there was a failure to appreciate how the material could be analysed, or the fact that mean maximum temperatures in Britain increased by one degree centigrade between 1900 and 1947, and phenology was abandoned in that year. Concern about the impact of human activity on climate in the 1990s, partly created by a switch from a cooling climate since 1950 to a warming one today, led to an upsurge of national interest led by the Woodland Trust.

I had, since 1994, done a standard weekly transect through ST5673, in Clifton, counting birds. The walk starts at the southern edge of ST5673 below the Suspension Bridge, and follows the edge of the Avon Gorge up to just below the Peregrine Watch point at the northern edge of the square. In 2002 I began to record systematically the first flowering of plants, and other phenomena such as bud break in trees, the ripening of fruit, and leaf fall. I did not record grasses. The use of a standard walk every week by the same person eliminated a very large number of the variables that otherwise affect the value of many phenological studies.

My object was simple, to discover what was the "normal" date at which species came into flower on the Downs in the early 21st century. Although there was a great deal of botanical data for the region, and indeed the Downs, there were only very general statements about the dates when species came into flower, and none at all on the normal duration of flowering. Although I thought I knew my standard route well, I soon found that for accuracy it was essential to know both when and where to look for each species, and I discovered new species on the route every year of the study. I also found successively more species and Table 1 shows the total number of species monitored in each year.

2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
110	163	179	199	193	216	216	215	218	229

Table 1. Total number of species recorded

There were also changes in the number of species that flowered or were present from year to year, but there were 163 for which I have nine or more years of data.

I have correlated the data with local weather records, for which I used the Long Ashton Research Station records from 1920-2002, and the Bristol weather station at Totterdown subsequently. I have used daily maximum figures rather than the more usual daily mean. I have also compiled records back to 1853 when GF Burder began his study of rainfall in Clifton, published in our proceedings, and calculated thirty year rolling averages which run from 1880 to the present. A thirty year average is the usual definition of climate, and of course such an average is always changing. Whether this change is cyclic, and over what time-span, and how it fits in to the much longer term cycles of glaciation and inter-glacial periods is a matter of urgent debate and study at the present.

Our climate clearly controls our flora, and hence in large degree our fauna, and it is thus important to have a clear understanding of how each of our native plant species reacts to temperature change. Gardeners and farmers have long had a detailed understanding of this in terms of the species that they cultivate, but there is little detailed research into the impact of change on the wild flora, although there is a recognition that this is itself changing fast influenced by such factors as acid rain, the rapid invasion by new or garden species, large-scale drainage projects, and diseases. I have given charts of the thirty year maximum for winter (December to February) and for March, April, May and June assuming that first flowering dates in April, May, June and July will be mainly influenced by the temperature of the previous month. Each chart covering the same time and temperature span.

During the decade the two coldest years, 2008 and 2010, were warmer than the 150 year average. The hottest, 2011, was second only to 1921, and 2003 was the fifth warmest year since 1853. On average the winters were closest to the long term norm, but 2001-2, 2006-7 and 2007-8 were exceptionally warm, and 2009-10 was exceptionally cold. The run of three cold winters starting in 2008-9 ended a spell of warm winter dating back to 1995-6. Spring 2011 was the second warmest since 1853, second to 1893, because it included the warmest April since 1853, but 2003, 2007, and 2009 were also exceptionally warm springs. In sharp contrast 2005, 2006 and 2008 were cold springs, though all were warmer than the spring temperatures throughout the 1960s and 1970s. The decade was thus one of great variation in temperature, and thus provided an excellent opportunity to study plant reaction to temperature change.

Plant activity is controlled by three main factors, water, light and temperature. In Bristol there is almost always sufficient rainfall. Since 1853 there have only been two occasions when there has been a month without rain, in April 1854 and September 1865. The least annual rainfall was in 1864 when there was just under 600mm. But prolonged dry weather in summer can force flowers to abandon flowering and produce seed, and can lead to early leaf loss in trees.

Light powers plant activity, and the difference between mid-summer and mid-winter light levels is about 90%. Daylight hours halve from 16 hours to eight, but the sun's maximum angle reduces from 75° at noon to 30°, sharply reducing the radiation per square metre. Added to that direct sunlight from a cloudless sky averages around four hours a day, just a third of average daylight hours. It is the variation in light levels that creates the seasonal pattern of activity rather than the pattern of temperature.

Temperature merely controls the speed of chemical reactions in the plant. However warm winter temperatures are, the low light levels ensure that only those plants that are exceptionally shade tolerant can continue to grow. Such plants vary very considerably in the date of first flowering, and react strongly to temperature.

The analysis of first flowering dates is split into five groups, the first being Spring flowers, that come into flower in the first three months of the year, and then species that come into flower, on average, in each of the subsequent four months, April, May, June and July. This ensures that the changes in temperature that each species responds to are related to the first flowering date. All dates are given as days after January 1st, which is Day 1

Spring flowers. Table 2 lists 14 species whose average first flowering date is before April 1st. It is arranged by average first date, given in days after January1st. It shows the full range of first dates during the decade, and this is compared with the range in average maximum winter temperature for December to February, which varied by 3.4°C between 5.7°C and 9.1°C.

	Avg	Range	Days/degree
Hazel	19	30	9
Celandine	41	84	25
Barren Strawberry	50	83	24
Alexanders	50	91	27
Yew	58	88	26
Cherry Plum	61	51	15
Wych Elm	63	44	13
Sweet Violet	70	33	10
Wallflower	75	73	21
Blackthorn	77	39	11
Ash	85	19	6
Forget-me-not	86	60	18
Wild Cherry	89	25	7
Hornbeam	90	24	7
Average	65	53	16

Table 2 Spring flowers, average first date, range and reaction to temperature, 2002-2011

The third column shows how much each individual species reacts to the amount of temperature change. It is remarkable that the average range for the 14 species is 53 days, or just over seven weeks, and this is a reaction of over two weeks to a change of one degree in temperature. Ash reacts least, Alexanders the most. It is perhaps important also to stress that there has been no trend change over the decade, just early years and late years. Should there be any permanent shift in the 30-year average winter temperature the plant response ought to be easily measurable.

The thirty-year winter average has been between 7.5°C and 8.0°C since 1920, but it did increase quite sharply by a whole degree from 6.5°C to 7.5°C between 1880 and 1920.

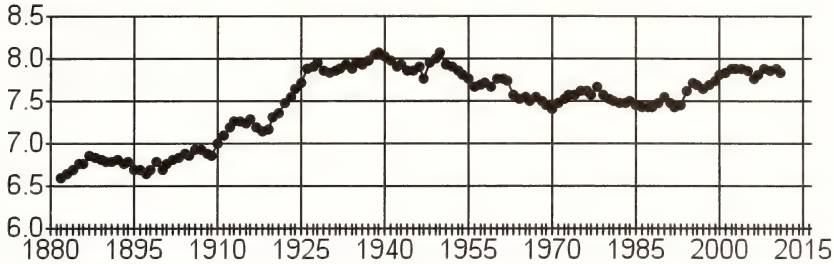

Chart 1 Thirty year rolling winter average temperature 1880-2011

April Flowers

Table 3 list 17 species whose average first date lies within April, from day 90 to day 120. It again illustrates a huge variation in the range for each species, from a minimum of 19 days for Silver Birch to a maximum of 101 for the Rock Rose. March average maximum temperatures, which will have a significant influence on April dates, ranged between 8.5°C and 13.2°C, a total of 4.7°C degrees, and the last column shows how each species reacted to this in terms of days change per degree. Most species lie between six and eight days to a degree, and it is only Cow Parsley, Smooth Sowthistle, Rock Rose and Wood Avens which have substantially greater response. They bring the average range up to 43 days, and the days per degree up to nine.

	av	Range	Days/degree
Cowslip	91	28	6
Hornbeam	92	32	7
Honesty	93	36	8
Bluebell	95	27	6
Silver Birch	97	19	4
Cow Parsley	98	89	19
Cuckoo Flower	102	27	6
Herb Robert	104	36	8
Sycamore	104	18	4
Horse Chestnut	107	32	7
Garlic Mustard	109	26	6
Hawthorn	111	33	7
Smooth Sowthistle	112	67	14
Wayfaring Tree	112	31	7
Holly	115	32	7
Rock Rose	115	101	21
Wood Avens	117	93	20
April average	104	43	9

Table 3April flowers, Average first date, range and days/degree 2002-2011

The thirty year Bristol average temperature for March was 8.5°C in 1890 and rose steadily by two whole degrees to 10.5°C by 1950, but then fell by a degree to 1987, before rising back to 10.5°C by 2011. Between 2002 and 2011 the 30-year average rose from 10.1°C to 10.4°C. However a decade is too short a period to discern any trend in first-flowering dates.

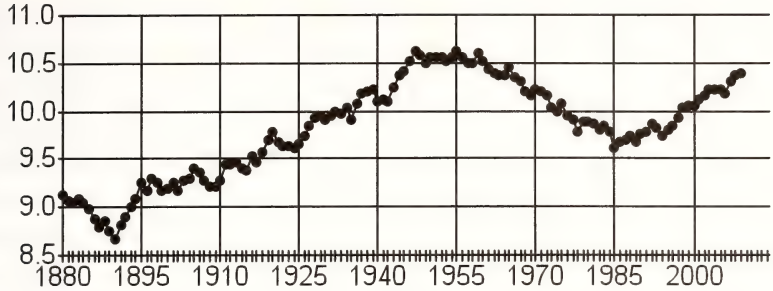

Chart 2 Thirty year rolling average March temperature 1880-2011

May flowers

Surprisingly there only ten species for which I have a full ten years worth of data during May. They show much greater consistency in the range, though it is still close to a full four weeks, and thus an average of close to four days per degree in reaction to temperature change in April. This may in part relate to the fact that six of them are shrubby perennials.

	Avg	Range	Day/degree
	Date	Days	Days
Ox-eye Daisy	121	30	4.7
Rosy Garlic	123	22	3.4
Whitebeam	127	20	3.1
Elder	132	31	4.8
Spindle	134	28	4.4
Hogweed	138	27	4.2
Blackberry	144	22	3.4
Dog Rose	144	33	5.2
Ragwort	146	27	4.2
Wild Privet	149	26	4.1
May avg	136	27	4.2

Table 4 May Flowers, average first date, date range and days/degree 2002-11

The thirty year pattern of April temperature in Bristol is very different to that of March In 1880 the 30-year average was 13.3°C, and this fell steadily to 1930 when it reached 12.0°C. It then rose spectacularly by 1.5°C to 13.5°C in 1962. There was then an abrupt fall to 12.4°C in 1994, before a rise to 13.2°C in 2011. This latter change was driven by two extraordinary years, 2007 and 2011 which had April temperatures of 17.4°C and 18.7°C respectively (breaking the previous 1893 record), compared with the 150 year average of 12.8°C. Over the decade of this study the thirty-year average rose from 12.4°C to 13.2°C. Both the two hot Aprils had a huge impact on subsequent first flowering dates, not just in May but in June as well. It is interesting to note however that the 30-year average April temperature is still below what it was in the 1960s.

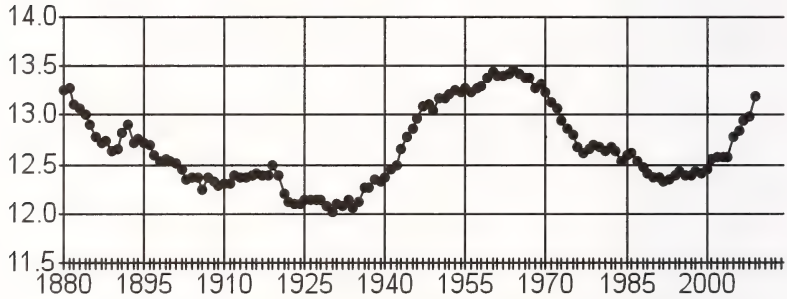

Chart 3 Thirty year rolling average of April temperature 1880-2011

June Flowers

Table 5 list the average first dates of 24 species that on average come into flower in June between day 150 and day 180. The range in dates is still wide, varying between twelve days for Common Lime and 52 for White Stonecrop, and an overall average range of 27 days, the same as May. May temperatures have varied much less that April ones, by 2.6 degrees between 15.3°C and 17.9°C. Thus the average change in days per degree is eleven days.

The thirty year May temperature average is again different, falling from 1880 to 1900 when it was 15.7°C, then rising by almost a degree to 16.5°C in 1920, staying at that level right through to 1965, then falling back to 15.8°C in 1996, and then rising steadily to 16.3°C in 2011. During the study decade it rose from 16.0°C to 16.3°C, and there is slight evidence of a trend to an earlier date in the annual average for the 24 species, but it will need another decade of data to be certain.

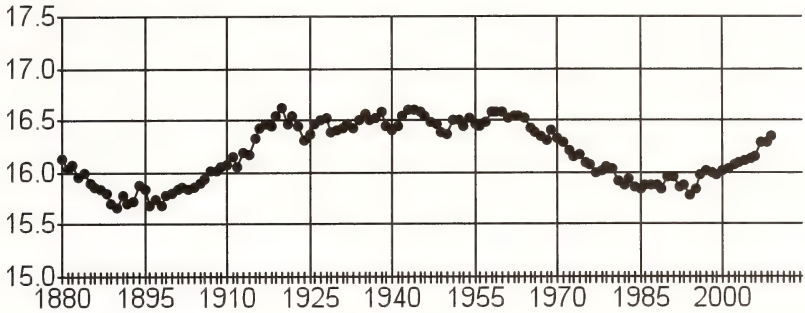

Chart 4 thirty year rolling average May temperature 1880-2011

	Avg	Range	Day/degree
	Date	Days	
Dogwood	151	34	13
Nipplewort	152	45	17
Thyme	153	54	21
Wall Lettuce	154	35	13
Dropwort	162	31	12
White Stonecrop	163	52	20
Parsley	165	28	11
Ladies Bedstraw	166	17	7
Prickly Lettuce	167	18	7
Spiked Speedwell	167	12	5
Enchanters Nightshade	168	24	9
Vervain	168	17	7
Common Lime	169	12	5
Self Heal	169	25	10

	Avg	Range	Day/degree
Madder	170	21	8
Field Convolvulus	171	14	5
Gladdon	171	16	6
Marjoram	171	28	11
Rose Bay Willowherb	172	18	7
Great Knapweed	174	44	17
Wood Sage	175	16	6
Spear Thistle	176	29	11
Harebell	179	41	16
Hedge Parsley	179	27	10
June average	167	27	11

Table 5 June Flowers, average first date, date range and days/degree 2002-11

July Flowers

Table 6 lists nine species that come into bloom during July, between day 180 and day 210. The range averages 31 days, very similar to May and June, but the days per degree is a lower figure than for June at seven. Ploughman's Spikenard is both uncommon, and seems to be very variable in date, and the range average would reduce to 28 days if it were omitted. Old Mans Beard is the most consistent.

	Avg	Range	Day/degree
	Date	Days	
Bristly Oxtongue	180	36	8
Common Knapweed	186	39	9
Hemp Agrimony	187	18	4
Old Mans Beard	187	15	3
Red Bartsia	187	40	9
Fennel	192	27	6
Burnet Saxifrage	195	20	5
Goldenrod	202	26	6
Ploughman's spikenard	202	61	14
July average	191	31	7

June temperature during the study decade varied from 17.6°C to 21.9°C, 4.3°C degrees. 2002 was particularly cold and 2010 the warmest, which was surprising in a year that otherwise was the coldest of the decade. Unlike the pattern of substantial change in the thirty year temperature pattern, June was close to 19.5°C more or less continually from 1880-1970, though there was a half degree dip between 1915 and 1929, and a recovery to 1940. However between 1960 and 2000 the average fell by a full degree from 19.7°C to 18.7°C. Between 2002 and 2011 the average increased from 18.8°C to 19.2°C, almost half a degree, and the average first flowering date of eight of the species (omitting Ploughman's Spikenard) appeared to be on a falling trend, though more data will be needed to confirm this. June temperatures are still lower than they were in the 1960s.

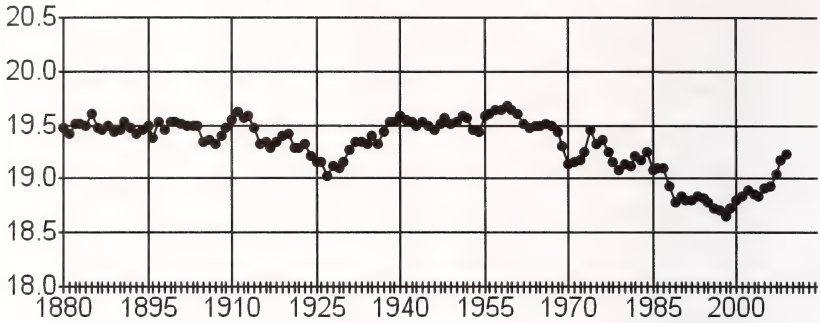

Chart 5 Thirty year rolling average June temperature 1880-2011

Summary

Table 6 summarises the averages for each monthly group. There is data for 74 species. The range of dates averages 36 days, though is greater in the first four months of the year than during May, June and July. Overall the evidence suggests that species react by a nine day change to a single degree change in the temperature. Over the past 150 years the rolling average temperature has altered by maximum of 1.5°C on a cyclic basis and this would imply that average flowering dates may have altered by two weeks

At present temperatures are increasing after a period of cooling in the second half of the twentieth century and are close to the previous maximum in the 1950s, though individual seasons and months show markedly differing patterns of change. It is odd that the previous period of rapid increase in temperature from around 1900 to around 1950, when the Meteorological Office actually ran a national phenology scheme that it was not recognised that this was affecting plants and other wildlife.

	Species	Av date	Range	Days/degree
	No.	Date	Days	Days
Spring	14	65	53	14
April	17	104	43	9
May	10	136	27	4
June	24	167	27	11
July	9	191	31	7
Average	74	133	36	9

Table 6 A summary of the first flowering dates for 74 species, 2002-2011

Duration of flowering

First flowering date is not the only effect that temperature has. It also affects the duration of total flowering time for each species. Rainfall also has a significant impact on duration. A dry spell will bring flowering rapidly to an end while warm and wet weather will enable many species to continue flowering long into the autumn, and some into winter. Duration of flowering will have an impact on total seed production. This will presumably have an impact on the structure of annual plant populations, though perennials are likely to change less, at least in the short term.

Duration of flowering varies from year to year. The average flowering duration for 145 species for which I have ten years of observation varied from a maximum of 18.2 weeks in 2011 to a minimum of 13.8weeks, in 2003, ie a full months difference, and an average of 15.6 weeks.

Individual species have a far greater range over the years. The smallest was Horse Chestnut whose range was just a single week, the shortest duration being five weeks, the longest six. The largest was Ox-eye Daisy with a 38 week range from 47 weeks to nine weeks. Because each species reacts in its own way to temperature, there is no simple correlation with annual temperature.

Second Flowering.

Second flowering is another uncommon reaction to temperature. It can occur in new young annual plants, stimulated into flower by high temperatures, in trees and perennial shrubs, and in plants whose normal flowering was cut short by mowing or drought. In the early days of the survey I failed to recognise its significance, and probably under-recorded it.

Table 7 lists 22 species that have, since 2007, been recorded in flower for a second time. They start at any time after week 30 (July 23rd) but average week 41 (Oct 8th), and second flowering can occur as late as Dec 21st. Sometimes the duration of this flowering is for as little as two weeks, but the average duration is six weeks. Some of the plants are new young plants, but eight are shrubby perennials. There is a rough correlation with autumn temperature, and the extraordinary autumn heat wave of 2011 stimulated the greatest number of second flowering weeks. This process is affected by the rainfall as well as the temperature, but, like over-wintering below, is likely to increase if average temperatures do.

Species	Years	Total weeks	Weeks/year
Bramble	1	13	13
Honesty	1	13	13
Oxford Ragwort	4	51	12
Holly	4	40	10
Tutsan	3	25	8
Dogwood	4	29	7
Golden Rod	1	7	7
Privet	3	21	7
Alexanders	3	17	6
Corn Salad	3	19	6
Ox-eye Daisy	1	6	6

Species	Years	Total weeks	Weeks/year
Wood Sage	3	17	6
Hogweed	3	14	5
Rock Rose	3	15	5
Salad Burnet	1	5	5
Snapdragon	3	16	5
Wall Lettuce	1	4	4
Elder	2	6	3
Ivy Broomrape	2	6	3
Thyme	1	3	3
Wallflower	2	6	3
Dog Rose	4	9	2

Table 7 Species recorded with a second flowering period 2007-11

Summary

Table 8 shows on an annual basis the total number of species, the total of weeks and the autumn mean maximum temperature (Sept-Nov).

	Species	Weeks	Autumn Temp
	No.	Total	C
2007	10	48	14.9
2008	6	43	13.6
2009	13	73	15.4
2010	8	53	14.2
2011	12	90	16.8

Table 8 Annual analysis of species with a second flowering period 2007-11

Over-wintering

Over the ten years there has never been a week in which no species were in flower. Graph 1 shows the maximum, average and minimum number of species recorded each week 2002-2011

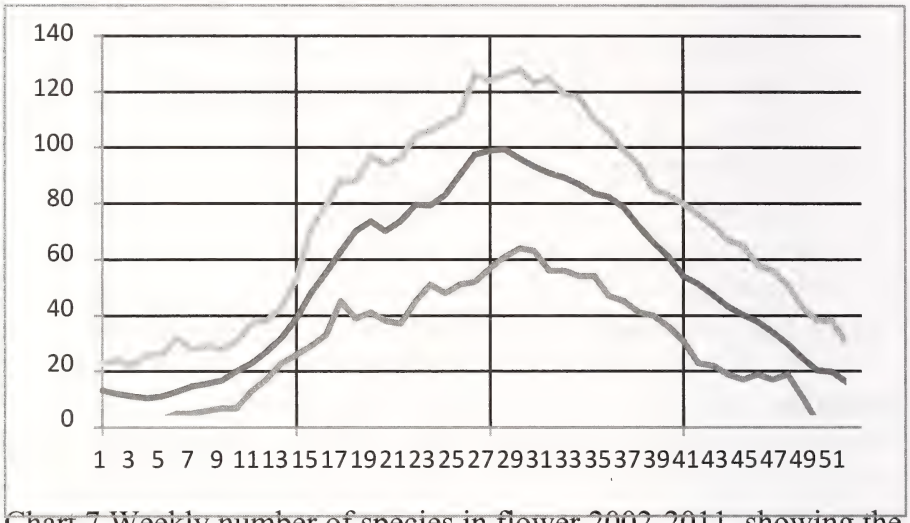

Chart 7 Weekly number of species in flower 2002-2011, showing the maximum, average and minimum counts.

0f the 149 species for which I have records covering nine or ten years, ten have achieved 52 weeks of flowering at least once, and another seven have come close. Table 7 lists these species, and shows their overall average duration in flower, the number of years in which they have over-wintered, and the maximum number of weeks in which they were recorded. To achieve 52 weeks in flower they need two successive warm winters, so that they are in flower on January 1st and still in flower on December 31st. This happened most obviously in 2007 and 2008. The table shows the species involved. The Downs is 300 feet up, and there may well be other species that survive at sea level and in sheltered environments.

	Av Duration	Years	Wks			Av Duration	Years	Wks
Daisy	49	9	52		Trailing Bellflower	36	1	52
Petty Spurge	42	3	52		Mexican Daisy	27	1	52
Dandelion	44	2	52		Smooth Sow - thistle	38		50
Ivy-leaved Toadflax	40	2	52		Yellow Fumitory	39		47
Adria bellflower	39	2	52		Oxeye daisy	19		47
Groundsel	40	1	52		Gorse	36		43
Red Valerian	40	1	52		Hairy Bittercress	22		40
Alkanet	37	1	52		Shepherds Purse	30		40
					Herb Robert	33		40

Table 7 Overwintering and potentially overwintering species.

Gorse is a winter flowering species, coming into flower at the earliest in week 31, 30th July, and ending flowering at the latest in week 23 (5 June). Ivy, which is not in the list because it only flowers in winter, comes into flower at the earliest in week 31 (July 31) and usually lasts until week 1 (Jan 1st), though has been recorded in flower as late as week 8 (Feb 28th). Hairy Bittercress, Shepherd's Purse, Field Speedwell, and Red Nettle have not been well observed, and they are also potential over-winterers.

Since 1853 there have been 24 winters with a temperature over 9°C, but two such winters in a row have only occurred six times, in 1911/12 and 1912/13, and four times since 1970. The thirty year winter average, shown in Chart 1 above, reached 8.3°C in 1939, then fell back to 7.4°C in 1980, and has since advanced to 7.8°C in 2011, though three successive cold winters have checked the trend. Should there be further advance more species may join this small group that are effectively continuously in flower.

Another group of interest over winter are those who come into flower prematurely, in warm winters, then cease flowering in a cold snap before coming back into flower at their normal date. These include Wallflower, and Oxford Ragwort in 2001 and 2007, Cow Parsley in 2008, Alexanders, Honesty, Cow Parsley and Hogweed in 2011.

Over-winterers need to be distinguished from the survivors, species that stay in flower throughout December and continue into January or February before finally becoming dormant and reappearing at the normal date. They include Ragwort, Small Scabius, Nipplewort, Hogweed, Blackberry, Wood Avens, Herb Robert, Yellow Fumitory and Ox-eye Daisy. The table shows the latest date in weeks to which these species have survived.

	Last week
Herb Robert	3
Wood Avens	3
Yellow Fumitory	3
Scabius	7
Blackberry	8
Nipplewort	8
Ragwort	8
Ox-eye Daisy	10

Table 8 Survivor species showing the last week of the new year in which they were recorded in flower.

Comparison with the past.

The only consistent record with which this study can be compared is that made by Thomas Preston at Marlborough over the twenty years 1865-1885. He calculated average first flowering dates for 41 species that are also present in this record, and are listed in table 9. Marlborough is an inland town, in a fairly sheltered site on the Kennet. Preston kept detailed weather records over the period, which was one of cooling temperatures. Table 9 shows the average temperatures over twenty years at Marlborough and ten at Clifton for the main seasons, and the differences. Springs were much cooler, and winters a little colder, but summer temperatures were similar.

	Marlborough	Clifton	Difference
Winter	6.9°C	7.8°C	0.9
Spring	12.6°C	14.1°C	1.5
Summer	20.4°C	20.7°C	0.3
Annual	13.2°C	14.3°C	1.1

Table 9 Average temperatures at Marlborough 1865-1885 and Clifton 2002-2011

Table 10 lists the average first date for the species, in the current Clifton date order, with gaps indicating the five periods summarised above, and showing the difference in days. The overall Clifton average of the 41 species is ten days earlier, and as the average annual temperature was a degree warmer, this suggests that the summary of the 79 species in this study which showed a difference of nine days per degree is true historically.

Some of the differences, especially those where the Marlborough dates are earlier than the Clifton ones are surprising, and the 48 day difference in Blackberry flowering is astonishing. The Marlborough average date is similar to the first ripening date today. And Hawthorn really did flower in mid-May in those days.

	Marlborough	Clifton	
	Avg first date	Avg first date	Difference
Hazel	31	17	-14
Lesser Celandine	38	39	1
Vernal Whitlow Grass	63	48	-15
Barren Strawberry	44	49	5
Dogs Mercury	45	50	5
Yew	49	50	1
Elm	66	63	-3
Sweet Violet	64	70	6
Blackthorn	91	77	-14
Ash	101	84	-17
Bulbous Buttercup	114	88	-26
Cowslip	94	90	-4
Bluebell	102	98	-4
Cuckoo Flower	96	101	5
Herb Robert	124	102	-22
Sycamore	125	103	-22
Garlic Mustard	111	107	-4
Horse Chestnut	126	107	-19
Wayfaring Tree	121	108	-13
Wood Avens	127	111	-16
Rock Rose	141	112	-29
Hawthorn	133	114	-19
Holly	138	114	-24
Ox-eye Daisy	141	119	-22
Elder	147	128	-14
Spindle	145	131	-14

	Marlborough	Clifton	
	Avg first date	Avg first date	Difference
Dog Rose	155	141	-14
Blackberry	189	141	-48
Wild Privet	171	146	-25
Dogwood	162	147	-15
Hogweed	136	148	12
Ragwort	173	160	-13
Ladies Bedstraw	178	166	-12
Self Heal	170	167	-3
Enchanters Nightshade	181	167	-14
Rose Bay Willowherb	186	170	-16
Harebell	188	175	-13
Hedge Parsley	176	180	4
Hemp Agrimony	175	186	-48
Red Bartsia	176	186	10
Burnet Saxifrage	165	193	28
Average	126	116	-10

Table 10. A comparison between the first dates at Marlborough, 1865-85 and Clifton 2002-2011

Conclusion

It is unfortunately not possible to compare Gilbert White's dates with this study, because he simply gave the earliest date, and occasionally the latest, rather than the average. Earliest dates are the result of an unusual stimulus, whereas what is important in any age is what is ordinary. The ordinary needs recording because you can be sure that it was not ordinary fifty years ago, and won't be ordinary in fifty year's time. I feel hugely indebted to my phenological predecessors, and hope that this fascinating and obsessive study will be of value to someone at some time in the future. It is very simple and easily repeated, and I only wish I had begun it fifty years ago.

Obituary

Jeffrey Boswall

Jeffery joined the BNS in 1960 presumably at the same time as he came to Bristol and joined the BBC Natural History Unit in Whiteladies Road. He became a leading figure in that organisation, not only as a producer working on programmes like Wildlife Safari, Natural World and the Private Lives, notably 'The Private Life of the Kingfisher' but also in front of the camera as a presenter. Fame is ephemeral, and today he is long forgotten by the public, but he was one of the first of the great television naturalists who have done so much in the past fifty years both to familiarise people with the extraordinary wonders of the world we live in and to make clear the grave threats that human activities pose. He thus played a highly significant role in the development of the environmental movement to which so many now seek to pay lip service. He also laid down two fundamental rules for wildlife photography; "never deceive your audience" and "never harm any form of wildlife by your activities". These continue to guide programme making, and both can still create controversy.

He was primarily interested in birds, and was a life-long member of the British Trust for Ornithology. He was particularly fascinated by bird song and calls, and guilt up a fascinating collection of artifacts that produced sounds similar to real bird-calls, and which had been developed around the world over the centuries as lures. His last talk to the BNS was on this topic. During his professional life he was too busy to be involved either with BTO surveys or with the day-to-day running of the BNS, but in his retirement he became involved with natural history around his home in Wraxall. From 2004 he gave regular dawn chorus walks in Towerhouse Wood, joined by up to 20 bird watchers. He insisted on starting at 4 am before many birds (and many of us!) were properly awake, but enabling us to see the bats and to hear the owls. Jeffery was very supportive of the work of the Friends of Towerhouse Wood, raising money for them by the small charge he made to those attending.

He died on 15 August 2012, aged 81 and the world has been diminished by the loss of his eccentricities, generosity, wit and charisma, and for the encouragement which he gave for all aspiring naturalists.

An Index to articles in this journal 1996-2011

RL Bland

The last index we published was by Mike Taylor, and it covered 1971-1995. It was a very detailed and cross-referenced index. This one is a simple list, in order of author and date. It does not give the full title of the articles but a brief summary, though that usually gives a good idea of the contents. I have included all the Biota because they have changed over time, and, perhaps regrettably, in the latest volume only invertebrates have been covered. The history of the Biota goes back a century to 1912 when JW White published his Flora, and then began to publish annual updates to it, which have continued to the present day. In 1936 HH Davis began regular bird notes, which became the Avon Bird Report, which has outgrown its parent so that it is now a separate publication. Mammal recording began along with the invertebrates in the 1960s. For many years from the sixties the Proceedings as they were then called, were dominated by the biota, and original articles played a more minor role, but in recent years that has begun to change and there are now regularly ten or more articles. The Biota have always sought to be a source of information on new discoveries and change, but in part their role has been taken over by the Bristol Environmental Record Centre (BRERC), which is a professional organisation, and now a key source of detailed data. The Avon Bird Report has moved from being notes on rarities to monitoring all local species with the help of specific surveys. Other taxa are not yet in a position to do this. The involvement of volunteers in surveys and the collection of data is now fundamental to the work of most major national organisations, as they could not possibly afford to gather the data needed themselves. Computer technology has made this ever easier and more effective, but this journal still has an important role to play in both assisting national organisations, and in publicising local results.

2001	Alexander KNA	Veteran trees and Invertebrates
2003	Atkins R	Food preference of Dysdera crocata
2006	Bailey M	The Heligoland trap
1999	Barnett RJ	Entomology in the BNS
2004	Barnett RJ	Invertebrates 2003
2004	Barnett RJ	Invertebrates 2004
2006	Barnett RJ	Invertebrates
2007	Barnett RJ	Invertebrates
2008	Barnett RJ	Invertebrates
2009	Barnett RJ	Invertebrates
2009	Barnett RJ	Reptiles
2010	Barnett RJ	Invertebrates

2011	Barnett RJ	Invertebrates
2005	Barnett RJ	Invertebrates
1996	Barnett RJ	Invertebrates
1997	Barnett RJ	Invertebrates
1998	Barnett RJ	Invertebrates
1999	Barnett RJ	Invertebrates
2000	Barnett RJ	Invertebrates
2001	Barnett RJ	Invertebrates
2002	Barnett RJ	Invertebrates
2003	Beckett M	Ida Roper
2009	Bland RL	Lorna Shaw's PhD on House Sparrows
2010	Bland RL	Review of "Trees in Nailsea"
1997	Bland RL	Garden birds in winter 1975-1998
1999	Bland RL	100 years of ornithological change
2000	Bland RL	Phenology 110 years on
2001	Bland RL	Bristol's ten largest trees
2001	Bland RL	Danish scurvy grass in the Bristol region
2001	Bland RL	Weather
2001	Bland RL	Phenological records 1998-2001
2002	Bland RL	Weather
2002	Bland RL	Adolph Leipner's vision; rerum cognoscere causas
2002	Bland RL	Phenology
2003	Bland RL	Fish in the Frome
2003	Bland RL	Weather
2003	Bland RL	Phenology
2004	Bland RL	Invasive aliens
2004	Bland RL	Poppies
2004	Bland RL	Ancient Hawthorns
2004	Bland RL	Fish on the Chew
2005	Bland RL	Weather

2005	Bland RL	Phenology
2005	Bland RL	Flora of Bristol Walls
2005	Bland RL	Mistletoe
2005	Bland RL	Climate change in Bristol
2006	Bland RL	Weather
2006	Bland RL	Weather extremes
2006	Bland RL	Phenology
2006	Bland RL	Frogspawn
2006	Bland RL	Street trees of Bristol
2006	Bland RL	Forests of the future
2006	Bland RL	Bees, bats, and bedbugs
2007	Bland RL	Weather
2007	Bland RL	Phenology
2008	Bland RL	Weather
2008	Bland RL	Phenology
2008	Bland RL	Tyntesfield Arboretum
2008	Bland RL	Lessons from the past
2008	Bland RL	Review, HH Davis biography
2009	Bland RL	Weather
2009	Bland RL	Miss Rogers' legacy
2009	Bland RL	Book review- Whitebeams of Britain
2010	Bland RL	Weather
2010	Bland RL	First flowering dates
2010	Bland RL	Phenology
2011	Bland RL	Weather
2011	Bland RL	Otters in the Bristol Docks
2011	Bland RL	Common Mammal Monitoring
2011	Bland RL	Plant reaction to temperature change
2011	Bland RL	Index 1996-2011
2009	Broughton H	Dormice

2006	Buck R	St George's flowerbank
2009	Burton J	Crow Lane open space
2009	Burton J	Badocks Wood
2011	Byles J	Blaise Castle estate
2005	Carpenter S	Fossil marine reptiles
2008	Carpenter S	Dakasdaurus carpenteri
2007	Chambers J	Jubilee Stone Wood
2005	Cropper R	The long-winged Conehead
2006	Cropper R	Grasshoppers of the UK
2008	Dallin S	Where will all the animals go?
2008	Davis E	The Downs bird community
2011	Dixon W	Moulding of the Bigwood
1996	Dyer KR	Definition of the Severn Estuary
2005	Evans M	Local naturalists
2001	Fay N	Veteran trees
2011	Gooding R	Roper memorial Epidiascope
2011	Gooding R	Harry Savory's glass slides
2001	Green T	The oak tree
2006	Hamilton M	Avon BAP
2004	Hayward J	Avon BAP
2011	Haywood M	Col Jones' Fern prints
2003	Hill-cottingham P	Shining Ramshorn snails
1998	Hiscock C	Lower Silurian of Tortwoth inlier
2008	Kern J	Avian feeding associations
2007	Leaf A	Bird life of Avon Docks
1996	Lee PH	Recent changes in bridgewater bay
2007	Lovatt C	Liverworts of the Avon Gorge
2003	Lovatt C	Swete's Flora bristoliensis
2004	Lovatt C	Botany 2004
2005	Lovatt C	Botany 2005

2007	Lovatt C	Botany 2006
2007	Lovatt C	JW White
2008	Lovatt C	Botany 2007
2008	Lovatt C	Botany 2008
2009	Lovatt C	GHK Thwaites
2010	Lovatt C	Botany 2009
2009	Mayne C	Folly Farm ponds
2004	Mc Phillimy H	Narroways Reserve
2006	Millman P	The botany of Tyntesfield
2006	Morris W	The Constant Librarian
2008	Moulin A	Moths of the Bristol region
2002	Moulin F	The natural history of ten acres
2002	Muston R	Pond organisms
2004	Mycology	Smith J
2010	Nicholson H	House Sparrows
1997	Obituary	Captain RGB Roe
1997	Obituary	CH Cummins
1997	Obituary	GE Sweet
1997	Obituary	TR Fry
1998	Obituary	Bob Savage
2000	Obituary	John Boyd
2000	Obituary	John Weeks
2004	Obituary	Rae Vernon
2005	Obituary	David Cope
2005	Obituary	ACK Fear
2005	Obituary	AJ Willis
2007	Obituary	DH Peregrine
2007	Obituary	Rachel Lee
2008	Obituary	Margaret Rogers
2008	Obituary	Pat Hill-Cottingham

2009	Obituary	Mike Taylor
2009	Obituary	Anne Hollowell
2009	Obituary	Trevor Silcocks
2009	Obituary	William Stanton
2010	Obituary	Philip Nethercott
2011	Obituary	Jeffery Boswall
2008	Obituary	S Curtis
2010	Quinn S	The Lichen trail
1998	Radley JD	Triassic strata at Aust
2002	Reece S	The Bristol Avon otter survey
2011	Rich T	Whitebeam in the Gully
2008	Roberts L	Lapwings
2005	Robinson A	Gordano Valley NNR
2009	Rogers MA	Honorary Fish
2010	Rowson R	The Leipner Lichen collection
1999	Savage RJG	Mines and quarries of Clifton
2004	Slade A	S Gloucester BAP
2004	Smith AG	Sand Bay Sandhoppers
2006	Smith AG	The Midland Thorn
2006	Smith AG	A Snail's migraine
2008	Smith AG	Where do flies go?
2001	Smith J	Wood decaying macromycetes on vetteran trees
2001	Smith J	Fungi records
2003	Smith J	Fungi
2001	Smith T	The Yew Tree
2006	Smith T	Towerhouse Wood
2006	Smith T	Tree names
2007	Smith T	Ivy
2007	Smith T	Botanical curiosities
2004	Stanton WI	Hot springs of Avon Gorge

2004	Stanton WI	Turbulent Avon
1997	Stanton WI	Badger problems in Westbury sub Mendip
2002	Taylor SM	Reflections
1996	Taylor SM	Index 1971-1995
1999	Taylor SM	100 years of Ornithology
2005	Taylor SM	Communication
2007	Taylor SM	From the Archives
2010	Thompson F	House Sparrows
2005	Tinsley HM	Holocene Woodland of Cumberland Basin
2000	Titchen A	The top ten tree hybrids in Bristol
2005	Town A	Clevedon toad patrol
2006	Town A	Toad patrol
2004	Trump DPC	Mammals
2005	Trump DPC	Mammals
2006	Trump DPC	Mammals
2007	Trump DPC	Mammals
2008	Trump DPC	Mammals
2009	Trump DPC	Mammals
2010	Trump DPC	Mammals
1996	Trump DPC	Mammals
1997	Trump DPC	Mammals
1998	Trump DPC	Mammals
1999	Trump DPC	Mammals
2000	Trump DPC	Mammals
2001	Trump DPC	Mammals
2002	Trump DPC	Mammals
2003	Trump DPC	Mammals
2003	Waring T	Dragonflies of Backwell lake
2000	Washbrook A	Return of the Otter
2006	Williams M	The Yew

1996	Willis AJ	Botany
1997	Willis AJ	Botany
1998	Willis AJ	Botany
1999	Willis AJ	Botany
2000	Willis AJ	Botany
2001	Willis AJ	Botany
2002	Willis AJ	Botany
2003	Willis AJ	Botany
2007	Willmott H	Adder's Tongue Spearwort
2009	Willmott H	Ponds in S Glos
2002	Wood M	Amphibians in the Bristol area
2007	Wood M	Arnos Vale

Bristol Naturalists' Society Annual Report, 2011.

1 Organisation.

At the AGM on 3 March 2011 The Secretary, R Muston, Treasurer, S Fay, Membership Secretary, A Wookey, Bulletin Editor, D Davies, Journal Editor, R Bland, Librarian, J Webster, Archivist, R Symes and Website Manager, D Strawford were all re-elected as officers and R Barnett, M Johnson, P Hilton R Steer, were chosen to represent the sections, and T Corner, HG Morris, N Hudson, M Pocock, and AG Smith as ordinary members.

2 Grants. In 2011 the Society made one grant in the sum of £343. Funding was provided for equipment to a local participant in the National Garden Moth Scheme.

3 Library. 2011 has been a very dynamic year for the BNS Library. The modernisation of the BNS Library set in motion by the new computer, plus the bar coding of the books, opened our eyes to the enormity of the task ahead. While the BNS is fortunate in attracting dedicated and knowledgeable members to serve on the library committee; the work involved in re-organising and cleaning thousands of books seemed almost impossible. Fortunately a new committee member Cathy Barron offered to become Assistant Librarian and over the course of many months, with great dedication and hard work has transformed the lending library.

We now look forward to 2012, when we will be systematically examining and researching the value of the large eclectic collection of old journals and books, with a view to careful preservation of the historical or intellectually valuable material, or its relocation to more suitable homes.

4 Archives.

The main changes in the archive collection during 2011 involved a substantial increase in the amount of material contributed to the Society. Some of this was relatively current, such as papers deposited by past Presidents, Treasurer, Membership Secretary and Hon. Secretary. A substantial collection given by Mrs Mary Taylor consisted of the papers accumulated by her late husband Mike, including many items of local and national ornithological interest, as well as early Society papers, such as those of the Publications and Library Committees. Another surprising addition was a set of 5 year diaries, covering 40 years, from the estate of Miss Margaret Rogers, who was President of the Society in 1958, and who recorded a great deal of natural history and weather information. These were all very welcome additions to the Archive Collection, albeit future storage issues need to be resolved. Unfortunately it was not possible to process many of these during the year. The Archivist was very much involved with the Library Committee in getting the library catalogue and bar-coding operating correctly, whilst dealing with all the issues of moving house after 30 years. This should not put off contributors from offering photographs, letters, notebooks, anecdotes, etc. about the Society. All will be catalogued and bar-coded in due course.

5 Society General Talks.
Four successful General talks were held. In February Helen Mugridge told us about her wildlife garden in the Forest of Dean. In March Cathy Mayne explained the differences between the four ponds at Folly Farm, the largest of which was funded by the society. The October meeting had to be transferred to December because of the speaker's ill health, and was a fascinating disquisition about the impact of the Harlequin Ladybird. In November Ian Harvey of the Forestry Commission described the massive impact that Wild Boars are making on the appearance and ecology of the Forest of Dean.

6 Society mid-week Walks.
These walks have been a very successful innovation this year. The idea was mooted at a BNS Council meeting, and taken up with enthusiasm by Tony Smith. Members and friends can bring to the event their own knowledge and skills, be it birding, plant-hunting, geological interpretation of the landscape, or the behaviour of foxes, deer, squirrels, mice or bugs. There have been unrehearsed contributions which have included church architecture, stained glass windows, medieval bench ends, iron-age hill-forts, lichens on bushes, even the minute architecture of burrs. The idea has attracted amblers, strongly dedicated ramblers, old and young, and a regular cairn terrier by prior permission of the leader. Every walk has been judged to be worthwhile and special in wonderful way and some have exploited the spectacular scenery of which our region can be very proud.
The monthly walks have included the Severn Vale, the Mendips, Dolebury, the Cotswolds and the Kennet and Avon canal and have ranged from two and a half miles to six and a half. We have been very fortunate that no walk has had to be postponed due to the inclemency of the weather and one occasion early rain did gave way to warm sunshine on the second leg with the refreshment break occurring at the half-way point. Walking is a very social way of understanding the countryside, enabling people to refresh their knowledge of wildlife and to pick up unexpected ecological insights. My thanks are due to those who have supported the enterprise in all their various ways.

7 Sectional reports; a)Botany.
The Botanical section of BNS has held 16 field meetings over the year. Two bryophyte meetings were held. Justin Smith led a meeting to Blaise Woods in April. As well as seeing a very good number of mosses and liverworts we were shown evidence of the ecological continuity of habitats to be found in this deep river valley. In the Autumn a meeting on Black Down (Mendips), led by Nick Hudson, produced some valuable records and, in particular, re-found species not seen for many years. Two 'Plant and Twig' meetings were run by Mark and Clare Kitchen at Blaise Woods in spring. Participants were given help in use of keys to identify non-flowering specimens.

BNS members joined a foray run by North Somerset Fungus Group at Hellenge Hill on a warm sunny day in November. An excellent array of fungi were found including rare limestone grassland species associated with rockrose and of particular note was Cortinarius cisticula- a Mediterranean species which can survive on the warm south-facing slopes of Hellenge Hill. Two large rings of Field Blewit were spectacular.Tony Smith led a Grasses, Sedges and Fern meeting at Snuff Mills - his home patch. Libby Houston led a meeting to see the newly identified Whitebeams of the Avon Gorge. It is exciting for the BNS be involved in this rapidly evolving area of plant identification. An ecology trip to the Black Downs was led by David Hill demonstrating the many natural features which would contribute to the flora present. Other field meetings were held at Walton Common, Stockwood Open Space, Cleeve Hill near Cheltenham, Tyntesfield, Redding Pits, Tickenham Moor, Kilcott Woods and Bristol Harbourside. A comprehensive botanical recording was undertaken at most sites.In addition, the Somerset and Gloucestershire Lichen group welcomed members of BNS to their meetings.

b)Geology Report. It has been an interesting year in the Geology Section.After an very enjoyable members' evening after our AGM in January, in February we were treated to an account of the latest discovery of feathered dinosaurs, given by Prof. Mike Benton. Our final talk of that winter season was an informal 'Presidential Address' by Roger Steer, about trips made, in recent years to the volcanoes of La Palma, Canary Islands and the fossil cliffs of Joggins in Nova Scotia.
During the summer, we were treated to a wonderful range of excursions, organised by Chris Townson. Tintern Quarry with David Owen of the Gloucester Geology Trust – Examining the Carboniferous exposure. Newark Park to see Jurassic fossils, Hock Cliff on the Severn, to collect Devil's Toenails (*Gryphea*) – Both led by Chris, and Dundry led by Simon Carpenter – To see the Jurassic fossils – A very good summer's outings.
Our winter programme restarted in October with Dr. Emily Rayfield, who told us about the work she and others have done on fossil jaw mechanics. November brought us Remmert Schouten – Fossil Prepartor at Bristol University. His talk was nominally on the mammoth fossils found in the North Sea, but he brought a wonderful fossil of the snout of a *Scelidosaurus* dinosaur.

c) Invertebrate Report. Ray Barnett and Tony Smith were re-elected Honorary President and Honorary Secretary, respectively at the AGM held at the Guide Association Hall, Westmoreland Road. Bristol. The following indoor meetings were held:-

18th January Section AGM & Presidential Address

15th February Portbury Wharf AWT Reserve *Bernie D'Arcy*

28th November The Wildlife of Dartmoor *John Walters* (a joint meeting with the Botany Section which organised the meeting).

and the following field meetings:

14th May Portbury Wharf AWT Reserve *Bernie D'Arcy*

4th June Westbury Medical Centre Hill Site *Tony Smith & Christine Muddiman*

d)Ornithology. 2011 was again a very active year for the Section. We organised 17 field trips. Amongst the many highlights in a varied programme we caught up with Ring Ouzel at Sand Point, had wonderful views of Bearded Tit at the Newport Wetlands, saw and heard Bitterns and Cuckoos on the Somerset Levels and hunting Peregrine and Hobby at Northwick Wharf. To add to the variety, instead of a demonstration of bird ringing at Chew Valley which was cancelled due to weather, we had a fascinating instruction on moth trapping and identification. The programme of talks was again of a uniformly high standard. John Sparks gave two beautifully illustrated talks on Venezuela and the South Atlantic. We also had a fascinating insight into the science of flight from Dr Timothy Seller and a wonderful series of images of the wildlife of the Cairngorms from Nick Martin We took part in various field surveys including monitoring blackcaps, listening for screaming swifts, counting birds for the BTO's bird atlas work and their annual Breeding Bird Survey. The 36th annual Winter Garden Survey was supported by thirty members.

8 Publicity.

In January the Downs Lichen trail leaflet was launched. Produced as a collaboration between BNS member Sheila Quin and the Avon Gorge and Downs Wildlife Project, the trail was part funded by the Society and the British Lichen Society. A talk and two guided walks about lichens were very well attended. The trail is exceedingly popular with the public and it has been well publicised through the local media.

In June, the Society attended the Bristol Festival of Nature (the UK's biggest celebration of the natural world which attracts more than 25,000 visitors). In August we took a stand at the Chew Valley wildlife open day. Over 164 people of all ages took part in our 'What am I?' wildlife identification quiz. The Society display was also available for visitors to look at and we had a number of publications for people to take away. The Society Secretary thrilled young and old alike with a close up view of aquatic wildife using a mini camera projected onto a laptop.

On August Bank Holiday the society stand was at the Botanical garden bee event, and many people took literature.Posters advertising Society events were produced on a regular basis and displayed in libraries. The Society's new website was also well used.
In November, a new membership leaflet and pull-up display were produced. The fresh, contemporary promotional materials should attract new members in 2012.

Membership At the end of the year there were 486 paid up members of the society. In the course of the year, Honorary member and former treasurer Mr P Nethercott and Mr Ron Payne, President of the Society in the 1980's died. We also lost Mr Martin Buck, Mr Roger Freeman, Mr Edward Brailsford, Mr NH Hollingsworth, Mr David Morris.

9 Relations with other organisations. The Society sends its records to the Bristol Environmental Records Centre, and supports the Avon and Bristol Biodiversity Action Plans. It supports the Avon Wildlife Trust. It is involved with the city Environmental Officer and the monitoring of the Avonmouth Wind Turbines, and carries out surveys for The British Trust for Ornithology, and the RSPB.

10 Thanks. The Society is grateful for the help and support it received from the Earth Sciences Department, University of Bristol, and Mrs Julie Finch, Director of Museums, Galleries and Archives, Bristol City Council, for continued support of the Society Library located within the City Museum & Art Gallery. It is also grateful to all those members of the society who gave so willingly of their time and energy in the course of the year to support the aims of the Society.

Bristol Naturalists' Society

Accounts 2011

Statement of financial activities for the year ended 31st December 2011

		2011	2010
Income			
Membership subscription		6556.25	6901.50
Gift Aid		1073.85	1150.63
B equests and donations		433.50	1201.00
Trading		279.10	61.34
Interets		194.69	233.94
Miscellaneous		50.00	0
Total		**8587.39**	**9548.41**
Expenditure			
A) Direct charitable			
Meetings		1245.78	1149.86
Books		626.31	848.34
Nature in Avon		1531.00	1645.00
Avon Bird Report		1470.00	1575.00
Bulletin		933.40	1254.77
White sheet		0.00	44.00
Distribution		1453.95	1292.27
Subscriptions		60.00	138.00
Publicity		1415.80	1370.05
Grants		182.70	4072.30
Total		**8918.94**	**13389.59**

B) Administration			
Print and stationary		119.03	174.74
Postage		113.73	138.45
Room Hire council		135.00	225
Insurance		133.02	137.65
Miscellaneous		457.43	2235.36
Total		958.21	2911.2
Operating surplus (deficit)		**-1289.76**	**-6752.38**

Balance sheet as at 31st December 2011

Asset			
Current Asset	Notes		
Prepayment	1	977.76	609.53
National Savings	2	0.00	12441.69
Bank (LLoyds)	3	847.95	472.63
CAF Gold	4	9530.04	28965.66
CAF Platinum	5	30072.00	0.00
		41427.75	**42489.51**
Liabilities			
Creditors			
Subscriptions in advance		521.50	106.00
Accruals		0.00	187.50
		521.50	293.50
Total assets less total liabilities		**40906.25**	**42196.01**

Capital			
General fund 31/12/2010		39696.01	39696.01
Net deficit 2011		-1289.76	
General Fund 31/12/11		38406.25	
150th Anniversary fund		2500.00	2500.00
		40906.25	**42196.01**

Notes

1	**Prepayments**		
	Meeting Rooms	189.00	
	Insurance	65.31	
	Periodicals	230.00	
	Publicity	89.00	
	150th anniversary	404.45	**977.76**
2	**National savings**		
	Opening Balance	12441.69	
	Interest	49.16	
	Transfer to CAF Gold	12490.85	**0.00**
3	**Lloyds Bank**		
	Statement #68	950.95	
	Unpaid cheque	103.00	**847.95**

4	**CAF Gold**		
		General Fund	150th Fund
	Opening balance	28815.66	150.00
	Interest	73.53	
	Transfer to Lloyds	-2000.00	
	Transfer from National		
	Savings	12490.85	
	Transfer	-2350.00	2350.00
	Transfer to CAF Platinum	-30000.00	
	Closing Balance	**7030.04**	**2500.00**
5	**CAF Platinum**		
	Opening Balance	0.00	
	Transfer from CAF Gold	30000.00	
	Interest	72.00	
	Closing balance		**30072.00**
6	**General Fund**		
	Bank Lloyds	847.95	
	CAF Gold	7030.04	
	CAF Platinum	30072.00	
	Prepayments	977.76	
	Creditors	-521.50	**38406.25**

Instructions for authors

The editor welcomes original papers or short notes on the natural history of the greater Bristol region for consideration for publication in Nature in Avon All papers for consideration should reach the editor by the end of November for publication in the following year. All Society Reports and Biota should reach the editor by the end of February in the year of publication.

Whenever possible, text should be submitted electronically in Word. The data for graphs should be sent in Excel, separately from the graph, as graphs have to be recreated to fit the page size of the journal. Any other illustrations should be submitted electronically.

The Editor welcomes digital photos of any natural history subject taken in the region, whether relevant to an article or not. They should be of the largest pixel size possible. However as the number of colour illustrations is strictly limited he cannot promise to print any

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Rerum cognoscere causas - Virgil

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