RETENTION OF EXTRA-WIDE, LOCK-ON, AND REGULAR BANDS ON WATERFOWL

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ABSTRACT

In tests of three types of bands -- extra-wide bands, lock-on bands, and regular U.S. Fish and Wildlife Service bands -- little difference was noted in the retention qualities of the three types on waterfowl. Therefore, there appeared to be no advantage in using either the extra-wide or the lock-on type of band rather than the regular band now in use by waterfowl banders on this continent. Waterfowl banded with two bands provided recovery data that were difficult to analyze but suggested that it might be worthwhile to identify banded birds with another type of mark and evaluate the retention of bands through subsequent recapture of the birds.

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INTRODUCTION

The loss of bands by birds is of concern in analyses of banding data because band loss will bias estimates of recovery and mortality rates made from band recovery data. During the middle and late 1950's, waterfowl biologists throughout North America cooperated in a study to compare the relative retention of different types of waterfowl bands and to evaluate band loss. One of the primary objectives of this study was to compare the retention of the regular U.S. Fish and Wildlife Service band (fig. 1), used for most banding on this continent, with that of two other types of bands, This report discusses the effects of band loss and reviews the data accumulated from the cooperative band retention study conducted by the Canadian Wildlife Service, the various State Conservation Departments and the Bureau of Sport Fisheries and Wildlife. The many cooperators in Canada and the United States listed in table 1 as well as those whose contributions were examined but not actually presented in this report deserve special thanks. Others who contributed were R. P. Shanahan, C. F. Kaczynski and R. I. Smith who compiled and summarized the data for the initial phase of this work and A. D. Geis who helped in the preparation of the final report.

Band Loss

The loss of bands occurs in two basic patterns: "initial" and "gradual." Initial loss occurs soon after application and before the first major recovery period (such as the first hunting season in game birds). Gradual loss occurs throughout the years of life of the banded cohort. Both initial and gradual band loss may occur in the same banded cohort.

Initial loss may occur within a short time after banding due to poor application. This may involve using bands too large for the birds -- a special problem when banding flightless young -- or bands may be weakened by excessive opening and closing. In addition, bands may be caught or hooked on some object and pulled off, and some birds may actually remove bands soon after application. Initial band loss lowers the band recovery rate (the proportion of the banded cohort that is recovered) because the number of banded birds available to be recovered is less than the number initially banded. This impairs the use of the band recovery rate as a measure of the rate of hunting harvest. However, if no further loss occurred, the subsequent recoveries would be valid for estimating mortality rate and making life table computations.

Gradual loss of bands by the banded cohort throughout its life span will affect recovery rate and the usefulness of the recovery data for estimating survival as well. This type of band loss can be attributed to wear and is illustrated by the deterioration of bands on birds inhabiting marine environments.

Table 2 contains hypothetical data that demonstrate the effect of band loss. Examples of initial band loss, gradual band loss and a combination of the two are shown. The effect of band loss on recovery rate is readily apparent. A 10 percent initial band loss would cause the indicated band recovery rate to be 10 percent lower; a 10 percent annual loss (gradual band loss) would have a much greater accumulative affect. Gradual band loss causes an upward bias, in the indicated annual mortality rate, similar in magnitude to the annual rate of band loss.

Thus band loss can cause a bias in both band recovery rate and in calculations of mortality or survival from band recovery series. Band loss causes the measured band recovery rate to be biased downward and the mortality rate, calculated by means of conventional methods, to be biased upward.

Techniques

In this report, recovery data from three different types of experimental banding are compared with recovery data from birds banded with regular U.S. Fish and Wildlife Service bands. Birds were banded experimentally in the following ways: (1) with extra-wide or "high" bands; (2) with lock-on bands; and (3) with one band on each leg, a regular band and an extra-wide or lock-on band. The three types of bands are illustrated in figure 1. Birds banded experimentally were matched with birds banded at the same time and place with regular U.S. Fish and Wildlife Service bands. In our analyses we examined the hypothesis that the extra-wide and lock-on bands would be retained at different rates than the regular bands. Better initial retention would be shown by first-hunting-season recovery rates higher than obtained with regular bands. Better band retention throughout the life of a banded cohort would be shown by lower estimated annual mortality rates for cohorts with the least band loss.

The numbers of birds banded for these experiments are shown in tables 3, 4 and 5. Differences between band recovery rates were tested for significance with Chi-square methods. Because there were so few significant differences among the comparisons of band recovery rates, we further tested the data with nonparametric methods (the "Sign Test": Snedecor, G. W. 1956. Statistical methods applied to experiments in agriculture and biology. 5th ed. Iowa State College Press, Ames. 534 pp.). This method takes into account the ranking of two treatments and in the present case was used to test the tendency for one type of band to have higher recovery rates than another.

RESULTS

Initial Band Loss

Extra-wide Bands

Table 3 compares birds banded with one extra-wide band and birds banded with one regular U.S. Fish and Wildlife Service band. Canada geese banded in California, Nevada and Alaska with wide bands appear to have had higher first-hunting-season recovery rates than those with regular bands but overall recovery rates (all years) were higher in only three of five comparisons. Male mallards banded in Minnesota with wide bands had lower recovery rates than their cohorts with regular bands but females banded with wide bands had higher recovery rates than females banded with regular bands. Blue-winged teal banded in Minnesota with regular bands had consistently higher recovery rates than those banded with the extra-wide bands. Thus, extra-wide bands yielded higher first-hunting-season recovery rates in 6 of the 11 comparisons but birds banded with regular bands had the higher rates in the other 5 cases. Birds banded with extra-wide bands had higher total recovery rates in 4 of the 11 comparisons while the regular bands yielded higher total recovery rates in the other 7 comparisons. This suggests that there was little difference in the relative initial retention of extra-wide and regular bands.

Lock-on Bands

The results of banding with lock-on bands were as follows: For paired samples of Canada geese and mallards, the higher recovery rates were about evenly divided between those with lock-on bands and those with regular bands. Among pintails the higher recovery rates were obtained with regular bands in three of the four comparisons. Scaup banded with lock-on bands showed higher first-hunting-season recovery rates in six of eight comparisons and higher total recovery rates in five of eight comparisons (no significant difference in either case). Data from blue and snow geese exhibited higher first-hunting-season and total recovery rates for lock-on bands in two comparisons. Considering all species and cohorts, those with lock-on bands had higher first-hunting-season recovery rates than those with regular bands in 16 of 32 comparisons and higher total recovery rates in 17 of the 32 comparisons. These results suggest that there was very little difference between the initial retention of lock-on and regular U.S. Fish and Wildlife Service bands.

Double Banding

Banding birds with two bands, one extra-wide or lock-on band and one regular U.S. Fish and Wildlife Service band, was designed to provide a comparison of the retention of the two types of bands. However, neither recapture records from banders nor recovery reports from hunters

were completely satisfactory for this study because they did not always indicate whether the bird had retained both bands. One good set of recapture records was provided by the Florida Game and Fresh Water Fish Commission. From January to April 1956, Florida biologists banded 862 adult and 1,055 immature lesser scaup with one extra-wide band and one regular band on each bird. In subsequent years 167 double-banded scaup were recaptured as follows: of 105 birds recaptured the following winter, seven (7 percent) had lost regular bands while five (5 percent) had lost extra-wide bands; of 48 scaup retrapped the second winter after banding 3 had lost regular bands but none had lost the extra-wide bands; of 14 birds recaptured the third year 1 had lost a regular band but no loss of extra-wide bands was detected. Among all scaup recaptured, 11 birds had lost regular bands, while 5 had lost the extra-wide bands. This indicates a band loss of about 7 percent for regular bands during the 3-year period, and about 3 percent for the extra-wide bands occurring entirely before the first recapture period. (This difference yields a Chi-square value of 2.363 which is between the 75 and 90 percent level of probability.) It should be noted, however, that even these good records did not detect cases where both bands had been lost.

Table 5 shows band recovery rates for other birds banded with two bands, one extra-wide or one lock-on plus one regular band as compared with rates for birds banded with only one regular band at the same time and location. Since people who recovered double-banded birds did not always say whether the birds carried one or two bands, the recovery data on double-banded birds was treated in a manner similar to that of the other experimental bandings. Namely, recovery rates for the double-banded birds were compared with those for birds banded at the same time and place with a single regular U.S. Fish and Wildlife Service band. In this analysis we assumed that the chances of retaining a band were greater on the double-banded birds and these data would provide a measure of the loss of regular bands on the single-banded birds.

The first-hunting-season recovery rates were higher for birds banded with two bands than for those banded with one band in 17 of 20 comparisons and total recovery rates were higher in 15 of 20 comparisons. The frequency with which recovery rates for double-banded birds exceeded those for single-banded birds suggests an initial loss of bands among the latter group. However, the data were complicated by the fact that band-reporting rates (proportion of recovered bands reported to the Bird Banding Laboratory) may have differed between double-banded birds and controls. It seems likely that a hunter would be more apt to report a bird with two bands than a bird with only one band simply because his curiosity is aroused or because he is less likely to overlook two bands than one band. Thus the higher recovery rate measured for the double-banded birds might be attributable to a higher band-reporting rate. Consequently, although there is a suggestion of initial band loss in the single-banded cohorts, it is difficult to draw any conclusions about the magnitude of this loss.

Gradual Band Loss

Gradual band loss should be demonstrated by a progressive shrinkage in the number of banded birds available to be recovered throughout the life span of the banded cohort. Thus the period during which bands are recovered should be shorter for a cohort experiencing band loss than for one experiencing no band loss. Between a cohort suffering gradual band loss and one experiencing no band loss, the one with gradual loss should exhibit a greater proportionate decrease between first, second, and later season recovery rates. The data in tables 3, 4 and 5 do not suggest a relation of this sort between cohorts banded with regular U.S. Fish and Wildlife Service bands and those banded with either extra-wide or lock-on bands. Thus, there is no indication that any of the band types were lost at a greater rate than the others.

Table 6 contains band recovery data resulting from the use of all three types of experimental banding mentioned previously. The band recoveries are listed by the hunting seasons in which they were taken and indexes to mortality rates were calculated from the recovery series using the dynamic method of calculating mortality rate. (A. D. Geis and R. D. Taber, 1963, Measuring hunting and other mortality. In: Wildlife Investigational Techniques. The Wildlife Society: 284-298.) These are indexes to mortality rates rather than actual mortality rates because, in most cases, not enough time had elapsed to obtain all recoveries. As mentioned earlier, if gradual band loss exists it should be revealed by mortality rates which are biased on the high side. Here then, if band loss is higher for the regular type bands, the mortality rate index for the cohorts banded with regular bands should be higher than the indexes for the experimentally banded birds. Of the 16 comparisons of mortality indexes, 10 groups of birds banded with the regular bands had higher mortality indexes while 6 groups had lower mortality indexes than those banded with the extra-wide bands, lock-on bands or birds that were double-banded. Most mortality indexes differed little between regular and experimentally banded cohorts and the average index for regular banded birds of all species was less than 2 percent higher than that for experimentally banded birds. These data show no evidence that gradual band loss occurred at a higher rate for regular bands than for any of the other types of bands or for double-banded birds.

DISCUSSION

The data presented in this report suggest that there was little difference in the retention of extra-wide bands, lock-on bands and regular U.S. Fish and Wildlife Service bands. Although a precise test of the relative retention of the regular and experimental types of bands was not obtained because sample sizes were frequently small, the data were adequate to conclude that, if a difference exists between the

retention of the regular and the experimental bands tried, this difference was small. Therefore, there would be no advantage in using extra-wide or lock-on bands instead of the type of band now in use in North America.

The data collected by Florida biologists on the recapture of double-banded scaup suggest that some band loss does occur. (The results of the comparisons of double- and single-banded birds, although complicated by a possible band-reporting rate difference, also suggested band loss.) Moreover, in some environments and with some species it may be a severe problem. We would urge individuals or agencies who have worked with double-banded birds to review their recapture records for evidence of band loss. In future studies, it would be profitable to attempt to obtain a measure of the magnitude of band loss through the technique used in the Florida recapture experiment, but to use a mark on the banded bird other than an extra band. Perhaps a wing tag, toe clip or web punch, etc., could be used to identify banded birds and then checked on subsequent recaptures to determine if the leg band had been lost (pers. comm. from C. J. Barstow). A permanent mark in place of an extra band would be valuable from the standpoint of (1) permanency and (2) the greater range of value of the recovery data (--recovery data from double-banded birds are not comparable to those from "normal" bandings since the extra band may introduce a difference in band-reporting rate).

Table 1.--Individuals and agencies participating in the study of band retention

Canadian Wildlife Service

Dr. F. G. Cooch
Dr. J. B. Gollop

State Conservation Departments

California
Colorado
Florida
Illinois
Indiana
Maryland
Minnesota
Missouri
Montana
New York
North Dakota
Oklahoma
Oregon
Vermont
Wisconsin
Wyoming

Bureau of Sport Fisheries and Wildlife

R. O. Halstead
C. R. Hayes
Alaska
Blackwater National Wildlife Refuge
Maine Coop. Wildlife Research Unit
Sacramento National Wildlife Refuge
St. Marks National Wildlife Refuge
Sand Lake National Wildlife Refuge
Swan Lake National Wildlife Refuge
Tule Lake National Wildlife Refuge
Valentine Lakes National Wildlife Refuge

Table 2.--Effects of band loss on numbers of banded birds available to be recovered. A banded cohort of 1,000 with an annual mortality rate of 50 percent is used and the indicated mortality rates associated with five patterns of band loss are shown.

Pattern of band loss	Number of banded birds available to be recovered in hunting seasons after banding										
	1	2	3	4	5	6	7	8	9	10	11
No band loss (control)	1,000	500	250	125	62	31	16	8	4	2	1
10 percent initial loss before first hunting season	900	450	225	112	56	28	14	7	4	2	1
10 percent annual loss after first hunting season	1,000	450	202	91	41	18	8	4	2	1	
10 percent initial loss before first hunting season and 10 percent annual loss thereafter	900	405	182	82	37	17	8	4	2	1	
20 percent as above	800	320	130	52	21	8	3	1			
5 percent annual loss after third hunting season	1,000	500	250	119	56	27	13	6	3	1	

	Indicated average annual mortality rate*	Percent difference from control
No band loss (control)	0.501	--
10 percent initial band loss before first hunting season	0.501	Same
10 percent annual band loss after first hunting season	0.551	+10
10 percent initial loss before first hunting season and 10 percent annual loss thereafter	0.548	+ 9
20 percent as above	0.601	+20
5 percent annual band loss after third hunting season	0.514	+ 3

*Calculated with dynamic method.

Table 3.--Recovery rates of Canada geese, mallards and blue-winged teal banded with extra-wide bands and regular bands

Species	Location of banding	Banding date	Age	Sex	Band type	Number banded	Recovery rates by hunting season of recovery	
							First	2nd & later
Canada geese	California-Nevada	June 57	Local	Unknown	Regular	328	.122	.140
					Wide	331	.160	.142
		June 59	Immature	Unknown	Regular	87	.126	.080
					Wide	87	.172	.034
		June 57-59	Adult	Male	Regular	335	.090	.096
					Wide	335	.108	.137
				Female	Regular	346	.067	.107
					Wide	343	.108	.102
	Alaska	July 57-59	Adult	Unknown	Regular	1,076	.028	.066
					Wide	900	.032	.062
Mallard	Minnesota	Aug.-Sept.57	Immature	Male	Regular	146	.212	.082
					Wide	149	.154	.128
				Female	Regular	211	.137*	.062
					Wide	191	.309*	.067
Blue-winged teal	Minnesota	Aug.-Sep.57	Adult	Male	Regular	36	.111	.000
					Wide	43	.046	.023
				Female	Regular	104	.125	.010
					Wide	123	.065	.000

Table 3.--Recovery rates of Canada geese, mallards and blue-winged teal banded with extra-wide bands and regular bands--continued

Species	Location of banding	Banding date	Age	Sex	Band type	Number banded	Recovery rates by hunting season of recovery: First	Recovery rates by hunting season of recovery: 2nd & later
Blue-winged teal (con.)	Minnesota	Aug.-Sept.57	Immature	Male	Regular	521	.152	.012
					Wide	540	.137	.015
				Female	Regular	581	.156	.010**
					Wide	536	.125	.017

*Significant difference at the 95 percent level.
**Significant difference at the 99 percent level.

Table 4.--Recovery rates of several species of waterfowl banded with lock-on bands and regular bands

Species	Location of banding	Banding date	Age	Sex	Band type	Number banded	Recovery rates by hunting season of recovery	
							First	2nd & later
Canada geese	Illinois	Hunting season 57-58	Adult	Unknown	Regular	542	.055	.157
					Lock-on	480	.050	.140
			Immature	Unknown	Regular	387	.116	.142
					Lock-on	419	.096	.124
		Hunting season 58-59	Adult	Unknown	Regular	601	.022	.113
					Lock-on	505	.028	.143
			Immature	Unknown	Regular	444	.088	.101
					Lock-on	489	.065	.151
Pintail	California	Aug.-Sept.-Oct. 57	Immature	Male	Regular	547	.112	.064
					Lock-on	547	.088	.042
				Female	Regular	584	.101**	.036*
					Lock-on	531	.041	.015
			Adult	Male	Regular	343	.032	.073
					Lock-on	384	.050	.039
				Female	Regular	214	.023	.037
					Lock-on	303	.023	.056
Mallard	Saskatchewan	June-July 57	Local	Male	Regular	243	.087*	.095
					Lock-on	114	.158*	.114
					Dog-caught regular	226	.053	.062
					Dog-caught lock-on	295	.085	.068

Table 4.--Recovery rates of several species of waterfowl banded with lock-on bands and regular bands--con.

Species	Location of banding	Banding date	Age	Sex	Band type	Number banded	Recovery rates by hunting season of recovery: First	2nd & later
Mallard (con.)	Saskatchewan	June-July 57	Local	Female	Regular	260	.077	.069
					Lock-on	142	.113	.063
					Dog-caught regular	215	.070	.042
					Dog-caught lock-on	300	.067	.063
	Indiana	September 58	Immature	Male	Regular	54	.148	.130
					Lock-on	97	.072	.113
				Female	Regular	52	.115	.135
					Lock-on	103	.116	.058
			Adult	Male	Regular	41	.049	.122
					Lock-on	39	.026	.051
				Female	Regular	53	.038	.000
					Lock-on	68	.029	.044
		Hunting season 58	Immature	Male	Regular	125	.136	.088
					Lock-on	114	.079	.088
				Female	Regular	47	.043	.043
					Lock-on	84	.048	.107
			Adult	Male	Regular	272	.070	.121
					Lock-on	194	.046	.082
				Female	Regular	89	.067	.045
					Lock-on	85	.059	.035

Table 4.--Recovery rates of several species of waterfowl banded with lock-on bands and regular bands--con.

Species	Location of banding	Banding date	Age	Sex	Band type	Number banded	Recovery rates by hunting season of recovery	
							First	2nd & later
Mallard (con.)	Indiana	Hunting season 59	Adult	Male	Regular	178	.056	.135*
					Lock-on	140	.043	.050
				Female	Regular	80	.038	.050
					Lock-on	87	.080	.034
Lesser scaup	Florida	Jan.-Apr. 57	Adult	Male	Regular	206	.015	.024
					Lock-on	501	.012	.026
				Female	Regular	58	.017	.035
					Lock-on	228	.031	.013
			Immature	Male	Regular	477	.017	.015
					Lock-on	690	.025	.023
				Female	Regular	98	.020	.000
					Lock-on	246	.033	.020
		Jan.-Apr. 58	Adult	Male	Regular	293	.024	.027
					Lock-on	285	.025	.021
				Female	Regular	70	.000	.014
					Lock-on	58	.034	.017
			Immature	Male	Regular	174	.011	.017
					Lock-on	181	.028	.017
				Female	Regular	44	.068	.000
					Lock-on	56	.054	.036

Table 4.--Recovery rates of several species of waterfowl banded with lock-on bands and regular bands--con.

Species	Location of banding	Banding date	Age	Sex	Band type	Number banded	Recovery rates by hunting season of recovery	
							First	2nd & later
Blue geese	Keewatin	July-Aug. 57	Unknown	Unknown	Regular	1,000	.029	.087**
					Lock-on	900	.038	.140
Lesser snow geese	Keewatin	July-Aug. 57	Unknown	Unknown	Regular	1,500	.039	.121
					Lock-on	1,599	.043	.145

*Significant difference at the 95 percent level.
**Significant difference at the 99 percent level.

Table 5.--Recovery rates of several species of ducks banded with two bands and one regular band

Species	Location of banding	Banding date	Age	Sex	Band type	Number banded	Recovery rates by hunting season of recovery	
							First	2nd & later
Pintail	California	Aug.-Sept. 56	Immature	Male	Regular	521	.079**	.063
					1 wide-1 reg.	516	.143	.056
				Female	Regular	367	.065	.044
					1 wide-1 reg.	365	.082	.071
			Adult	Male	Regular	773	.048	.078**
					1 wide-1 reg.	873	.066	.129
				Female	Regular	319	.028	.048
					1 wide-1 reg.	332	.045	.066
Mallard	Oregon	Jan.-Feb. 57	Adult	Male	Regular	576	.061	.125*
					1 wide-1 reg.	565	.078	.189
				Female	Regular	324	.049	.090
					1 wide-1 reg.	335	.066	.075
Black duck	Maine	July-Aug. 56	Immature	Male	Regular	201	.114*	.060
					1 wide-1 reg.	172	.192	.058
				Female	Regular	160	.081**	.062
					1 wide-1 reg.	147	.211	.061
Blue-winged teal	North Dakota	July-Aug. 56	Local	Male	Regular	336	.036	.018
					1 wide-1 reg.	301	.056	.013
				Female	Regular	298	.037	.017
					1 wide-1 reg.	280	.043	.025

Table 5.--Recovery rates of several species of ducks banded with two bands and one regular band--continued

Species	Location of banding	Banding date	Age	Sex	Band type	Number banded	Recovery rates by hunting season of recovery: First	Recovery rates by hunting season of recovery: 2nd & later
Blue-winged teal (con.)	North Dakota	July-Aug. 56	Adult	Male	Regular	337	.018	.021
					1 wide-1 reg.	335	.009	.018
				Female	Regular	70	.014	.043
					1 wide-1 reg.	77	.052	.013
American widgeon	Oregon	Jan.-Feb. 57	Adult	Male	Regular	211	.085	.104
					1 wide-1 reg.	210	.091	.162
				Female	Regular	67	.045	.030
					1 wide-1 reg.	65	.092	.123
Green-winged teal	California	Jan.-Feb. 58	Adult	Male	Regular	381	.013*	.021
					1 wide-1 reg.	381	.039*	.029
				Female	Regular	119	.034	.008
					1 wide-1 reg.	119	.034	.000
Black duck	New York	Jan.-Apr. 59	Adult	Male	Regular	256	.027	.090
					1 lock-on-1 reg.	303	.030	.053
				Female	Regular	271	.044	.041
					1 lock-on-1 reg.	193	.041	.026
		Aug.-Sept. 58	Immature	Male	Regular	62	.129	.048
					1 lock-on-1 reg.	254	.173	.102
				Female	Regular	31	.097	.129
					1 lock-on-1 reg.	243	.140	.041

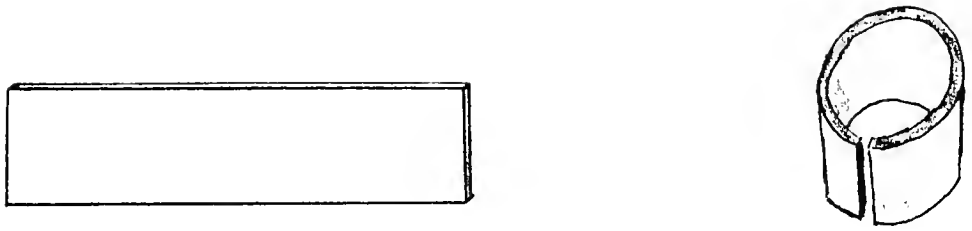
*Significant difference at the 95 percent level.
**Significant difference at the 99 percent level.

Table 6.--Band recovery series and mortality rate indexes for birds banded with two bands, extra-wide bands and lock-on bands (50 or more recoveries for each experimental and control)

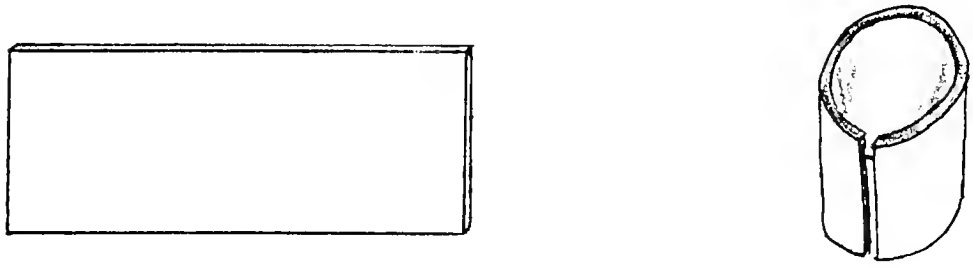
Species	Age	Sex	Band type	Number banded	Hunting seasons survived 1	2	3	4	5	6	7	8	Index to average annual mortality rate
Double bands													
Pintail	Adult	Male	Regular	773	37	25	11	6	9	2	4	3	.383
(California)			1 wide-1 reg.	873	58	45	23	12	12	14	4	3	.371
	Immature	Male	Regular	521	41	17	9	2	0	4	0	1	.521
			1 wide-1 reg.	516	74	10	6	3	4	3	0	3	.554
	Immature	Female	Regular	367	24	4	6	1	2	1	1	1	.472
			1 wide-1 reg.	365	30	12	7	3	2	1	0	1	.505
Mallard	Adult	Male	Regular	576	35	33	17	9	6	6	4	0	.390
(Oregon)			1 wide-1 reg.	565	44	39	30	17	13	6	6	2	.358
Extra-wide bands													
Blue-winged teal	Immature	Male	Regular	521	79	3	1	0	0	1	1	0	.842
(Minnesota)			Wide	540	74	4	2	0	0	2	0	0	.820
	Immature	Female	Regular	581	91	5	0	1	0	0	0	-	.924
			Wide	536	67	5	1	2	0	0	1	-	.799
Canada geese	Local	Unknown	Regular	328	40	14	17	5	6	1	3	-	.439
(Calif.-Nevada)			Wide	331	53	17	17	6	6	1	0	-	.505
	Adult	Male	Regular	335	30	12	15	1	3	0	1	-	.496
			Wide	335	36	13	15	10	7	0	1	-	.434
	Adult	Female	Regular	346	23	6	18	4	8	1	0	-	.397
			Wide	343	37	10	14	7	4	0	0	-	.490
(Alaska)	Adult	Unknown	Regular	1,076	30	22	18	15	8	3	4	1	.358
			Wide	900	29	14	12	8	13	4	4	1	.340

Table 6.--Band recovery series and mortality rate indexes for birds banded with two bands, extra-wide bands and lock-on bands (50 or more recoveries for each experimental and control)--continued

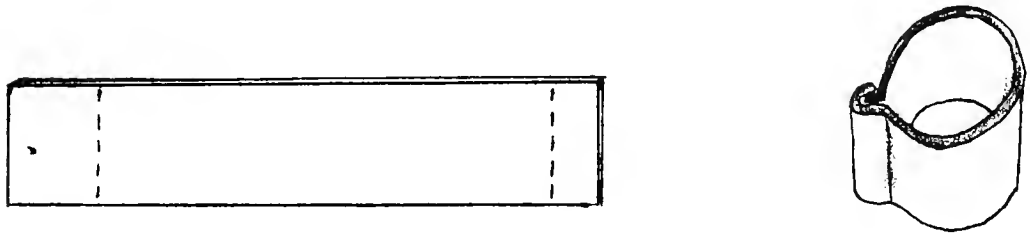
Species	Age	Sex	Band type	Number banded	Hunting seasons survived 1	2	3	4	5	6	7	8	Index to average annual mortality rate
Lock-on bands													
Canada geese (Illinois)	Adult	Unknown	Regular	542	30	32	19	10	11	9	4	-	.351
			Lock-on	480	24	24	18	10	7	5	3	-	.361
	Immature	Unknown	Regular	387	45	26	15	7	2	3	2	-	.471
			Lock-on	419	40	25	13	6	6	0	2	-	.467
	Adult	Unknown	Regular	601	13	32	17	12	4	3	0	-	.378
			Lock-on	505	14	27	21	6	10	8	1	-	.335
	Immature	Unknown	Regular	444	39	19	7	14	4	1	-	-	.466
			Lock-on	489	32	24	12	20	12	6	-	-	.363
Pintail (California)	Immature	Male	Regular	547	61	21	7	4	2	1	4	-	.544
			Lock-on	547	48	13	5	3	2	0	1	-	.643
Lesser Snow geese (Keewatin)	Unknown	Unknown	Regular	1,500	59	65	27	29	37	15	9	0	.333
			Lock-on	1,599	69	77	41	35	42	18	19	1	.320
Blue geese (Keewatin)	Unknown	Unknown	Regular	1,000	29	22	6	22	24	9	4	0	.304
			Lock-on	900	34	38	23	20	21	16	8	1	.307



Regular U.S. Fish and Wildlife Service band



Extra-wide or "high" band



Lock-on band

Figure 1.--Types of bird bands used in the experiments on band retention. Bands are shown open (left) and applied (right).

The Department of the Interior, created in 1849, is a Department of Conservation, concerned with management, conservation, and development of the Nation's water, wildlife, fish, mineral, forest, and park and recreational resources. It has major responsibilities also for Indian and Territorial affairs.

As America's principal conservation agency, the Department works to assure that nonrenewable resources are developed and used wisely, that park and recreational resources are conserved for the future, and that renewable resources make their full contribution to the progress, prosperity, and security of the United States, now and in the future.

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FISH AND WILDLIFE SERVICE
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