SURVIVAL IN BIRDS BANDED AT THE HASTINGS RESERVATION

By JEAN M. LINSDALE

Banding of birds was one of our first undertakings after we moved, in 1937, to the Hastings Reservation. This location is in the northern part of the Santa Lucia Mountains in Monterey County, California, and about 100 miles south of Berkeley. Our banding has been restricted to the winter months or to the season when the most numerous winter visitant birds are present. We have kept within a half mile section of the canyon where living quarters of the Reservation are located. The number of traps used has been small; rarely have we been able to assemble more than twenty at one time. To cover the area suitably we have to move the traps at frequent intervals. Nearly every person who lives on the Reservation in the winter becomes interested in the trapping. At least 15 people have had a share in the operation of the traps, some of them for several seasons; and several others have helped in the study of the records. The following persons have had a part in the banding study: Janet Cahoon, Rachel Davis, F. E. Durham, R. B. Finley, Jr., J. A. Gray, Jr., R. Holdenried, P. D. Hurd, D. Linsdale, J. M. Linsdale, Mary Ann Linsdale, Hulda M. Love, J. Moojen, T. A. Riney, E. L. Sumner, Sr., L. P. Tevis, Jr., P. Q. Tomich, H. G. Weston, Jr., and L. Williams.

We had numerous objectives in thus devoting a share of our attention to trapping and banding of birds. The handling of live birds has a special value in gaining a better acquaintance with species and individuals. This applies to color and pattern and change of plumages as well as to such characteristics as size and mannerisms which are seldom, or poorly, revealed by examination at long range. The total number of birds banded in an area through a season usually differs considerably from counts or estimates, however carefully these may be made. Our estimates invariably turn out to be too low. The home areas of individuals and flocks through the winter season and changes in them are shown with remarkable accuracy by the repeated records of captures. We come to anticipate certain kinds of change as each season progresses. These local movements are characteristic for the separate species and the recognition of them is useful in the placing of the traps. For example, each spring nearly the whole population of white-crowned and golden-crowned sparrows moves up the canyon in the weeks preceding the migration and we are likely to intercept most of the birds by keeping the traps in one location. For resident species the localization of pairs before the nesting season is clearly evident. Some relations between species, such as their habits when feeding together, their characteristic means of demonstrating intolerance, and the encounters with predators, are made prominent to the bird trapper. We are able to study the external parasites. especially ticks, lice, and flies and to examine the birds for parasites in the blood. A few recoveries from a distance indicate the nature of some of the travels away from the Reservation. Finally, we get much evidence of the survival of individual birds.

In the eleven years since the fall of 1937 we have trapped and banded 5726 birds belonging to 36 species. The California quail with 248 individuals was the most numerous of the 6 non-passerine species. Birds of infrequent occurrence on the area were a Wilson snipe, a red-winged blackbird, two English sparrows, a green-tailed towhee, four white-throated sparrows, and a Harris sparrow. Special attention has been given to the 15 kinds of sparrows. and mainly to the towhees and the crowned sparrows. The 283 spotted towhees, 452 brown towhees, 1258 white-crowned sparrows, and 2749 golden-crowned sparrows make up four-fifths of the total and provide most of our material for study. The first two are strictly resident and sedentary. The second two are present in winter only and nest far to the north, mainly in Canada. For these two species there

have been more than 20,000 captures, an average of close to six for each bird. For a summary of the status of each kind of bird on the Reservation see the Condor (49: 236-241).

Table 1

Birds Banded on the Hastings Reservation, November, 1937, to June, 1948

Sharp-shinned hawk, *Accipiter striatus*	3
California quail, *Lophortyx californica*	248
Wilson snipe, *Capella gallinago*	1
Mourning dove, *Zenaidura macroura*	2
Barn owl, *Tyto alba*	2
Red-shafted flicker, *Colapter cafer*	2
Ash-throated flycatcher, *Myiarchus cinerascens*	1
California jay, *Aphelocoma californica*	62
Yellow-billed magpie, *Pica nuttallii*	12
Plain titmouse, *Parus inornatus*	21
White-breasted nuthatch, *Sitta carolinensis*	1
Wren-tit, *Chamaea fasciata*	75
House wren, *Troglodytes aëdon*	9
Bewick wren, *Thryomanes bewickii*	12
California thrasher, *Toxostoma redivivum*	73
Varied thrush, *Ixoreus naevius*	2
Hermit thrush, *Hylocichla guttata*	25
Mexican bluebird, *Sialia mexicana*	1
Townsend warbler, *Dendroica townsendi*	1
English sparrow, *Passer domesticus*	2
Red-winged blackbird, *Agelaius phoeniceus*	1
Bullock oriole, *Icterus bullockii*	7
Black-headed grosbeak, *Pheucticus melanocephalus*	2
Purple finch, *Carpodacus purpureus*	16
House finch, *Carpodacus mexicanus*	20
Green-tailed towhee, *Chlorura chlorura*	1
Spotted towhee, *Pipilo maculatus*	283
Brown towhee, *Pipilo fuscus*	452
Lark sparrow, *Chondestes grammacus*	18
Oregon junco, *Junco oreganus*	233
Harris sparrow, *Zonotrichia querula*	1
White-crowned sparrow, *Zonotrichia leucophrys*	1258
Golden-crowned sparrow, *Zonotrichia coronata*	2749
White-throated sparrow, *Zonotrichia albicollis*	4
Fox sparrow, *Passerella iliaca*	63
Lincoln sparrow, *Passerella lincolnii*	20
Song sparrow, *Passerella melodia*	43
Total (36 species)	5726

Besides the small number of traps our evidence is marred by insufficient use of them. Other work makes it impracticable to attend the traps as continuously and as regularly as we would like. It is sometimes obvious that our baits do not compete satisfactorily with the foods naturally available. Some irregularity in our results comes from deviations in the weather. For example, a February snowfall may bring a swarm of birds into

the traps, but these retreat to other sections of the mountains when the ground is again uncovered. Elements of this kind must be considered in any study of the trapping results.

Five birds out of the nearly 6000 have been recovered from distant places. A white-crowned sparrow first banded on September 30, 1940, as an adult was retrapped on October 19 and 31 of the same year. It was found on the following January 14 at Salinas about 20 miles to the north where, presumably, it was picked up dead. This record shows that even though the species seems to be remarkably localized during its winter stay on the Reservation, there is a continuous shifting in the population which takes the birds to more or less distant places even before the normal time for migration. We have not yet, however, captured a white-crowned sparrow which we recognized as belonging to the resident coastal race which is abundant less than 20 miles to the west.

Three recoveries have been golden-crowned sparrows. The nearest recovery was of a bird we banded on November 21, 1944, and which on April 2, 1945, was "caught, band removed, bird released in good condition at Livermore, California" by J. W. Foster, Veterans Hospital, Livermore. This is about 90 miles north of the Reservation. We have no way to know whether this bird returned to the Reservation and was banded anew. Another bird, banded on March 24, 1942, was trapped 12 times by April 17. On April 15 of the following year this individual was recovered at the east end of Jefferson County, Washington, by Emily Scholl, of the Seattle Audubon Society. This one had gone about 800 miles toward its summer home. The third golden-crown recovery was of a bird trapped on February 6 and 9, 1939, and picked up on May 10 of the same year by George E. Darby, R. W. Large Memorial Hospital, Campbell Island P.O., Bella Bella, British Columbia. This is a little under 1000 miles from the Reservation.

A song sparrow trapped beside the stream near the buildings five times from February 19 to March 27, 1946, was found dead on March 31, 1947, by Cherie Addenin at Robles del Rio on the Carmel River about 15 miles downstream from the Reservation and 10 miles away airline. This was at the beginning of a period of dry years and the bird may have moved down the stream because of the drying up of its original home surroundings.

All these items have some bearing on our study of survival in the banded birds. Numerous others must be considered also. The trapping itself affects the survival in ways not readily measured. Injuries to birds caused by the traps seem to be infrequent and usually recovery is rapid, but some deaths must result from this source. A few birds die at the time of capture with no clue as to the cause, which may be some kind of shock. Only in rare examples does the removal of birds from the trap and handling of them result in injury or death, and this despite special experience and care on the part of the trapper. Even the most reliable trapper is capable of leaving birds exposed too long to the heat of sunshine or the cold of night or of a storm. Birds in traps attract animals to eat them. Sharp-shinned, Cooper and sparrow hawks, along with ground squirrels and chipmunks have destroyed too many of our trapped birds. They learn to watch the trap sites and they are persistent in returning to these special hunting grounds. Traps set for mammals provide an additional, artificial hazard for small birds and a few birds that have moved for short distances from the bird-trapping area have been killed in this manner. An opposite kind of influence is the extra food supplied as bait, but it is not clear how much this favors longer life.

All the losses of birds traceable to the trapping numbered 174 which amounted to only 0.03 of one per cent of the birds banded. Just half of the known deaths were caused by some animal (bird or mammal). The remainder (87) resulted from failure of the trap, exposure to weather, and miscellaneous causes. Numbers of banded birds that died as a result of the trapping or from some other recorded cause were as follows:

Golden-crowned sparrow	83	California thrasher	2
White-crowned sparrow	52	Oregon junco	2
Brown towhee	20	Yellow-billed magpie	1
Spotted towhee	7	Bullock oriole	1
California quail	4		
Song sparrow	2	Total	174

The bands may have some harmful effect on the birds from the rare injury they cause and the still rarer impediment of catching on some object like a stick or wire. They have greater importance in our learning of survival because they wear so thin as to be lost while the bird still lives. In the last year or two numerous examples of bands so worn as to be near the point of dropping off have been found. Even if these are carefully replaced when discovered, there must be some that are lost. This is not encouraging for any person considering a long program of bird banding to determine survival.

This brief outline of our trapping supplies background to review the records of survival so far accumulated. On the basis of yearly returns about half the species trapped have appeared in the traps at least a year after the time of first capture. Fifteen per cent of all the banded individuals have been still present, or have returned, at least a year after banding. This proportion is low because it is based on the total number banded and some of these were banded only this year. The numbers of survivors, of all species, for successive years were 1696, 621, 281, 139, 55, 24, 11, and 3. Expressed as ratios of the number banded in these species, the values for the years are 30.2, 11, 5, 4.8, 0.1, 0.04, 0.02, and 0.005.

Winter visitant species were listed as surviving for a year if caught in the winter season after the season of first capture. An exception is the white-crowned sparrows in which the brown head stripes are replaced in the spring; winter birds first captured with black stripes were listed as one year old at time of first capture. Resident species first

Table 2

Survival of Birds Banded on the Hastings Reservation from 1937 to 1948

			Years							
	Banded	Died	1	2	3	4	5	6	7	8
California quail	248	4	58	26	11	2	1	0	0	0
California jay	62	0	40	8	4	2	1	0	0	0
Yellow-billed magpie	12	1	4	1	1	1	0	0	0	0
Plain titmouse	21	0	6	2	0	0	0	0	0	0
Wren-tit	75	0	18	11	6	6	5	3	1	0
House wren	9	0	4	1	0	0	0	0	0	0
Bewick wren	12	0	2	2	1	0	0	0	0	0
California thrasher	73	2	15	8	2	1	1	1	0	0
Hermit thrush	25	0	10	2	1	1	0	0	0	0
Bullock oriole	7	1	1	1	0	0	0	0	0	0
Spotted towhee	283	7	94	41	25	15	6	4	1	0
Brown towhee	452	20	184	83	51	29	9	3	2	0
Oregon junco	233	2	20	19	10	5	2	1	1	1
White-crowned sparrow	1258	52	763	179	82	37	18	10	5	2
Golden-crowned sparrow	2749	83	441	214	75	35	9	0	0	0
White-throated sparrow	4	0	2	2	1	0	0	0	0	0
Fox sparrow	63	0	9	7	6	2	1	0	0	0
Song sparrow	43	2	25	15	5	3	2	2	1	0
Total	5628	174	1696	621	281	139	55	24	11	3

captured after March 1 and before young of the year appeared are listed as surviving at least one year.

Table 3

Banding Records of Crowned Sparrows on the Hastings Reservation, November, 1937, to April, 1948

	White-crowned sparrow					Golden-crowned sparrow			
Date	New im.	New ad.	Ret.	Repeat	Total	New	Ret.	Repeat	Total
1937									
Nov.	16	31	0	9	56	31	0	7	38
Dec.	11	24	0	106	141	19	0	47	66
Yr.	27	55	0	115	197	50	0	54	104
1938									
Jan.	1	1	0	23	25	0	0	4	4
Apr.	0	2	1	2	5	2	0	0	2
Oct.	66	25	28	130	249	18	4	14	36
Nov.	28	21	7	70	126	99	2	105	206
Dec.	6	9	1	47	63	69	1	88	158
Yr.	101	58	37	272	468	188	7	211	406
1939									
Jan.	4	1	8	38	51	18	2	30	50
Feb.	0	0	10	97	107	93	2	56	151
Mar.	6	4	17	33	60	20	2	28	50
Apr.	2	13	10	54	79	49	12	337	398
Nov.	0	0	1	0	1	0	0	0	0
Dec.	0	0	0	0	0	2	0	0	2
Yr.	12	18	46	222	298	182	18	451	651
1940									
Jan.	50	10	41	186	287	91	23	144	258
Feb.	4	1	4	107	116	8	8	33	49
Mar.	1	0	0	9	10	0	1	3	4
Apr.	3	13	13	89	118	27	6	131	164
Sept.	11	5	3	3	22	0	1	0	1
Oct.	80	22	38	166	306	152	35	152	339
Nov.	22	7	18	115	162	108	23	311	442
Dec.	3	0	5	36	44	32	4	93	129
Yr.	174	58	122	711	1065	418	101	867	1386
1941									
Jan.	4	2	17	43	66	39	19	118	176
Feb.	4	0	23	86	113	25	14	137	176
Mar.	6	2	35	214	257	19	18	180	217
Oct.	89	13	38	139	279	113	24	110	247
Nov.	17	0	16	228	261	25	13	116	154
Dec.	0	1	0	27	28	4	0	21	25
Yr.	120	18	129	737	1004	225	88	682	995
1942									
Jan.	15	2	14	127	158	33	16	144	193
Feb.	0	0	4	90	94	7	8	84	99
Mar.	1	5	17	281	304	86	40	383	509
Apr.	0	4	0	54	58	62	20	528	610
Sept.	8	3	0	1	12	1	0	0	1
Oct.	76	10	35	248	369	202	46	412	660
Nov.	14	3	8	101	126	66	26	309	401
Dec.	8	0	5	46	59	37	11	162	210
Yr.	122	27	83	948	1180	494	167	2022	2683
1943									
Jan.	2	0	5	47	54	34	5	441	480
Feb.	0	0	0	3	3	13	2	49	64
Mar.	5	0	4	161	170	27	3	501	531
Yr.	7	0	9	211	227	74	10	991	1075

Date	White-crowned sparrow					Golden-crowned sparrow			
	New im.	New ad.	Ret.	Repeat	Total	New	Ret.	Repeat	Total
1944									
Jan.	9	2	19	184	214	56	40	219	315
Feb.	7	3	13	133	156	52	19	476	547
Mar.	2	3	3	109	117	25	19	553	597
Apr.	0	1	0	17	18	29	5	241	275
Oct.	9	1	4	4	18	17	8	1	26
Nov.	90	4	12	191	297	131	23	126	280
Dec.	3	0	0	75	78	14	9	98	121
Yr.	120	14	51	713	898	324	123	1714	2161
1945									
Jan.	4	1	4	131	140	13	12	178	203
Feb.	4	0	4	48	56	5	5	141	151
Mar.	0	0	0	60	60	11	2	67	80
Apr.	0	0	0	0	0	2	0	4	6
Oct.	68	23	20	143	254	133	22	147	302
Nov.	11	2	14	183	210	69	27	536	632
Dec.	0	0	0	0	0	4	0	37	41
Yr.	87	26	42	565	720	237	68	1110	1415
1946									
Jan.	2	0	3	83	88	34	11	408	453
Feb.	6	1	0	117	124	25	5	343	373
Mar.	3	2	3	83	91	14	2	192	208
Apr.	0	1	1	13	15	4	1	91	96
Sept.	11	6	1	4	22	0	0	0	0
Oct.	41	16	18	69	144	129	31	116	276
Nov.	32	6	12	62	112	61	12	102	175
Dec.	0	0	1	26	27	0	1	8	9
Yr.	95	32	39	457	623	267	63	1260	1590
1947									
Jan.	0	0	0	2	2	0	0	3	3
Feb.	2	0	1	30	33	3	6	38	47
Mar.	0	0	2	7	9	4	12	17	33
Apr.	1	0	1	18	20	10	3	108	121
Oct.	53	12	24	92	181	66	19	67	152
Nov.	9	4	10	108	131	112	20	282	414
Dec.	5	0	2	50	57	40	8	245	293
Yr.	70	16	40	307	433	235	68	760	1063
1948									
Jan.	0	0	0	13	13	1	0	49	50
Feb.	0	0	1	145	146	23	0	151	174
Mar.	0	1	2	136	139	31	11	518	560
Yr.	0	1	3	284	298	55	11	718	784
Total	935	323	601	5552	7411	2749	724	10,840	14,313

For a comparison of the species each is considered separately. A California quail was recaptured after 5 years. A California jay survived at least 5 years. A yellow-billed magpie was found dead 4 years after it was first trapped. A Bewick wren was captured after 3 years. A California thrasher has been trapped in 6 years. Two wren-tits survived 5 years. A hermit thrush was trapped 4 years after its first capture. A Bullock oriole was taken after 2 years. Fifteen spotted towhees survived for 4 years and one for 7 years; 15 brown towhees were trapped after 4 years and two came into the traps after 7 years. The longest record of life span for a junco is 8 years. Nine golden-crowned sparrows returned for 5 winters and 18 white-crowned sparrows have returned after 5 years, while 5 have been captured after 7 years, and 2 lived at least 8 years. One white-throated

sparrow came back for a third winter. A fox sparrow was caught 5 years after the first capture. One song sparrow has been retrapped after 7 years.

These records show no great difference in survival between the strictly resident species and the ones which winter here after a long migration. The longest record of survival, that of the junco which was caught after 8 years, is probably that of a migrating bird. In this species we expect a prominent wave of migration in mid-March of each year. Not many individuals have been trapped and there have been few repeats, but the number of returns has been high. Only 233 have been banded but in successive years returns have numbered 20, 19, 10, 5, 2, 1, 1, and 1.

Table 4

Survival of White-crowned Sparrows

Each column shows number of birds surviving in successive winters out of those first captured in the season indicated at the head of the column. Upper number (Bk) indicates adult when first trapped; lower number (Bn) indicates young of the year. Total of birds alive each winter is indicated on the right.

	1937 1938	1938 1939	1939 1940	1940 1941	1941 1942	1942 1943	1943 1944	1944 1945	1945 1946	1946 1947	1947 1948	Total
1937	Bk 58											
1938	Bn 28											86
1938	32	73										
1939	15	112										232
1939	14	30	24									
1940	11	35	58									172
1940	8	20	4	38								
1941	8	24	31	130								263
1941	7	7	1	7	25							
1942	4	11	14	28	122							226
1942	2	2	1	1	3	16						
1943	2	7	8	9	25	113						209
1943	1	2	0	1	1	1	9					
1944	0	3	5	1	10	16	18					68
1944	0	1	0	1	0	1	1	6				
1945	1	2	3	1	6	8	5	110				146
1945		1	0	0	0	0	0	1	29			
1946		2	3	0	5	5	3	26	90			165
1946		0	0	0	0	0	0	0	6	28		
1947		1	1	0	2	2	1	15	14	87		157
1947							0	0	4	6	17	
1948							1	8	7	13	67	123

The figures for survival have more significance when the size of the original population is known and the reduction can be traced through successive years. This information is available for the white-crowned and golden-crowned sparrows, the two wintering species for which we have the most complete records. By placing the total number of new captures at the top of successive columns representing the separate years and by dropping each new year one line, a table can be made in which the columns read downward show the remainders of each year's new birds and each horizontal line shows the approximate ages of the population present each year. The more thorough the trapping the more reliable will be the figures in representing the true changes in the population.

Table 5

Survival of Golden-crowned Sparrows

Each column shows number of birds surviving in successive winters out of those first captured in the season indicated at the head of the column. Total of birds alive each winter is indicated on the right.

	1937 1938	1938 1939	1939 1940	1940 1941	1941 1942	1942 1943	1943 1944	1944 1945	1945 1946	1946 1947	1947 1948	Total
1937 1938	52											52
1938 1939	5	366										371
1939 1940	5	62	128									195
1940 1941	3	44	54	375								486
1941 1942	1	18	30	75	345							469
1942 1943		12	12	35	57	346						462
1943 1944			8	9	16	59	162					253
1944 1945			2	4	6	26	33	193				264
1945 1946				1	1	15	23	33	282			355
1946 1947					1	9	1	20	37	207		275
1947 1948						5	0	11	15	26	218	275

For these wintering species we might assume that all the birds which survive come back to the same winter home established in their first year's migration.

We know, however, that this habit is not universal, though the tendency is remarkably strong. Even in the two being considered, there is a clear difference in this respect. The golden-crowned sparrows are trapped in greater numbers each year; usually there are about twice as many as white-crowns. The proportion, however, which comes back in the second and successive years is much smaller. The percentages of second year returns for immature white-crowns range from 14.2 to 53.6 and average 27.1 for 10 years; for adults, the range is from 11.1 to 55.0, average 21.9. For golden-crowns the range is from 9.6 to 42.1, average 18.6.

Percentage of Each Year's New Birds Surviving the Second Year

	White-crown		Golden-crown
	im.	ad.	
1938-39	53.6	55.0	9.6
1939-40	31.1	41.0	17.0
1940-41	53.4	16.7	42.1
1941-42	21.5	18.4	20.0
1942-43	20.5	12.0	16.5
1943-44	14.2	6.2	17.0
1944-45	22.8	11.1	20.4
1945-46	23.6	16.7	17.4
1946-47	15.4	20.6	13.2
1947-48	15.0	21.4	12.5
Average	27.1	21.9	18.6

My conclusion from all our observations on this topic is that we are in the true wintering ground of a greater number of the white-crowns than golden-crowns captured, that the golden-crowns move on to some other location, and that in general they are less sedentary in winter. It is possible that the white-crowns really live longer, as these records seem to show, but this is not necessarily true.

The white-crowned sparrows which come to winter on the Reservation belong to races in which the young retain brown-striped heads through the first winter only. This distinction between young birds and old birds helps to show that establishment of a winter home is generally firmly fixed in the first winter. Our records show a preponderance of young birds in the new captures each season. Some of the black-striped ones may have been missed in the trapping of previous years. Some are not trapped until after the spring molt. Others may have lived in the vicinity but not far from the area trapped. The number likely to be individuals that have changed winter quarters must be small. The numbers of adults and young newly trapped each year and the ratios between them are indicated in the following summary:

	Number			Per cent	
	Adult	Young		Adult	Young
1937-38	58	28		67.4	32.6
1938-39	73	112		39.5	60.5
1939-40	24	58		29.2	70.8
1940-41	38	130		22.6	77.4
1941-42	25	122		17.0	83.0
1942-43	16	113		12.4	87.6
1943-44	9	18		33.3	66.7
1944-45	6	110		5.0	95.0
1945-46	29	90		24.4	75.6
1946-47	28	87		24.3	75.7
1947-48	17	67		20.1	79.9
Total	325	935	Mean	26.8	73.2

In reviewing these observations, attention is directed to the small size of the area concerned in these winter studies. A long strip of twenty acres would include every trapping station as well as the ranges on the Reservation of nearly all the individual birds concerned. When this is compared with the long line of travel, over a thousand miles for the migrant species, the remarkable effectiveness of the controls over the birds which come and stay and return repeatedly between the two homes is given special emphasis. The rigidity of these controls is further demonstrated when we realize how small a part of the whole population of each species is represented on our minute area. If 4000 crowned sparrows have wintered on our 20 acres in the last 11 years, how many have come to the 100 million acres of California? How was each of them able to find and stay in its particular home area? Before we make guesses pertaining to these questions, we need to know more about what the birds really do.

Hastings Reservation, Monterey County, California, June 28, 1948.