The bottom of the slot in the rod carrying the expanded band is then placed against the bird's leg and the band pushed over the base of the rod with a sliding push of the thumb while the rod is held in the hand. The pressure should be applied at one end of the opened band so that it will lead the other end and begin to wrap around the leg ahead of the other. When the band is released from the rod, its spring causes it to encircle the leg with a snap and a motion too fast for the eye to follow.

The operation is extremely easy and with reasonable care the maladjustment of a band rarely occurs. If it does happen, one can carefully expand the band by holding the edge of the band with a fingernail and remove it almost as easily as when the band is free and without injury to the bird.

Different sized rods will be convenient for different sized bands and the circumference of the rod should be about a third larger than the length of the unrolled band. The slot should, of course, be sufficiently deep so that the bird's leg will lie well within the edges and at the end of the rod slot when the band is released. An old-fashioned match stick provides an excellent medium for practice as well as some entertainment.

The rod can be whittled from any suitable piece of wood, but it can be made most easily from four- or five-inch pieces of hardwood doweling of sizes from one-quarter to one-half inches in diameter. While the bands are not distributed in sizes they do, however, vary considerably in length. A dowel five-sixteenths inch in diameter is satisfactory except for the extreme lengths of bands.

A rather sharp-edged, half-round wood file is an excellent tool for pointing the rods and for cutting the grooves.

159 Elm Street, Northampton, Massachusetts.

THE FATE OF BANDED KENT ISLAND HERRING GULLS[1]

BY RAYMOND A. PAYNTER, JR.

For the past thirteen years Bowdoin College has maintained a scientific station on Kent Island, Grand Manan, New Brunswick, Canada (Bay of Fundy, Lat. 44°35′N., Long. 66°45′W.). The island, an ornithological paradise situated at the junction of the Transition and Canadian faunal zones, is composed of one hundred and fifty acres of variable terrain. The northern end of the island supports a few

[1]Contribution number 17, Bowdoin Scientific Station, Kent Island, Bay of Fundy, New Brunswick, Canada, and Osborn Zoological Laboratory, Yale University.

hundred pairs of Herring Gulls, *Larus argentatus smithsonianus* Coues, along the shore and a large colony of Leach's Petrels, *Oceanodroma leucorhoa leucorhoa* (Vieillot), in the interior, and is covered with a thick stand of spruce. The central portion is a meadow where the buildings of the station are located, while the southern end is partly marshy with dead spruces occupying about seventy-five per cent. of the area. This section has a colony of an estimated thirty thousand nesting Herring Gulls, at least one thousand Eiders, *Somateria mollissima dresseri* Sharpe, one hundred Black Guillemots, *Cepphus grylle atlantis* Salomonsen, a few petrels, and about fifteen pairs of the Great Black-backed Gull, *Larus marinus* Linnaeus. The rugged shoreline, mud flats, and surrounding waters are rich in marine life, and offer an almost inexhaustible food supply for the more than one hundred species of resident and transitory birds.

Since 1934, as part of the program of the station, extensive bird banding operations have been carried on under the direction of Dr. Alfred O. Gross. Thus far, as illustrated in Table 1, a total of 1,635 adult and 34,557 immature Herring Gulls have been banded.

TABLE 1. HERRING GULLS BANDED AT KENT ISLAND

Year	Young	Adults	Total
1934	2,248	—	2,248
1935	6,754	50	6,804
1936	7,600	400	8,000
1937	4,651	200	4,851
1938	3,059	720	3,779
1939	3,000	110	3,110
1940	800	—	800
1941	1,300	155	1,455
1942	687	—	687
1943	2,258	—	2,258
1944	2,000	—	2,000
1945	200	—	200
	34,557	1,635	36,192

Returns have been received from 1,252 or 3.62 per cent. of the gulls banded when immature, and from 121 or 7.40 per cent. of the gulls banded as adults. These have come from a vast region extending from Newfoundland and Quebec on the north, to the West Indies, and Central America as far south as British Honduras. Most of the recoveries were made along the Atlantic seaboard, but two birds were recovered as far west as North and South Dakota, and one as far east as the northern coast of Spain.

The geographical distribution of returns in relation to migration routes and distances has been discussed by Dr. Gross in an earlier paper (1940). The purpose of this paper is to examine briefly the fate of the

1,373 gulls from which returns have been received up to December 31, 1945. This large number of returns distributed over an extended period, provides a unique source for reliable data on the fate of the Herring Gull.

I wish to express my appreciation to Dr. Alfred O. Gross of Bowdoin College for recommending this subject, and for his constant encouragement and assistance in its preparation. I am also indebted to Dr. Edward S. Deevey of Yale University for his aid in preparing the statistical aspects of the problem, and for his many helpful suggestions.

Three general methods of banding have been practiced. First, banding the young before they are able to fly. This is the most successful method and has accounted for 34,557 birds. Second, trapping the adults in large cage-like structures baited with herring. This is very effective if the herring schools are not abundant off shore, but it requires constant attention to prevent over-crowding and mortality. About twelve hundred birds have been banded in this manner. Third, "Jacking" the adults on foggy nights with a strong light. Approximately four hundred gulls have been banded by this more difficult procedure. In the future it is hoped to increase the operation, for within the last year it has proven a valuable method for obtaining longevity records and returns.

In recording the ages of the gulls, a July 1 to June 30 year has been adopted. All birds banded as adults are at least third or fourth year birds as they seldom return to the colony until the third, or more usually, the fourth year. An estimated five or six hundred first and second-year gulls are present on the island in the summer, but none have been banded.

Banding operations were begun in the summer of 1934 and the records arbitrarily terminated on December 31, 1945. This would seemingly be a ten and one-half year study, but no records were received from the Fish and Wildlife Service for this last half-year period, due to a wartime personnel shortage. Later reports show there were recoveries within this period, but for practical purposes the study will be considered as covering ten years.

The following facts should be borne in mind throughout this paper. Presumably, all banded birds suffering fates such as death in animal traps or fish nets are recovered and reported, while those dying from diseases, predators, etc., are recovered only by chance. Thus, not all returns are of equal significance. The fates closely allied with human activities appear more common than they actually are. For example, 54 of the 1,252 returns of birds banded when immature were recovered by fishermen. This is 4.31 per cent. of the total recoveries. However, it would be incorrect to say that nearly one-twentieth of Kent Island Herring Gulls suffer death in the fishing industry, because we are reasonably certain the 54 returns are the *only* birds, of the 34,557 banded, suffering this fate. Therefore, it is more nearly correct to state the mortality rate for this cause as .15 per cent., or three in every two thousand gulls.

The next consideration is the pronounced variation in age distribution. Although the records cover a ten-year period, and banding has been carried on throughout that time, the reliability of the data decreases in the older age groups because only a relatively small number of birds have been banded the full ten years. This number increases in the lower age brackets, making the data more reliable. To determine the life expectancy and mean age, certain adjustments must be made.

CAUSES OF DEATH

In analyzing the returns, two main divisions are formed—one for birds banded when adults, and the other for birds banded when immature. These have been broken down into Tables 2, 3, and 4, with fourteen classifications indicating the type of recovery and the order of frequency. The classifications are rather arbitrary because there is no definite procedure for reporting banded gulls and the reports are often incomplete in the details of the manner of recovery. This necessitates an unknown degree of error in the percentages of recoveries by various causes. For example, some gulls are reported as "found." This may mean found dead, found injured, etc.

I. FOUND DEAD: 695 RETURNS. The largest number of reports merely state, "found dead." It is obvious this is a general statement and throws no light on the cause of death.

Six hundred and seventy or 53.51 per cent. of the returns from gulls banded when immature are reported in this manner. The first-year birds make up 43.58 per cent. of the total, and the number grows progressively smaller as the age advances. Even considering the inaccuracies of the age distribution, this correlation seems attributable to a general weakness experienced during moulting, fatigue from the long migration flights which gradually diminish as the gulls grow older, and the lack of experience to cope with the frequent hazards which beset any bird.

The returns by states for this group show New York with one-fifth of the recoveries. This may be explained by the presence of a large harbor and garbage dumps which provide abundant food for birds of scavengering habits, plus the large number of observers and ornithologists affording a greater opportunity for the recovery of dead gulls.

The returns from gulls banded as adults vary greatly from the preceding group. Only slightly more than one-fourth of the total recoveries are classified as "found dead." This further substantiates the theory that the combined forces of migration fatigue, moulting weakness, and lack of experience may be the prime causes of death for the younger gulls.

II. CAUGHT: 115 RETURNS. Nearly all the birds reported as "caught" could have been placed under other divisions if the persons reporting had been acquainted with the need for details and accuracy.

TABLE 2
RECOVERIES OF GULLS BANDED AS ADULTS

Fate	New Brunswick	Nova Scotia	New York	Mass.	Maine	Virginia	Connecticut	Louisiana	Maryland	New Jersey	North Carolina	Rhode Island	Total	%
Found Dead	15	3	8	4	2	1				1		1	35	28.92
Collected	33												33	27.27
Captured and Released	21												21	17.35
Found	1	4						1					6	4.95
Injured or Ill	3	2		1									6	4.95
No Information	2	3		1									6	4.95
Shot	2	1		1			1						5	4.13
Caught by Fisherman		3									1		4	3.30
Caught		2											2	1.65
Dropped by Eagle						1							1	.82
Caught in Muskrat Trap									1				1	.82
Probably Found Dead		1											1	.82
Total	77	19	8	7	2	2	1	1	1	1	1	1	121	100%
%	63.63	15.70	6.61	5.78	1.65	1.65	.82	.82	.82	.82	.82	.82		

TABLE 3

RECOVERIES BY STATES OF GULLS BANDED AS YOUNG

Fate	New York	New Brunswick	Massachusetts	Florida	New Jersey	Nova Scotia	Maine	Virginia	Louisiana	North Carolina	Texas	Connecticut	Georgia	Mississippi	Rhode Island	Alabama	Newfoundland	Maryland	South Carolina	Delaware	Prince Edward Island	Mexico	New Hampshire	Ohio	Ontario	Pennsylvania	Quebec	Cuba	British Honduras	Indiana	Jamaica	Kentucky	Lat. 46° 30′ N. Long. 14° W.	Michigan	Missouri	North Dakota	South Dakota	Tennessee	Vermont	TOTAL	PER CENT.
Found dead	139	80	73	36	60	38	49	32	13	21	18	27	11	7	17	7	3	8	6	6	3	1	3	3	1	3	2	1						1				1	670	53.51
Caught	3	6	1	21	4	5	10	6	16	11	6		2	5	1	5	2		2		1	3			1			1	1										113	9.02
Injured or ill	16	14	7	6	6	10	2	5	6	4	2	1	1	3		4	1	2		3		1			1														95	7.58
Shot	6	3	3	5	2	9	5	3	2	2	4		5	2	1		8	1	1			1								1					1	1	1		67	5.35
Found	6	8	4	3	5	6	6	3	4	4	2		1	2	1						1					1							1						58	4.63
Caught by fisherman	3	3		3	1	12	3	9	2	4	4		3	1		1	1	2	1				1																54	4.31
Probably found dead	2	6	2	3		3	2	2	2		3			2	1	2			1		3																		34	2.71
Killed	5	5			1	1			1		1		2			2	5	1	1			1									1								27	2.14
Captured and released		23	1																											1								25	1.99
No information	1	4	2	7	1			3	1		3						1																					23	1.83
Caught in muskrat trap									12		1			1		1			1	2																		18	1.43
Collected		13								1				1																								15	1.19
Band recovered		5			1		1		1	1	2																											11	.87
Killed by automobile				2	3			1			1	1																										8	.63
Killed by airplane	3		2	2															1																			8	.63
Taken			1				1		2					1																								5	.39
Shot under gull control permit																		4																				4	.31
"Oiled"											2																											2	.15
Found tied to another gull													1		1																							2	.15
Came aboard ship at sea																																1						1	.07
Killed by eagle							1																															1	.07
Killed by train					1																																	1	.07
Caught in scoot bin							1																															1	.07
Band found in fox den															1																							1	.07
Observed				1																																		1	.07
Caught in fence				1																																		1	.07
Tame bird				1																																		1	.07
Fell down chimney				1																																		1	.07
Killed by fish unloading machine										1																													1	.07
Foot found in fish stomach		1																																				1	.07
Caught in hog pen										1																													1	.07
Choked to death on mullet										1																													1	.07
TOTAL	184	171	96	92	85	84	81	64	62	51	49	29	26	25	23	22	21	18	14	11	8	7	4	3	3	3	3	2	1	1	1	1	1	1	1	1	1	1	1,252	100%
PER CENT.	14.69	13.65	7.66	7.34	6.78	6.70	6.46	5.11	4.95	4.07	3.91	2.31	2.07	1.99	1.83	1.75	1.67	1.43	11.11	.87	.63	.55	.31	.23	.23	.23	.23	.15	.07	.07	.07	.07	07	.07	.07	.07	.07	.07	.07		

TABLE 4

AGE OF RECOVERY OF GULLS BANDED AS YOUNG

Fate	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Total	%
Found dead	292	161	81	48	41	25	8	6	7	1	670	53.51
Caught	90	11	6	3		2	1				113	9.02
Injured or ill	53	13	10	5	6	2	3	1		2	95	7.58
Shot	48	11	3	1	2	1	1				67	5.35
Found	19	17	9	7	2	3			1		58	4.63
Caught by fisherman	39	9	2			1	2	1			54	4.31
Probably found dead	21	7	1	1	3	1					34	2.71
Killed	22	3	2								27	2.14
Captured and released				5	6	7	6	1			25	1.99
No information	16	4			1	1	1				23	1.83
Caught in muskrat trap	16	2									18	1.43
Collected	3	1			2	4	5				15	1.19
Band recovered	4	4	2	1							11	.87
Killed by automobile	4	2	1		1						8	.63
Killed by airplane	8										8	.63
Taken	3	1					1				5	.39
Shot under gull control permit		3	1								4	.31
"Oiled"	2										2	.15
Found tied to another gull	2										2	.15
Came aboard ship at sea		1									1	.07
Killed by eagle	1										1	.07
Killed by train		1									1	.07
Caught in scoot bin								1			1	.07
Band found in fox den		1									1	.07
Observed	1										1	.07
Caught in fence	1										1	.07
Tame bird	1										1	.07
Fell down chimney	1										1	.07
Killed by fish unloading machine	1										1	.07
Foot found in fish stomach	1										1	.07
Caught in hog pen		1									1	.07
Choked to death on mullet		1									1	.07
Total	650	253	118	71	64	47	28	10	8	3	1,252	100%
%	51.91	20.20	9.42	5.67	5.11	3.76	2.23	.79	.63	.23		

The first-year birds are most susceptible to recovery with approximately 80 per cent. of the returns. The second-year birds show a sharp decrease to 10 per cent. This sudden drop is due to a shortening of the migration limits which removes the birds from the muskrat trapping regions of Louisiana where many returns are received as simply "caught" rather than "caught in a muskrat trap," which is the twelfth most numerous cause for recovery.

There are only two returns for the adult grouping. Both are from Nova Scotia where the fishing industry claims the lives of many gulls. These are, in all probability, the results of fishing accidents.

III. ILL OR INJURED: 101 RETURNS. The terms "ill" and "injured" have been combined because of the difficulty in diagnosing the bird's malady. Ninety-five or 7.5 per cent. of the recoveries of birds banded when young were from this cause. Again the first-year birds were most numerous, with 53 recoveries. Only 13 second-year birds were recovered, and there is a regular decline in the succeeding ages.

By states the recoveries for New Brunswick, Canada are greatest with a total of 14 birds. The presence of students in the field at the Bowdoin Scientific Station, as well as the existence of the gulls for over half the year in a colony, account for the numerous returns in an isolated locality.

Breeding activities are perhaps the outstanding causes of injury and illness on the island. During the mating season and the establishment of nesting territories, the gulls fight and in their hurried flights through the dead spruces not uncommonly fly into limbs, impaling themselves on the sharp ends. Also, birds often become caught in the underbrush or in cracks in logs and are attacked by rival gulls until they free themselves, badly injured, or die.

Only 5 per cent. of the gulls banded when mature are found ill or injured. This is a difference of 2.5 per cent., and indicates further a tendency for the younger birds to be more susceptible to injuries and illness.

IV. SHOT: 72 RETURNS. Sixty-seven or 5.35 per cent. of the returns from the birds banded as juveniles are received in this manner. It is possible the number would be even greater if the fear of prosecution did not cause many returns to be sent in as merely "killed."

Forty-eight returns are from first-year gulls. The heaviest returns for districts come from Newfoundland and Nova Scotia where shooting is permitted as a means of control. The single returns from Jamaica, South Dakota, North Dakota, and Tennessee come from this source and prove to be new migration records for Kent Island gulls. Five or 4.13 per cent. of the recoveries for the adult division fall in this classification.

V. FOUND: 64 RETURNS. Nineteen first-year birds and 17 second-year birds were incompletely reported as "found." There is a regular decline in the remaining years.

There are six returns in the adult division. A Louisiana return is the

only record of an adult Kent Island gull being recovered so far south. This bird was banded as an adult, indicating it was at least three years old, on July 3, 1939, and recovered in March of 1940.

VI. CAUGHT BY FISHERMEN: 58 RETURNS. Because the Herring Gull is a scavenger, large flocks congregate among the fishing boats and wharves to take waste fish from the decks and occasionally bait from trawl lines. These habits are the cause of death or recovery for many gulls.

Fifty-four of the returns from gulls banded as young come from this cause. The first-year birds caught in this manner total 39, while there are only nine second-year birds.

An unusual recovery was made by Mr. Colon S. Morrison, a fisherman of Perry, Maine, who found a sixth-year bird (number 36-64889) with only one leg in the bottom of his boat. The bird had gorged itself on fish offal until unable to fly. We may only speculate on the manner in which the bird lost its leg.

Four or 3.30 per cent. of the returns for birds banded as adults are from fishermen.

VII. COLLECTED: 48 RETURNS. This is the only grouping in which returns from gulls banded as adults total more than those from birds banded when young. Thirteen of the 15 recoveries in the division of banded immature birds come from Kent Island where they are collected during investigations. The two remaining returns are from Mississippi and North Carolina.

Thirty-three or 27.27 per cent. of the returns in the adult division also come from collecting operations at Kent Island. There are no returns from other districts.

VIII. CAPTURED AND RELEASED: 46 RETURNS. In the process of banding adult gulls by means of traps or jacking, 46 previously banded birds were recovered. Twenty-five were banded when young and 21 when adults. The only return from Indiana comes from this source and there is also a return from Massachusetts. Presumably both birds were caught in animal traps. The 21 returns from gulls banded when adults are from Kent Island.

IX. PROBABLY FOUND DEAD: 35 RETURNS. Thirty-four gulls banded when immature and one as an adult are reported in a manner which fails to specify distinctly the cause of recovery, but merely hints at finding the bird dead.

X. NO INFORMATION: 29 RETURNS. Twenty-nine reports were received in which details, other than the band numbers and states in which the birds were recovered, are lacking. Twenty-three of the recoveries are from birds banded as young and six from adults.

XI. KILLED: 27 RETURNS. None of the gulls in the adult division are re-

ported as killed, but there are 27 in the immature group. The exact circumstances of death are a matter of conjecture.

XII. CAUGHT IN MUSKRAT TRAP: 19 RETURNS. Eighteen or 1.43 per cent. of the returns from gulls banded as young and one banded as an adult were received from trappers. Sixteen are first-year birds and two second-year birds. The returns by states are primarily in the southern regions where the muskrat industry is concentrated. The predominance of young birds caught is not attributable to lack of experience because only immature gulls migrate into these regions.

While the records do not show a very large percentage of returns from this source, it should be remembered many "caught" returns come from the states also showing an abundance of trapping records. This leads one to believe the term "caught" should frequently be interpreted as "caught in a muskrat trap."

XIII. BAND RECOVERED: 11 RETURNS. Eleven reports state "band recovered," probably meaning from a dead gull.

XIV. MISCELLANEOUS: 43 RETURNS. The 19 fates occurring most infrequently have been placed under this classification. Twelve fates have occurred only once in the combined total of 1,373 returns. Only one return is from a bird banded as an adult. The majority of the records are from first and second-year birds, but one gull is reported "taken" in its seventh-year, and another was "caught in a scoot bin" at a canning factory in its eighth year.

Automobiles and airplanes both took a toll of eight birds. Three were killed by planes in New York, two in Massachusetts, two in Florida, and one in South Carolina. All were first-year birds and all were killed either at an airport or in the vicinity of one.

Considerable effort was made to contact the observers of these unusual accidents, but in many instances they were servicemen who moved so frequently their addresses were lost. However, information was received from two recoverers and from pilots who, although not ornithologists, have had considerable flying experience.

Mr. Earle F. Cook, Jr., of Dorchester, Massachusetts, reports the following incident. While he was along the shore of Savin Hill Bay, Dorchester, early one morning in October, 1944, two planes based at the Squantum Naval Air Station flew over the bay frightening a group of feeding Herring Gulls into the air. As the planes circled for a landing, the gulls flew to a slightly higher altitude. Suddenly gull number 36-650733 dropped down between the two planes and was caught in the slipstream of the first and thrown into the propeller of the second. As the mangled bird was thrown into the air and then fell into the water, the motor skipped, but the pilot seemed to have no difficulty in keeping the plane under control.

Gull number 39-662465 was killed in October, 1943, at the Charleston Naval Air Station. Mr. J. W. Eddy, who made the recovery, reports that gulls flock on the warm asphalt runways during cool weather, but the noise of the engines usually frightens them off in ample time. This bird, the only incident of which he knows, was struck by the leading edge of the wing of a plane as it took off, but inflicted no damage to the plane.

Pilots have reported striking birds, resulting in near accidents, while "wave skipping" over the Gulf of Mexico. At such speeds it is impossible to identify the birds, but pilots have expressed the opinion gulls are the principal victims. A naval officer reports one case where a plane crashed, killing the pilot, after hitting an unidentified sea bird. He has official photographs of the accident which may not be published.

Five birds are reported as "taken." Two returns are from Louisiana and therefore may refer to birds caught in animal traps. During the winter of 1937 three second-year birds and one third-year bird were shot in Baltimore, Maryland, under a Herring Gull Control permit. Two birds were recovered in Texas with oiled plumage.

In Georgia and Rhode Island two unusual but similar recoveries were made. In some manner a banded gull became tied to another gull by the leg. This may have been the result of pranksters who found the birds disabled and tied them together; or more probably the gulls were feeding in dumps and became entangled in strings.

The longest and most unusual migration flight of a Kent Island gull was made by number 36-648130. This gull was banded when a bird of the year on August 13, 1936, and recovered alive in November, 1937, aboard a ship off the northern coast of Spain at Lat. 46°30′N., Long. 14°W., approximately 2,600 miles from Kent Island.

Two birds are reported killed by eagles. One banded August 10, 1940, was killed at Lubec, Maine, on May 22, 1941. The other was banded August 15, 1938, as an adult, and recovered in Driver, Virginia, on April 1, 1940.

The remaining returns refer to fates occurring only once in the records and are listed in Tables 3 and 4.

THE IMPORTANCE OF HUMAN INFLUENCE

The question now arises, What effect does human activity have upon the mortality rate? The returns from birds banded when immature have been grouped in Table 5 under two headings.

1. "Natural recoveries" which strictly embrace the 674 recoveries of dead birds which, insofar as we can ascertain, died without direct human influence. The classifications in question are "found dead," "killed by an eagle," "band found in fox den," "band found in fish stomach," and "choked to death on mullet."

2. "Artificial recovery," which embraces the remaining 578 returns

including birds recovered alive as well as those dying from human activity.

In this manner, in spite of unrectifiable errors in classification and reporting, two approximately equal categories are formed.

From Table 5 it is evident that there is little difference between "natural" and "artificial" deaths with respect to ages at which they occur, with the possible exception of the first year of life. In this year, 46 per cent. of the natural deaths occur, while 60 per cent. of the artificial deaths are recorded. Since changing one percentage will change the rest, the usual methods of testing the statistical significance are not applicable to the first-year values. We may, however, examine the influence of the first-year differences on the mean length of life.

TABLE 5

NATURAL AND ARTIFICIAL RECOVERIES

Age	1	2	3	4	5	6	7	8	9	10	Total
Natural recovery	294	163	81	48	41	25	8	6	7	1	674
Per cent.	46.20	24.18	12.17	7.12	6.09	3.70	1.18	.89	1.03	.01	
Artificial recovery	356	90	37	23	23	22	20	4	1	2	578
Per cent.	60.16	15.50	6.40	3.97	3.97	3.80	3.46	.69	.17	.34	
Total	650	253	118	71	64	47	28	10	8	3	1,252
Per cent.	51.91	20.20	9.42	5.67	5.11	3.76	2.23	.78	.63	.23	

The mean length of life of birds recovered artificially is 2.3 $\pm$ .23 years, while those dying naturally live 2.5 $\pm$ .16 years. The difference between these two means, 0.2 years, proves to be only .34 times its own standard error, and hence cannot be adjudged significant. We are therefore justified in taking the mean length of life of the whole series, 2.44 $\pm$ .12 years, as the best approximation to the truth. It follows that human activities have essentially no influence on the life span of the Herring Gull, which is not regularly shot or trapped, and that those birds which died from human interference would, in all probability, have died at about the same time from natural causes.

EXPECTATION OF LIFE AND THE MAINTENANCE OF THE POPULATION

The data of Table 5 can be cast in the form of a conventional *life table*, so that the expectation of life, or mean after lifetime at any age,

can be calculated. This is done in Table 6, according to the method of Pearl (1940).

The symbol d'_x represents the original data values for age at death of the whole population, corrected for the fact that decreasing numbers of returns at greater ages are to be expected simply because the elapsed time has been less. In ten years of banding operations there are ten years in which first-year returns can be expected. The returns are therefore divided by 10, to give the number of first-year returns per year. The nine-year total of second-year returns is divided by 9, etc.

Using the resulting values of d'_x as representing the original, or "raw" data for deaths at age x, and converting these to a relative (per thousand) basis, the life table functions are calculated. These are d_x, the number of deaths at age x; l_x, the number of survivors at age x out of 1,000 hatched; q_x, the mortality rate per 1,000 alive at the beginning of the age interval; and e_x, the mean after lifetime remaining to individuals attaining age x.

Table 6 shows, in the l_x and q_x columns, first, that there is very heavy mortality in the first year of life, as might be expected in a natural population. Second, that after the third year, there is a more gradual decline in the number of survivors. Third, that at the fourth year (breeding year) there are 30.5 birds surviving out of 100 banded. From the e_x column it is seen that there is an increase in the life expectancy until the fourth year, at which point the mean after lifetime drops to 2.64 years.

No data are available on the mortality rate between laying and banding and there are also differences of opinion as to the average number of eggs laid per nest. Townsend (in Bent, 1921) says, "Three eggs constitute a set, although the number is sometimes only two, and in very rare cases one or four." Gross (1940) gives an average of 1.93 eggs which is based on the work of one of his students at Kent Island. The census may have been taken either early or late in the nesting season and therefore too low. Information accumulated since 1940 by Dr. Gross, but not yet analyzed in detail, suggests that the correct figure is approximately 2.5 eggs per nest. However, accepting these disparities, we may tentatively estimate the rate of reproduction and expose the errors in the life expectancy data.

To compute the rate of reproduction, we must assume banding takes place at hatching rather than later, and we must also assume the number of males and females is equal throughout the life span.

If of 100 birds hatched, 30.5 survive to breed and breed for 2.64 years, laying 1.93 (Gross) eggs per year, 80 eggs are laid per one hundred gulls hatched. If the number of eggs per nest is 3 (Townsend), the total is 119.26 eggs.

The calculations suggest that the number of eggs per nest must be between 1.93 and 3.0 eggs if the population is to remain constant. It

TABLE 6

LIFE TABLE BASED ON RETURNS OF 1,252 BIRDS BANDED AS CHICKS AT KENT ISLAND 1934-45

x	d'x	dx	lx	1000 qx	ex
Age in years	Average number of birds dying at age x in any given year	Number dying in age interval out of 1000 hatched	Number surviving at beginning of age interval out of 1000 hatched	Mortality rate per 1000 alive at beginning of age interval	Expectation of life remaining to those attaining the age interval (expressed in years)
0-1	65.0	419	1000	419	2.44
1-2	28.1	181	581	311	2.82
2-3	14.8	95	400	238	2.88
3-4	10.1	65	305	213	2.64
4-5	10.7	69	240	288	2.20
5-6	9.4	60	171	351	1.90
6-7	7.0	45	111	405	1.66
7-8	3.3	21	66	318	1.46
8-9	4.0	26	45	577	.91
9-10	3.0	19	19	1000	.50

must not be forgotten, however, that the origin of the life table has been taken at the chick stage, when banding first becomes practicable, and the egg and downy-young mortality have been left out of account. This is an error which operates to make the above calculations too high. If we assume the rather Utopian number of 3 eggs, we find that at least 19 birds are lost between the egg stage and the age of banding. This seems to be too small a margin of safety, for Kendeigh (1942) has shown that even among passerine birds few species are successful in rearing to the age of fledging so high a proportion of young. Since the reproduction potential cannot be much higher than 3 eggs per pair per year of breeding activity, and since field experience indicates that the population is not declining, it is evident that the life expectancy as calculated from the life table is too low to fit the facts.

There are two sources of error which can be supposed to operate in this direction, and it appears that when correction can be made for these the life expectancy and the reproduction potential will balance each other. One of these is the arbitrary termination of the observations after ten years of banding. From other banding stations (Cooke, Gross) we know that some returns from Herring Gulls may be expected until at least the fifteenth year. There is no reason to suppose that Kent Island Gulls do not live so long; they may even live longer. The second source of error, which is probably less significant quantitatively, lies in the assumption of equal sex ratios throughout the life span. It is known, from studies with other animals (see, for example, MacArthur and Baillie, 1932) that the longevity of females is in general longer than that of males. If female Herring Gulls live longer than males, i.e. longer than the whole population assumed to show equal sex ratios throughout life, the reproductive potential of the breeding birds will be automatically enhanced.

These calculations, insufficient as they inevitably are, should serve to illustrate the advantage of the life table method of analyzing data. The weaknesses in the computations are easily seen and enable us to hazard assumptions which should not prove to be too far from the truth when additional information is available.[1]

[1]Since this manuscript was accepted for publication a paper has appeared by Hubert Marshall (*Auk*, 64(2): 188-198, 1947) in which the longevity of the Herring Gull is discussed. This study is based on the Fish and Wildlife Service records and presumably includes returns from Kent Island. Several discrepancies in our findings are evident. These will be discussed in the near future when research on the downy-young mortality is completed and the problem can be reconsidered in the light of new findings.

REFERENCES

BENT, A. C.
1921. Life Histories of North American Gulls and Terns. *Bull. 113, U. S. Nat. Museum.*

COOKE, M. T.
1937. Some longevity records of wild birds. *Bird-Banding*, 8: 52-65.
1946. Returns of banded birds: Some recent records of interest. *Bird-Banding*, 17: 63-71.

GROSS, A. O.
1940. The migration of Kent Island Herring Gulls. *Bird-Banding*, 11: 129-155.

KENDEIGH, S. C.
1942. Analysis of losses in the nesting of birds. *The Journ. of Wildlife Management*, 6: 19-26.

MACARTHUR, J. W., AND W. H. T. BAILLIE.
1932. Sex differences in mortality in Abraxas-type species. *The Quart. Rev. of Biology*, VII: 313-325.

PEARL, R.
1940. *Introduction to Medical Biometry and Statistics.* 3rd edition, Philadelphia, W. B. Saunders Co., 537 pp.

Osborn Zoological Laboratory
Yale University
New Haven, Connecticut.

GENERAL NOTES

Another Transatlantic Species.—The Ring-billed Gull is now added to the list of species that have made transatlantic flights. Ring-billed Gull 41-669469, banded as an immature, June 10, 1945, in Georgian Bay, on Gull Island, five miles west of Penetang, Ontario, by H. H. Southam, was killed November 4, 1945, at Horta, island of Fayal in the Azores.—MAY THACHER COOKE, U. S. Fish and Wildlife Service.

Female Eastern Nighthawk No. 44-201539 is nesting for at least the third consecutive season on the roof of Weaver High School in Hartford, Connecticut. We are now able to add another brief chapter to the story of this bird which was begun in *Bird-Banding* 17(2): 55-60 and continued in 17(4): 168.

As in the case of each of the two previous years, two eggs were laid. These were discovered on June 17. One was very slightly the larger, measuring, in mm., 30.0 by 23.0 as compared with 29.8 by 22.6 for the other egg. The difference in size fails to explain satisfactorily the great difference in weight, however, for the eggs weigh 5.46 g. and 2.65 g. respectively.

There is reason to believe that neither egg is developing normally. The heavier one has a circular depression about 2.5 mm. in diameter in the shell where it has been crushed slightly inward. The subnormal weight of the other egg suggests some very serious imperfection in its condition.

The distribution of weight of the contents within the shell of each egg is such that the center of gravity is close to the smaller, more pointed end. The significance of this condition became apparent as the result of the bird's selection of a smooth tarred area for her nesting site. This space of about thirty square inches has none of the pebbles which cover most of the roof. As we watched repeated gusts of wind blew against the eggs. Instead of rolling from the "nest" they spun around, each following its own little circular path with its weighted end pointed inward towards the center.

Our final visit to the roof showed the bird incubating the heavier egg in the "nest" while the lighter one lay just over a foot away among the pebbles. Apparently its lighter weight had failed to anchor it against the breeze.—G. HAPGOOD PARKS, 99 Warrenton Avenue, Hartford 5, Connecticut.