

ANNUAL SURVIVAL RATES OF BREEDING ADULT ROSEATE TERNS

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ABSTRACT.—Analyses of the capture-recapture data on 910 individual Roseate Terns (*Sterna dougallii*) trapped from 1978–1987 as breeding adults on nests on Falkner Island, Connecticut, estimate the average annual minimum adult survival rate to be 0.74–0.75. There was weak evidence of year-to-year variation in annual survival rates during the study period. The Jolly-Seber models used to estimate survival rates also generated estimates of population size and capture probabilities. To determine the relative importance of adult mortality and permanent emigration in contributing to the estimated annual loss of one-fourth of the breeding population will require further study of intercolony movement between all the major colony sites. Assuming that the loss of birds from the Falkner Island colony site is due mostly to mortality rather than permanent emigration, and that the survival rate of this breeding population is typical of the entire North Atlantic breeding population, then the survival rate of this endangered species is low in comparison to the survival rates of several other marine bird species in the orders Procellariiformes, Pelecaniformes, and Charadriiformes. Received 23 December 1987, accepted 18 January 1989.

ROSEATE TERN (*Sterna dougallii*) breeding populations in the western North Atlantic have declined since the 1930s. It has been suggested that the decline has resulted, in part, from increased mortality on the wintering grounds (Nisbet 1980, 1981a; Buckley and Buckley 1981; Gochfeld 1983; Roseate Tern Recovery Team 1988). Rates of change in the size of any population are a function of survival rate, reproductive rate, and rates of immigration and emigration. Unfortunately, historical information is not available on most of these aspects of Roseate Tern population dynamics, so the direct comparison of current survival rates with those of earlier periods is not possible. Another approach to the causes of the Roseate Tern decline is a comparative one in which characteristics of the tern population are compared with those of other presumably "healthy" marine bird populations. We analyzed one aspect of the capture-recapture data from a Roseate Tern breeding colony on Falkner Island, Connecticut. We estimated survival rates from these data and compared them with estimates of survival rates of other marine birds based on similar mark-and-recapture or mark-and-resight studies. We also used the capture-recapture data to estimate breeding population sizes and compared these with estimates based on nest count data.

STUDY AREA AND METHODS

Study site and field techniques.—Descriptions of the Falkner Island colony site, located in Long Island Sound about 5 km south of Guilford, Connecticut, and some of the general methods used to study the Roseate and Common (*S. hirundo*) terns that nest on the island were given by Spendelow (1982). Starting at the beginning of the Common Tern breeding season in early May, we searched the main Roseate Tern nesting areas on the northern and southern ends of the island for new nests at 1- to 3-day intervals through early August each year. Other parts of the island where the Roseates nest infrequently or in small numbers were searched for new nests at 3- to 5-day intervals. Once found and properly identified, Roseate Tern nests were examined daily (weather permitting) or at no greater than 3-day intervals until all eggs had either been lost or hatched. If possible, we determined the initiation date of nests discovered after the beginning of incubation by back-dating 23 days from the known or estimated hatching date of the first chick.

During 1978–1980, most adult Roseate Terns were trapped on their nests within a few days before or after the expected hatching dates. Often both adults were trapped on the same day. Since 1981 we have tried to avoid trapping both members of a pair on the same day and, where possible, we waited until their chicks were several days old before trapping a pair of adults to reduce the possibility of investigator-induced mortality of eggs and young (see Nisbet 1981b).

Roseate Terns that nested in the open, in vegetated areas, under small boards, or inside tires (Spendelow 1982) were trapped in box-shaped or circular Potter-style treadle traps (for design, see figure 2.10 in Canadian Wildlife Service and U.S. Fish and Wildlife Service 1977). For situations where nests were hidden under rocks, logs, or large boards, we constructed just the front 5–10 cm of a treadle trap. After observing from a nearby blind how the adults approached these nests, we set the “fronts” in place to allow easy access to the eggs, but blocked off other possible avenues of escape.

Captured adult terns were banded with USFWS size 2 bands and released. If banded previously, they were released after the old band numbers were recorded. Worn bands were replaced as necessary. We used aluminum bands on birds trapped through 1986. In 1987 all Roseate Terns were given stainless steel (incoloy) bands. It is doubtful that loss of aluminum or incoloy bands from previously trapped adults was a problem during the 10-yr study period (Nisbet and Hatch 1983).

Time and manpower constraints, as well as nest failures that occurred prior to the time a nest was considered “trappable” (i.e. after ca. 15 days of incubation), prevented us from trapping adults from all the Roseate Tern nests on the island each year. We concentrated our efforts on those areas with the greatest number of accessible nests (i.e. those out in the open, in vegetated areas, or inside tires). In the first 3 yr of the study (Spendelow and Sibley unpubl. data), a low percentage of the presumably older, more experienced birds (those that made the earliest nests) were trapped, which produced some heterogeneity in annual capture probabilities. Possible effects of such heterogeneity on parameter estimates are discussed below.

During 1978–1982, perhaps as many as 50 pairs of Roseate Terns nested with a small colony of Common Terns about 6 km away from Falkner on Tuxis Island, off Madison, Connecticut. At least 3 of 5 adult Roseates trapped on Tuxis in 1980 were trapped on Falkner one or more times from 1980 to 1982 (Spendelow unpubl. data). We presume some movement also occurred in the opposite direction. The Tuxis colony site was deserted in 1983, when rats invaded the island, and few terns have nested there subsequently.

Other colony sites where one or more Roseates are known to have bred before or after being trapped on Falkner Island include Bird Island, Massachusetts (about 170 km away, and about 1,700 pairs maximum size during the study period); Great Gull Island, New York (45 km, 800 pairs); Cedar Beach, New York (90 km, 100 pairs); Gardiner's Island, New York (50 km, 75 pairs); Hicks Island, New York (55 km, 70 pairs); Southold, New York (25 km, 25 pairs), and Waterford Island, Connecticut (40 km, 10 pairs). Other sites probably are used by birds that have nested at Falkner Island, but we believe the amount of movement back-and-forth from Falkner Island to all other sites is much

less than the amount of intercolony movement that occurred between the birds on Falkner and Tuxis islands. Possible effects of the intercolony movement on parameter estimates also are discussed below.

Data analysis.—Survival rates and population sizes were estimated from the capture-recapture data with the Jolly-Seber (Jolly 1965, Seber 1965) and related reduced-parameter models (Brownie et al. 1986) for open populations. We based decisions about model appropriateness on goodness-of-fit tests and tests between models (Pollock et al. 1985, Brownie et al. 1986). Computations of all capture-recapture estimates and test statistics were carried out using program JOLLY (Brownie et al. 1986). Reasons for preferring model-based capture-recapture estimators (e.g. see North and Morgan 1985) to “return rate” and other enumeration statistics often used with bird-banding data were discussed in detail by Nichols and Pollock (1983) and Loery and Nichols (1985).

Estimates of population size also were made from nest count data. Common and Roseate terns usually require a minimum of 8–10 days to renest after a clutch that has been incubated for a week or more fails (DiCostanzo 1980, Spendelow 1982). We made these estimates by counting the cumulative total number of nest initiations by each nest census date and subtracting the number of nest failures known to have occurred 10 or more days prior to that date. The resulting values were then plotted against time and a curve was fitted by eye to determine an approximate asymptotic maximum. Under the assumption that not all pairs renest after a failure and to allow for the possibility of a small amount of intercolony movement along with late nesting by younger birds (Hays 1978, Spendelow 1982), we rounded the asymptotic maximum up to the next highest 5-pair interval and arrived at a final population size estimate. Unlike Common Terns (Hays 1984, Wiggins et al. 1984), Roseate Terns have not been observed raising a second brood in a single season, so the estimates based on the nest count data are of the minimum number of pairs necessary to produce the total number of nests initiated by a given census date.

RESULTS

Comparison of models.—From 1978 to 1987, we caught 910 different adult Roseate Terns at least once on Falkner Island. The capture-recapture data for these birds are summarized in Table 1. The test of Model D (survival and capture probabilities constant from year to year, Brownie et al. 1986) vs. Model A (survival and capture probabilities modeled as year-specific, Jolly 1965) provided strong evidence that survival and capture probabilities varied from year to year ($\chi^2_{15} = 140.7$, $P < 0.0001$; Brownie et al.

TABLE 1. Breeding adult Roseate Tern capture-recapture data from Falkner Island, Connecticut, 1978–1987, summarized in "B-Table" format (Leslie et al. 1953).

Last captured in year	Year of recapture									
	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
1978	—	17	6	4	6	1	0	2	0	0
1979	—	—	17	18	9	1	2	1	0	0
1980	—	—	—	36	11	1	4	3	0	1
1981	—	—	—	—	44	18	10	9	2	9
1982	—	—	—	—	—	27	14	10	1	5
1983	—	—	—	—	—	—	24	12	1	5
1984	—	—	—	—	—	—	—	32	1	18
1985	—	—	—	—	—	—	—	—	10	44
1986	—	—	—	—	—	—	—	—	—	19
1987	—	—	—	—	—	—	—	—	—	—
Total recaptures	0	17	23	58	70	48	54	69	15	101
New birds captured	92	126	77	155	67	33	89	108	46	117
Total birds captured	92	143	100	213	137	81	143	177	61	218
% new birds	100	88	77	73	49	41	62	61	75	54

1986). The test of Model B (survival constant, capture probabilities vary from year to year) vs. Model A yielded weak evidence of year-to-year variation in survival ($\chi^2_8 = 13.0$, $P = 0.07$). The goodness-of-fit tests indicated reasonable fit for Model A ($\chi^2_{22} = 30.2$, $P = 0.11$; Pollock et al. 1985) and rejection for Model B ($\chi^2_{29} = 43.2$, $P = 0.04$; Brownie et al. 1986), but the goodness-of-fit probabilities were fairly similar for both models. The most conservative approach would be to rely primarily on Model A estimates. However, Model B estimates tend to be more precise than those of Model A and we present both for comparison.

Survival rate, population size, and capture probability estimates.—Model A yields annual estimates of survival rate with an arithmetic mean of 0.75 (Table 2). Model B assumes no year-to-year variation in survival rate and produces a constant survival estimate of 0.74. The Model B estimate is somewhat more precise than those of Model A because Model B has fewer estimated parameters. These estimates should be interpreted as representing a minimal rate of survival as all survival estimates based on capture-recapture data include both mortality and permanent emigration in their complement.

Estimates of adult population size, \hat{N}_i , obtained using Model A, Model B, and the nest count data are presented in Table 3. The ratios of the estimates of N_i derived from the nest count data to those produced by using Model B also are presented. For practical purposes, the nest count \hat{N}_i is considered our best estimate of

the actual number of adults that nested on Falkner Island during year i . The model-based \hat{N}_i likely overestimated the number of birds that nested on Falkner Island in any given year because of the temporary emigration of Falkner Island birds that nested on other islands in Long Island Sound (or elsewhere) during other years and later returned to Falkner. The last column in Table 3 provides information about the degree to which the model-based \hat{N}_i may have been influenced by temporary emigration. In general, the ratio values in 1983–1987, larger than those in 1978–1982, are indicative of the reduction in temporary emigration from Falkner Island to Tuxis Island after rats invaded the latter site. The low ratio values for 1980 and 1986 are discussed below.

TABLE 2. Survival rate estimates, $\hat{\phi}_i$, for breeding adult Roseate Terns on Falkner Island, Connecticut, 1978–1986.

Year	Model A		Model B	
	$\hat{\phi}_i$	$\hat{SE}(\hat{\phi}_i)$	$\hat{\phi}$	$\hat{SE}(\hat{\phi})$
1978	0.79	0.14		
1979	0.51	0.07		
1980	0.86	0.09		
1981	0.72	0.08		
1982	0.64	0.08		
1983	1.02	0.15		
1984	0.66	0.10		
1985	0.83	0.18		
1986	—	—		
Mean	0.75	0.03	0.74	0.02

TABLE 3. Estimates of breeding population size, \hat{N}_i , and capture probability, \hat{P}_i , for breeding adult Roseate Terns on Falkner Island, Connecticut, 1978–1987.

Year	Nest count data		Model A				Model B				Ratio ^b
	\hat{N}_i	\hat{P}_i^a	\hat{N}_i	$\hat{SE}(\hat{N}_i)$	\hat{P}_i	$\hat{SE}(\hat{P}_i)$	\hat{N}_i	$\hat{SE}(\hat{N}_i)$	\hat{P}_i	$\hat{SE}(\hat{P}_i)$	
1978	420	0.22	—	—	—	—	—	—	—	—	—
1979	360	0.40	583	151	0.23	0.06	560	109	0.25	0.06	0.64
1980	200	0.50	425	82	0.23	0.05	576	92	0.17	0.03	0.35
1981	370	0.58	559	71	0.38	0.05	576	52	0.37	0.04	0.64
1982	270	0.51	432	53	0.31	0.04	449	30	0.30	0.03	0.60
1983	280	0.28	310	42	0.26	0.04	373	28	0.22	0.03	0.75
1984	410	0.35	583	88	0.24	0.04	518	47	0.28	0.04	0.79
1985	470	0.38	529	74	0.33	0.05	535	46	0.33	0.04	0.88
1986	350	0.17	1,027	302	0.06	0.02	958	190	0.06	0.02	0.37
1987	330	0.66	—	—	—	—	445	40	0.49	0.05	0.74

^a Estimated as n_i/\hat{N}_i .

^b Ratio = \hat{N}_i (nest count data)/ \hat{N}_i (Model B).

Capture probabilities derived from Model A, Model B, and the nest count data are presented in Table 3. We obtained the nest count data estimate by dividing the number of breeding birds caught in year i , n_i , by the nest count estimate of total population size, \hat{N}_i .

The estimates of population size and capture probability are relevant to our consideration of survival rate because they permit insight about permanent and temporary emigration. The population size estimates under models A and B tend to be higher than the estimates based on nest counts. Also, the estimated capture probabilities under models A and B are lower than those based on nest count data (Table 3).

DISCUSSION

Comparison of models and biases resulting from violations of assumptions.—Assumptions of the Jolly-Seber model were discussed with respect to avian studies by Pollock (1981) and Nichols et al. (1981). The assumptions of primary concern in our study were that all individuals have the same time-specific survival and capture probabilities, and that all emigration from the sampled population is permanent.

Goodness-of-fit tests provide an assessment of how well data conform to model assumptions. Based on the simulations of Pollock et al. (1985: table 1, figure 1), we believe the power of the test to detect heterogeneous capture probabilities was low. We noted previously that trapping procedures were likely to produce some degree of heterogeneity in capture probability. For example, in 1986 trapping did not begin until July when most of the first-time breeders

were still incubating eggs or had young chicks, but after many of the more experienced adults already had half- to almost full-grown chicks and were reluctant to enter the traps. The bias that results from catching a disproportionately large number of "new" birds (Table 1) produces a considerable overestimate of the population size (Table 3). However, unlike population size estimates, Jolly-Seber survival rate estimates are robust to such heterogeneity and any bias should be small (Carothers 1973, 1979). Power of the goodness-of-fit test to detect heterogeneous survival and both heterogeneous survival and capture probabilities was fair to good (Pollock et al. 1985: tables 2, 3). Also, the survival rate estimator for a special case of the Jolly-Seber model has been shown to be robust to small-to-moderate heterogeneity in survival (Pollock and Raveling 1982, Nichols et al. 1982).

The movements of birds between nearby Tuxis Island and Falkner Island during 1978–1982 and intercolony movement between more distant colony sites throughout the study period required that we consider the effects of violation of the assumption that there was no temporary, but only permanent emigration. We used large-sample approximations similar to those of Carothers (1973) and Nichols and Pollock (1983) to examine the bias in survival rate expected to result from this absence of geographic closure. As an extreme example, we assumed that 300–350 birds bred primarily on Falkner and 100–150 birds bred primarily on Tuxis during 1978–1982. From 1983 to 1987 all birds were considered to breed on Falkner. For Falkner birds we assumed capture probabilities equal to the estimates based on nest-count data (Table 3). We

assumed that Tuxis birds had only a small chance of being captured on Falkner (0.05) during 1978–1982, but that their capture probabilities equaled those of the Falkner birds for 1983–1987. All birds were assumed to have annual survival probabilities of 0.75. The expected value of the Jolly-Seber survival rate estimator ranged from 0.72 to 0.76 under these assumptions, which yielded biases of <3%. Thus, our survival rate estimates should exhibit only a small bias from this degree of intercolony movement and temporary emigration during the early years of the study.

We are not as confident in our model-based estimates of population size and capture probabilities, and suspect that they may exhibit relatively large biases during some years. Temporary emigration leads to overestimation of population size (Balsler 1981), as does a permanent "trap-shy" response by some individuals (Nichols et al. 1984). If we regard the nest-count \hat{N}_i as our best estimates of the number of birds that breed on Falkner Island, then they provide a basis for evaluating the model-based estimates. During 1978–1982, the years in which temporary emigration was believed to be most important because of the existence of the Tuxis colony, the model-based \hat{N}_i were substantially larger than the nest-count \hat{N}_i (see ratios in Table 3). The differences between model-based and nest-count \hat{N}_i were smaller during 1983–1987 (except as already noted for 1986), and we believe that the model-based estimates exhibit less bias during this period.

Other factors may produce high model-based estimates of population size and low model-based estimates of capture probabilities relative to estimates based on nest count data. For example, some birds may simply not breed in a particular year rather than emigrate temporarily to a different colony site and return to their former site at a later time. The relatively large differences in the nest-count and model-based estimates of population sizes and capture probabilities in 1980 may have been due, in part, to this phenomenon of a skipped year (perhaps resulting from low food-resource availability) rather than, as in 1986, the bias resulting from investigator-induced heterogeneity in the capture rates of old vs. first-time breeders.

The between-model and goodness-of-fit tests (Brownie et al. 1986) test for temporal variation in capture and survival probabilities. The Model B vs. Model A test provided some evidence

TABLE 4. Estimates of annual survival rates (ϕ) of marine birds based on mark-and-recapture or mark-and-resighting studies only.

Family/Species	ϕ	Reference
PROCELLARIIFORMES		
Diomedidae		
<i>Diomedea exulans</i>	0.91–0.97	Weimerskirch et al. 1987
<i>D. epomophora</i>	0.97	Richdale 1952
<i>D. irrorata</i>	0.96	Harris 1979
<i>D. immutabilis</i>	0.91	Rice & Kenyon 1962
<i>D. melanophris</i>	0.88	Weimerskirch et al. 1987
<i>D. bulleri</i>	0.89	Richdale & Warham 1973
<i>D. chlororhynchus</i>	0.91	Weimerskirch et al. 1987
<i>Phoebastria fusca</i>	0.95	Weimerskirch et al. 1987
<i>P. palpebrata</i>	0.97	Weimerskirch et al. 1987
Procellariidae		
<i>Fulmarus glacialis</i>	0.95–0.97	Dunnett & Ollason 1978
<i>Puffinus griseus</i>	0.93	Richdale 1963
<i>P. puffinus</i>	0.90	Perrins et al. 1973
<i>P. lherminieri</i>	0.93	Harris 1979
Hydrobatidae		
<i>Oceanites oceanicus</i>	0.91	Beck & Brown 1972
<i>Oceanodroma leucorhoa</i>	0.94	Morse & Buchheister 1977
PELECANIFORMES		
Sulidae		
<i>Sula bassana</i>	0.95	Nelson 1978
CHARADRIIFORMES		
Laridae-Larinae		
<i>Larus argentatus</i>	0.91–0.93	Kadlec & Drury 1968
<i>L. ridibundus</i>	0.82	Clobert et al. 1987
<i>Creagrus furcatus</i>	0.94	Harris 1979
<i>Rissa tridactyla</i>	0.81–0.86	Coulson & Wooller 1976
Laridae-Sterninae		
<i>Sterna dougallii</i>	0.74–0.75	This study
<i>S. hirundo</i>	0.92	DiCostanzo 1980
<i>S. paradisaea</i>	0.87–0.88	Coulson & Horobin 1976
Alcidae		
<i>Alca torda</i>	0.89–0.92	Lloyd & Perrins 1977
<i>Uria aalge</i>	0.88–0.92	Birkhead & Hudson 1977
<i>Fratercula arctica</i>	0.95–0.96	Ashcroft 1979, Harris 1983

of temporal variation in survival probabilities. Survival probabilities probably vary to some degree from year to year, but such variation does not appear to be large, and it may be reasonable to model survival as a constant for estimation purposes.

Comparisons to other species of marine birds.—Our Roseate Tern survival estimates are substantially lower than published estimates based on capture-recapture or capture-resight data for other species of marine birds (Table 4). Most of these estimates were not based on good estimation models (except Dunnett and Ollason 1978, Clobert et al. 1987, Weimerskirch and Jouvantin 1987, and Weimerskirch et al. 1987). Many of the methods used in the past under-

estimated survival rate (see Nichols and Pollock 1983), so the conclusion of low survival in Roseate Terns is valid.

Possible causes of low survival rates of Roseate Terns at Falkner Island.—It is possible that a substantial proportion of the loss of breeding individuals from the Falkner Island colony site was due to permanent emigration. However, evidence based on the immigration rates to Falkner Island of birds banded as young at other colony sites suggests that this was probably not the case, and that most of the loss was due to mortality that occurred when birds were off the breeding colonies. The nearest large breeding colony of Roseate Terns to Falkner Island is Great Gull Island, New York, about 45 km away. Only a small percentage (usually <2%) of the Roseate Tern chicks banded at Great Gull Island each year between 1970 and 1984 have been trapped as breeding adults at Falkner Island, whereas ca. 10% of chicks banded on Falkner Island during this same time period have returned to breed as adults at their natal colony (Spendelow unpubl. data). This suggests that only a small amount of dispersal and intercolony movement takes place between these two colonies. Corroboration of this hypothesis will require a knowledge of how many chicks from Falkner Island settle as adults on Great Gull Island.

Nisbet (1980, 1981a) suggested that there was strong circumstantial evidence that low survival of terns on the wintering grounds in the 1970s may have been due to increased human predation during this period, but this hypothesis has not been tested. We have little direct evidence regarding Roseate Terns on their wintering grounds, but, like Nisbet, we feel that little adult mortality occurs during the breeding season. We lack historical or current information from other colonies on survival rates of adults or immatures, reproductive rates, or rates of immigration and emigration, and are forced to view the low survival estimates of the birds at Falkner Island as cause for concern.

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100 Years Ago in The Auk



From "A bird wave" by Philip Cox (1889, *Auk* 6: 241-243):

"Early one morning in April, 1885, I started from Newcastle, New Brunswick, for a day's duck shooting on the Miramichi River, which was then free of ice. Snow was falling when I left my house, the tumbling flakes forming a strange contrast with the blossoms, bursting buds, and catkins of the trees and shrubs. Presently birds were seen flying eastward, and upon looking upward, through the snow which was by this time falling thick and fast, I saw hundreds of Robins (*Merula migratoria*), Song Sparrows (*Melospiza fasciata*), and Juncos (*Junco hyemalis*) mingled together in an unbroken column and passing noiselessly on. Some of the birds were only a few feet above the tops of the tallest trees, while others were higher up, the column extending so far skyward that the topmost line could with difficulty be outlined amid the falling flakes. The width of the column—from flank to flank—appeared to average about twenty-five yards. Outside of these flanks few birds were to be seen—either toward the centre of the river, or over the meadow through which I was walking; the bulk were massed in this narrow column and kept directly over the margin of the shore, apparently guided by the line of strong contrast between the whitened meadow and the dark waters of the river. They moved on in perfect silence, save for the flutter of the myriad wings,—not a note was heard from them. Their flight was slow and suggested weariness, but they displayed no inclination to rest, though the tree-tops were thrust so temptingly toward them. However, in about half an hour from the time when they were first observed some individuals showed a disposition to halt. An occasional Song Sparrow or Junco would alight on the top of a tall tree, and after remaining at rest for a few seconds—never longer than half a minute—would grow uneasy and utter a rather faint cry or

chirp. This call would be answered by one or more of those on the wing, and then the loiterer would rise and join them.

"The storm increasing, I abandoned the idea of looking for Ducks that day, and seeking the refuge of an adjacent house, for more than two hours I watched this bird wave as it rolled along. There was no gap, no cessation, neither was there deviation from the line of the river bank. As the time passed the smaller birds displayed evidence of growing more and more weary. Increased numbers alighted, and these took longer rests, and made more energetic demands for a general halt. About eight o'clock, and as if by the command of a leader, or by magic, the moving host vanished.

"Previous to this morning only an occasional early bird of these spring migrants had been observed, but now as I returned homeward I found every bush and fence swarming with birds. As snow had fallen to the depth of some four or five inches, little food could be obtained, and by noon great flocks had gathered in the farmyards, and that afternoon many a kind hand strewed crumbs and seeds upon the snow for these little friends—heralds of warm days and smiling fields.

"How was this wave formed? What brought this throng of birds together? I cannot think that they had wintered within a limited area and begun the movement northward at the same hour. I am inclined to the opinion that such flocks are comparatively small at the start, and increase by attracting similar small companies as they move along. Often, in the early spring, I hear on soft mild evenings, faint bird calls from the sky, which are answered from brush and tree, and these, in my opinion, are the trumpeters who call together the winged armies of the air."