1971 - 1974 No. 72

PROCEEDINGS

OF THE

LINNAEAN SOCIETY

OF

NEW YORK

For the Four Years Ending

March 1974

Date of Issue: December 1974

The Linnaean Society of New York

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Contents

Breeding Biology of the California Least Tern

Barbara W. Massey

Introduction

The California Least Tern, *Sterna albifrons browni* Mearns (1916), is a race of *S. albifrons* Pallas, a cosmopolitan, polytypic species (Peters, 1934; Burleigh & Lowery, 1942). In North America, the race *antillarum* (Lesson) occurs on the eastern coast, the race *athalassos* Burleigh and Lowery in the river systems of the central United States, and the race *browni* on the western coast.

Literature on the biology of the species is sparse. The nominate race, which breeds throughout Europe, western Asia and on the coasts of Africa, was given some attention by the Marples in their book on British terns (Marples and Marples, 1934) and, more recently, a detailed account of the breeding biology of a north German colony was given by Schönert (1961). A general, comprehensive survey of the European and Asian populations can be found in "Birds of the Soviet Union" (Dement'ev, *et al.*, 1969).

The races breeding in eastern and mid-western United States have been studied in some detail. Wolk (1954, 1974) observed a colony of *antillarum* in New York and North Carolina, and Hardy (1957) reported on the zoogeography and ecology of *athalassos*. Davis (1968, 1974) studied the behavior of the western race, *browni*.

The California Least Tern has nested traditionally on beaches with adjacent estuaries along the coast from Monterey County, California, to Baja California, Mexico. Earlier in this century, large colonies of nesting birds could be seen every summer in places like Long Beach, Redondo Beach and Sunset Beach in southern California, and Moss Landing in the north, areas from which they have long since disappeared. It has been an unhappy experience in the past ten years to watch the colony at Huntington Beach State

Park dwindle from several hundred nests to a remnant group of nine pairs in 1971.

Following World War II, with its resultant population growth, the numbers and sizes of breeding colonies drastically declined in California. In 1970, *Sterna albifrons browni* was placed on the endangered species lists of both the U. S. Fish and Wildlife Service (U. S. Department of the Interior, 1973) and the State of California (California Department of Fish and Game, 1972). The California Department of Fish and Game conducted a survey of the known nesting sites along the coast (Craig, 1971) and estimated that the total number of nesting pairs in 1970 was 300.

The urgency of the need to protect our diminishing Least Tern population has been apparent for several years. However, an effective program of protection could not be carried out without more knowledge of the birds' breeding habits and requirements. Thus, for two seasons, in 1970 and 1971, I closely observed a colony of these terns and my observations are summarized below.

Acknowledgements

This research was done in partial fulfillment of the requirements for an M.A. in Biology at California State University, Long Beach.

I wish to express my deepest gratitude to Dr. Charles T. Collins, who steered this study, from inception to completion, with an enthusiasm which was contagious, and with assistance even from the jungles of Venezuela, and to the other members of my graduate committee, Drs. Stuart L. Warter, Donald D. Shipley and Kenneth E. Maxwell, for their help in various phases of the work. To Howard Leach, Robert Mallette and the State Department of Fish and Game, I owe a debt of gratitude for arranging to underwrite the cost of one summer of field study on this endangered species.

I should like to thank also Jay Sheppard, whose expertise in recording bird calls and in trapping burrowing owls was invaluable; Arnold Small and Herb Clarke, bird photographers *par excellence*, who were responsible for pictures of adult Least Terns; and Dr. William Hardy for rendering sonograms from tape-recorded calls.

Methods of Study

I observed the terns from the time they arrived to the time they left the nesting grounds. Aerial phases of courtship were watched early in the season and once egg laying began, individual nests could be observed from a blind.

On a single day during each season lengths and widths of eggs were measured with dial calipers to the nearest 0.1 mm. and were weighed to the nearest 0.1 gram on a 10-gram capacity Pesola spring balance.

Chicks were aluminum banded in all colonies except in Camp Pendleton. In 1970 nestlings were banded on the right leg with a U. S. Fish and Wildlife Service aluminum band. Some of these were also color banded with a red plastic band on the left leg. Color bands slide off the legs of chicks weighing less than 30 g. In 1971, a piece of yellow plastic tape was wrapped around the aluminum band of some young birds instead of using color bands. This helped to make them more easily identifiable during the post-fledging period. All bands were put on the left leg in 1971.

Chicks were weighed on Pesola balances of 10-, 30-, and 100-gram capacities.

Vocalizations were recorded in the field using an Akai portable tape recorder. During the early part of the season, calls were recorded from the edge of the ternery using an omni-directional microphone mounted in a 24-inch parabolic reflector which was hand held. After the chicks hatched, a blind was set up within 15 feet of a nest. The microphone was placed in a fixed position at the nest, without a reflector. The birds adjusted quickly to the presence of the blind and microphone.

Study Area

Description

Most of the study was conducted in Sunset Aquatic Park, in Huntington Beach, Orange County, California where Least Terns are known to have nested since 1969 (Collins, pers. comm.). The park, primarily a small boat marina, is located on the northern end of Huntington Harbour in Huntington Beach at 33° 44′ N., and 118° 4′ W. The terns nest on the north side, an undeveloped area of sand dredged from the main channel in Anaheim slough. In 1970, one section was filled in February and by late May was being extensively used for nesting. There was *no* plant cover. Plant succession has progressed in two years from the initial stage of

Russian Thistle (*Salsola kali*) and Ice Plant (*Mesambryanthemum nodiflorum*) to the tall shrub stage characterized by *Baccharis emoryi*. In 1971 there was far less bare sand for the terns to nest on than in 1970.

Supplemental data have come from observing colonies at Huntington Beach State Park (1970, 1971) and Santa Margarita Lagoon (1971). Two small satellite colonies were found in 1971 in Huntington Beach (Warner Avenue and Pacific Coast Highway) and Long Beach (San Gabriel River and Pacific Coast Highway).

Weather

Weather at Sunset Aquatic Park is very mild throughout the breeding season. Temperatures were not measured at the nesting ground, but daily temperatures for nearby Long Beach, recorded in climatological data, U. S. Department of Commerce, National Oceanic and Atmospheric Administration, during the summer of 1970, ranged between 49° and 98° F. (9.4° and 36.7°C.) There were 13 days during the three-month period when daytime temperature rose above 90° F. Daily temperatures in the summer of 1971 were similar.

Rain is rare in southern California after 1 May. During the summer of 1970, the total precipitation was 0.67 inches (17 mm), all of which fell on one day in May; in 1971 there was no measurable rain throughout May, June or July.

Ecology

Colony Size

The Least Tern has always shown considerable range in colony size, unlike many other terns which only nest in large aggregates (Palmer, 1941; Dinsmore, 1972). There are many reports in the literature of a few nesting pairs breeding successfully (Norman and Saunders, 1969; Montgomery, 1959) and I have watched several small colonies in Orange County where young were raised successfully. Other colonies contain hundreds of birds. The largest one presently active in California is at Santa Margarita Lagoon, Camp Pendleton, where 336 nests were counted in 1971 (Swickard, 1971).

The size of the breeding colony at Sunset Aquatic Park has fluctuated markedly during the three seasons it has been under observation. In 1969, there were probably fewer than 50 pairs (Collins, pers. comm.). In 1970, I estimated nearly 100 nests of which 73 were marked. In 1971, there were 23 nests.

Habitat

Least Terns usually occupy a sand-shell beach which is relatively free of plant growth. This was typical of sites on the California coast (Redondo Beach and Huntington Beach) where there were large annual breeding colonies. Today such a site exists only at Camp Pendleton, between the ocean and Santa Margarita Lagoon. Where the terns have been forced away from the beaches, they have often occupied places such as the sand-fill sites at Sunset Aquatic Park and in Mission Bay, San Diego.

In 1969 and 1970, Least Terns nested on newly-dried sand dumped at Sunset Aquatic Park when there were no plants. In 1971, a section (Figure 1, site C) was overgrown with ice plant and was not used for nesting.

In 1971, a small colony of about five pairs nested on the west side of the San Gabriel River, just north of Pacific Coast Highway in Long Beach. The site is an abandoned trash dump, now on oil company land. The substrate is dry powdery dirt.

Food

Fish is the staple diet of the California Least Tern. I have never seen any food but fish being caught, carried, or eaten by adults or fed to chicks. Judging from discarded fish picked up on the nesting grounds during courtship period, adults at Sunset Aquatic Park feed on three species mainly: *Engraulis mordax*, northern anchovy; *Cymatogaster aggregata*, shiner perch; and *Atherinops affinis*, topsmelt. Fish sizes ranged from 4-9 cm. in length and 1.6-2 cm. in depth.

At Santa Margarita Lagoon the terns feed heavily on the anchovy *Anchoa compressa* and the killifish *Fundulus parvipinnis* as well as on *E. mordax* and *A. affinis* but *C. aggregata* has not

been found there either discarded on the ternery or in seinings from the lagoon (Swickard, 1971).

Hardy (1957) reported *Notropis blennius*, the river shiner, as the dominant food. In Europe, the species has a more diversified diet, feeding on insects, crustaceans, mollusks, and annelid worms as well as sand eels and other small fish (Marples and Marples, 1934; Schönert, 1961; Dement'ev, *et al.*, 1969).

Breeding Biology

Time of Arrival

In 1970, the first sighting of a Least Tern in the Huntington Beach area was made on 24 April; in 1971 the date was 1 May. For several weeks thereafter the number of birds in the area increased gradually. The colony at Sunset Aquatic Park did not use the nesting grounds until just before egg laying, so it was difficult to determine arrival patterns, or to establish numbers until nesting began. On 9 May, 32 birds were observed courting, loafing, preening, or bathing. At Huntington Beach State Park and Santa Margarita Lagoon, where the nesting grounds are on beach sites, Davis (1968) and Swickard (1971) reported arrival occurring in waves and the birds loafing and roosting close to the nesting grounds. At Sunset Aquatic Park, I could not determine where the birds roosted at night before nesting began.

At Santa Margarita Lagoon in 1971, the first 12 birds were sighted on 29 April. The following day 38 were counted, and on 12 May there were 100 birds. The population continued to increase throughout May until it reached the maximum of 600 on 31 May.

Vocalizations

Least Terns are exceedingly vocal throughout the breeding cycle. Often one's first awareness of the birds' presence is the sound of the basic four-figure call from a pair in high flight, so high as to render them invisible to the ground observer. The four-figure call is the most commonly heard and easily identified

of Least Tern calls and is used throughout the breeding period. It is often given by a bird carrying a small fish in its bill. In the courtship period it is sounded by birds during the Fish Flight, and also by the fish-bringer (presumably the male) in a Courtship Feeding sequence. During the incubation period when either member of the pair flies in to relieve the other on the nest, the four-figure call is sounded by the bird flying in and is recognized by the bird on the nest. On these occasions a fish (and feeding of the mate) may or may not be involved. After the chicks hatch, either parent will use the call when approaching with a fish for the young. This call, although not invariably linked with the carrying of a fish, is heard so frequently in this connection that I find it referred to in my notes as the "fish-flight call."

The four-figure call is difficult to render phonetically. No two representations are alike in the literature. For the Little Tern in England it has been represented as "Wēdi $did\bar{e}$, Wēdi $did\bar{e}$," showing a rising inflection on the third note (Marples and Marples, 1934). In the United States, three listeners studying three different races have set down three phonetic transcriptions of what they heard. On the east coast, *Sterna albifrons antillarum* calls *K'ee-you–hud-dut*, *K'ee-you–hud-dut* (Wolk, 1954, 1974). The interior Least Tern, *Sterna albifrons athalassos* calls *keedee-cui, keedee-cui* (Hardy, 1957) and in California, *Sterna albifrons browni* sounds *kee-zink*, *kee-zink*! (Davis, 1968, 1974). The only agreement is that the call contains four parts.

Rather than add another phonetic version, I will deal with the four-figure call visually, by the use of sonograms. Figure 2 illustrates the four-figure calls of three different adults, and another is shown in Figure 3 (lower sonogram). The call is 0.6 to 0.7 seconds in duration, with the second and fourth figures accented. The second is uttered with the greatest intensity. Individual variation is apparent in the sonograms and is recognizable in the field with careful listening. Length of time a figure is held, duration of pause between the second and third figures, inflection and pitch can all vary.

The calls shown in Figure 2 were all recorded on 12 June 1971, close to the end of the incubation period. Nests were almost

constantly attended. Birds were flying in with fish to feed their mates, or to exchange places on the nest, and the four-figure call was recorded as it was made by the incoming bird.

Members of a pair recognize each other by the four-figure call. When a Least Tern is sitting quietly on eggs and its mate calls as it flies in, the brooding bird will begin shifting position on the nest, and turning its head in the direction of the incoming bird, which soon lands close by. There follows a nest exchange or a feeding sequence, giving the observer a clear sign that a pair is interacting. The returning bird begins calling from perhaps one kilometer away, as it approaches the nesting grounds, and the call must be distinguished by its mate from among many being sounded simultaneously by other Least Terns.

The same phenomenon occurs later between parents and their chicks. A chick learns before it is a day old to recognize the individual voices of its parents and responds by begging if it is hungry. It too seems to distinguish the individual call of its parent through many being sounded in the air over the ternery.

The importance of individual voiceprints becomes apparent when one considers the structure of a Least Tern breeding colony. Quick recognition of pair members may be better attained by sound than by sight when the sexes look so alike that small identifying differences may not be recognized from a distance. Parents apparently find their wandering offspring by use of the four-figure call. The chick seems to recognize the voice of its parent, respond, and in turn be recognized by its response.

Adults use a rich, throaty, crooning call on the ground when "talking" to their offspring, particularly when urging them to return to be brooded. This call is longer and more intricate than the four-figure call. There are six figures followed by a ragged upward slur, of rising intensity (Figure 3, upper). The call bears enough similarities to the four-figure call to sound as if it were derived from it. This can be seen as well as heard. Three of the four pieces of the "talking" call bear close resemblance to those of the four-figure call (Figure 3, lower) but are richer in content. The fourth phrase, the final slur, is a new component.

At least three alarm calls can be distinguished in the adult

vocabulary, seeming to signify varying degrees of urgency. The mildest may be written phonetically as *zwreep* in agreement with Wolk (1954, 1974) who heard similar alarm calls in New York. The second in intensity sounds like *kit-kit-kit-kit*—, a repeated staccato on a high note. When most agitated, as during the mobbing of an intruder, the birds dive and at the low point of the arc emit a harsh scream, accompanied by defecation on the offender.

Juveniles begin vocalizing at a very early age as part of the begging pattern. Their high-pitched *cheep* is given in response to a parent's arrival with a fish. After they are airborne, their calls can be readily distinguished from those of the adult, being high-pitched two- or three-figure calls.

Calls cannot always be distinguished as clearly as they are set forth here. A bird's reaction can be complex in character and a mixture of bits of several calls is not uncommon.

Courtship

Palmer (1941), in describing courtship of the Common Tern, distinguishes two phases: aerial, characterized by Fish Flights and Aerial Glides and ground, including Courtship Feeding, Posturing, the Parade and Copulation. The sequence of patterns which I have observed in the Least Tern is similar to those of the Common Tern.

The aerial phases of courtship took place during a two to three week period after arrival. This is the period of pairing and the birds engage in fish flights and aerial glides. Both have been described well by Wolk (1954, 1974) and Davis (1968) and are similar to the aerial courtship of the Common Tern (Tinbergen, 1931; Palmer, 1941).

The ground phase of courtship differs from the Common Tern in several ways. Courtship feeding dominates the early ground phase. The male feeds the female in the following manner. He flies in with a fish, calling the four-figure "fish flight" call, and lands close to the waiting female. She runs over and takes the fish from him and swallows it and he raises his head in the "triumph" posture, as it was called by Schönert (1961), and flies off, calling,

to return shortly with another fish. This continues, often for three or four feedings until the female loses interest and ceases to respond. Courtship Feeding seems to play a major role in cementing the pair bond.

The Posture and Parade sequence which is performed by a pair of Least Terns might well be called a Fish Dance. The female assumes the Bent posture, head down and wagging, tail raised, wings slightly extended and fluttering. The male with a small fish held crosswise in his bill, wings also extended and quivering, tail slightly raised, walks around the female with neck extended and head wagging, periodically snapping the head up and down with a motion which flicks the fish and makes it flash in the sun. As the male parades slowly around the female, she turns so that she continues to face him.

Copulation

Fish exchange is an integral part of the copulatory act. My observations of copulation agree with those of Wolk (1954, 1974). I would like to add two points to his description. The flicking of the fish by the male is often observed prior to mounting which was not reported by Wolk. Also, on at least one occasion following a copulation when there had been a fish exchange, the male remounted immediately with no fish in his bill and the female lifted her bill towards his bill as if to accept a fish. (The movement seemed to be performed with no relation to whether or not there was a fish in the male's bill.)

Nest

The nest of the Least Tern is a very simple affair, usually consisting of a shallow, round depression scraped out by the female. Scrape-making began in both 1970 and 1971 one or two days prior to laying, and several trial scrapes were made before the bird settled in one. Occasionally the nest was lined with mollusk shell fragments. In 1971, five of the 23 nests were partially or completely shell-lined. Occasionally, more elaborate nests have been found. Swickard (1971) reported one completely lined with twigs at Santa Margarita Lagoon.

Nests were spaced at least 10 feet apart at Sunset Aquatic Park during both seasons. In 1970 the colony consisted of three distinct sub-colonies nesting in three separate sites within a 15-acre area. In 1971 the colony was small and undivided and was compacted within three acres on Site B (Figure 1).

Although the creation of a nest hollow is usually a very simple process, the female may make several scrapes before laying an egg. On 20 June 1971, I watched from a blind as a pair of Least Terns prepared for egg laying. The individuals of this pair were differentiated by the amount of black on the bill tip. Sexes were determined by behavior during copulation. The female scratched out a hollow with her feet, pivoting in a circle, then settled in it. The male paraded around her as she worked and both made low, crooning sounds which are modifications of the four-figure call and which are also used to "talk" to chicks (see **Vocalizations**). The female appeared to be brooding, but when I checked an hour later there was no egg in the scrape. The spot was marked as a possible nest and the next day was still empty. On 22 June one egg was in the marked scrape. The next morning, I set up a blind after noting that there was still one egg in the nest. During the next hour the female laid a second egg while under observation.

Intraspecific territoriality is not a strong drive in Least Terns. They are not close-nesting birds, the colony being a loose-knit organization whose chief function seems to be a common defense against intrusion. During incubation, a brooding bird does not leave the eggs to repulse another adult which may land too close to the nest. If the brooding bird's mate is standing by, which is often the case, it will chase off the intruder. The chicks begin to wander freely when a few days old and are not attacked by neighboring adults when they venture onto their territories.

During the incubation period both parents brood. When one of the pair returns to the nest and seems anxious to brood, there is often reluctance shown by the bird on the nest at giving up its place. Much attention has been given the amount and duration of time devoted to incubation by each pair member (Hardy, 1957; Davis, 1968, 1974) so that aspect of the cycle will not be dwelt on here.

Relations with Other Species

When an intruder enters the ternery during the incubation period, brooding birds will stay on nests until the last possible moment. When leaving the nest, the bird flies silently and low along the ground for three to six meters before rising into the air and sounding alarm calls. This reaction occurs in response to the following animals: humans, Black-tailed Jack Rabbits (*Lepus californicus*), dogs, Forster's Terns (*Sterna forsteri*), Caspian Terns (*Hydroprogne caspia*), several species of gulls (*Larus* spp.), Black Tern (*Chlidonias niger*), Burrowing Owl (*Speotyto cunicularia*), White-tailed Kite (*Elanus leucurus*), American Kestrel (*Falco sparverius*), Red-tailed Hawk (*Buteo jamaicensis*) and Loggerhead Shrike (*Lanius ludovicianus*). In the spring of 1971, a male Burrowing Owl took up residence on the island at Sunset Aquatic Park before the terns arrived. Judging from their reaction to him during the pre-nesting period when nest-site selection was underway, the owl was a large factor in keeping the birds from nesting on the island during that season.

Species which were tolerated without reaction by the nesting Least Terns were the Horned Lark (*Eremophila alpestris*), Snowy Plover (*Charadrius alexandrinus*) and Killdeer (*C. vociferus*), all of which nested on or near the ternery. Cliff Swallows (*Petrochelidon pyrrhonota*) appeared regularly in large numbers and swooped low over the ground catching insects without alarming the terns.

Predation

I observed no egg predation during either season at Sunset Aquatic Park. This is apparently unusual for Least Tern colonies. Others, Swickard (1971), Hagar (1937), and Sheppard (pers. comm.) have reported varying degrees of egg predation in Least Tern colonies.

Although many chicks disappeared, it could never be established which predators were responsible.

Second Nesting

Because Least Terns feed their young for at least several weeks

after they are airborne, there is not enough time for a second brood, and it is not a part of the normal breeding cycle. It is likely, however, that the stragglers who lay eggs after the main wave of hatching is over may be parents whose eggs or chicks have not survived, and who are making a second attempt, or possibly late arrivals to the nesting grounds. No evidence on this question was gathered during this study, but experiments with the Little Tern in Germany showed that if all eggs in a nest were removed early in the incubation period the birds would re-nest (Schönert, 1961).

Egg Laying

In 1970, eggs were laid from 13 May to 10 July, with 72% laid between 3 June and 22 June. Seventy-three nests contained a total of 157 eggs. Clutch size ranged from one to three, with two-egg nests predominating. Four nests contained one egg, 54 held two eggs and 15 had three eggs. The first clutch was laid on 13, 14, and 15 May and the first eggs of the second clutch appeared 11 days later. When there was more than one egg per nest, laying was usually on consecutive days.

In 1971, the first egg appeared on 24 May. Twenty-three nests contained a total of 53 eggs. There was one nest with a single egg, 14 with two eggs, and eight with three eggs. Eighty seven percent of the eggs were laid during the next 11 days. The remaining three clutches were laid during the next few weeks with the last egg being laid approximately 1 July.

Other records for first eggs in California colonies are 19-21 May (Davis, 1968) and 18 May (Swickard, 1971). Swickard reported two as the most frequent clutch size at Santa Margarita Lagoon, while Davis found an equal distribution of two- and three-egg clutches at Huntington Beach State Park in 1959 and 1960.

Elsewhere in California, two-egg nests have been reported as most frequent at Santa Margarita Lagoon in 1971 (Swickard, 1971), while Davis (1968) found an equal distribution of two- and three-egg clutches at Huntington Beach State Park in 1959 and

1960. Hardy (1957) reported a preponderance of three-egg nests for the interior race of the Least Tern and cites variation at other colonies in the midwest. In Europe, two-egg clutches (Marples and Marples, 1934) and three-egg clutches (Schönert, 1961) have been in the majority at colonies in England and Germany respectively.

When there was more than one egg per nest, laying was on consecutive days in all observed instances except one (in 1971) where two days elapsed between layings.

Egg Weights and Measurements

Eggs were weighed and measured on a single day during each season at Sunset Aquatic Park. In 1970, data were collected on 36 eggs from 17 nests on 6 June. On 12 June 1971 data were collected on 43 eggs from 19 nests. In addition, 27 eggs were weighed and measured in the colony at Santa Margarita Lagoon on 5 June 1971. Data are also available on 16 eggs from Huntington Beach State Park which were measured on 6 June and 10 June 1969 (Collins, pers. comm.). The data for all these years are summarized in Table 1. The mean weight (± 2 standard errors) for all 122 eggs was 8.09 g. ± 0.12. The range was 5.5-10.0 g.

The two lightest eggs weighed 5.5 g and 6 g and were out of line with the rest of the group. All other eggs weighed 6.8 g or more. One of the light eggs (5.5 g) failed to hatch at the expected time at Sunset Aquatic Park and was abandoned by the parent birds four days later. Subsequent examination showed that the egg was addled. The fate of the other lightweight egg (from Santa Margarita Lagoon) is not known. It may be assumed that both were abnormal, and the weight range for viable eggs is 6.8 to 10 g.

Lengths and widths were measured on all 122 eggs and the range was found to be 27.5-35.7 mm (30.52 ± 0.24) in length and 20.7-25.3 mm (23.07 ± 0.16) in width. The largest egg measured 35.7 x 25.3 mm, the smallest 27.5 x 22.2 mm and 34.3 x 20.7 mm.

Egg size for the California Least Tern compares very closely with measurements of the interior race, *athalassos* (Hardy, 1957),

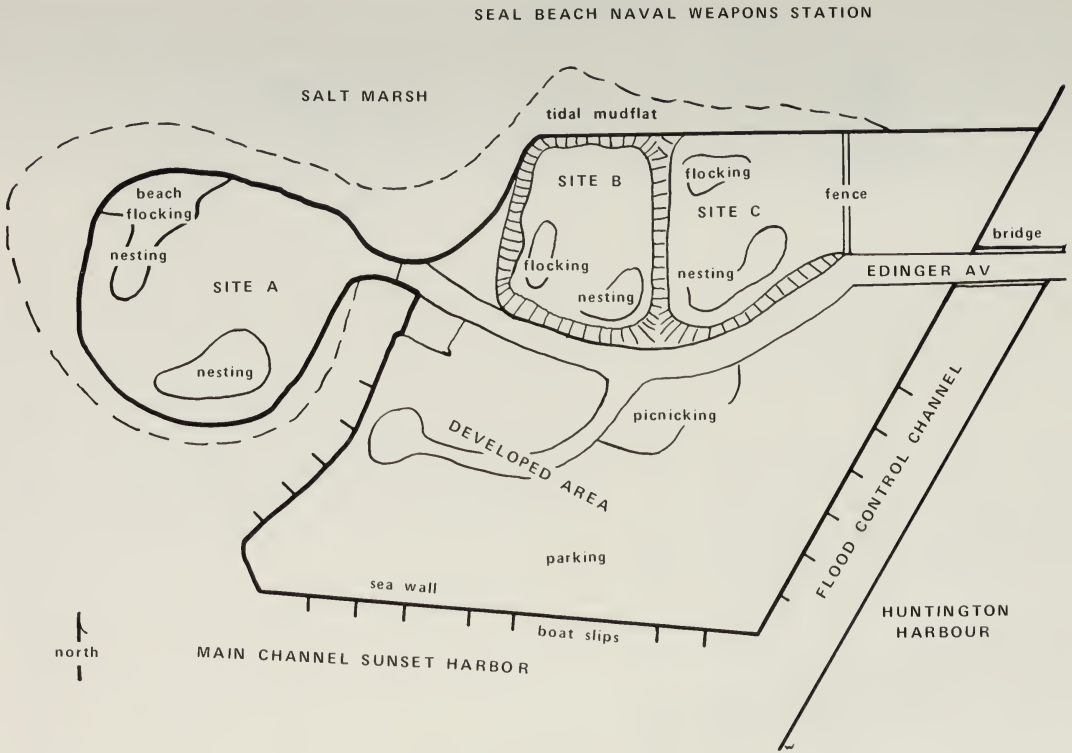

Figure 1. Sketch of Sunset Aquatic Park, Huntington Beach, California.

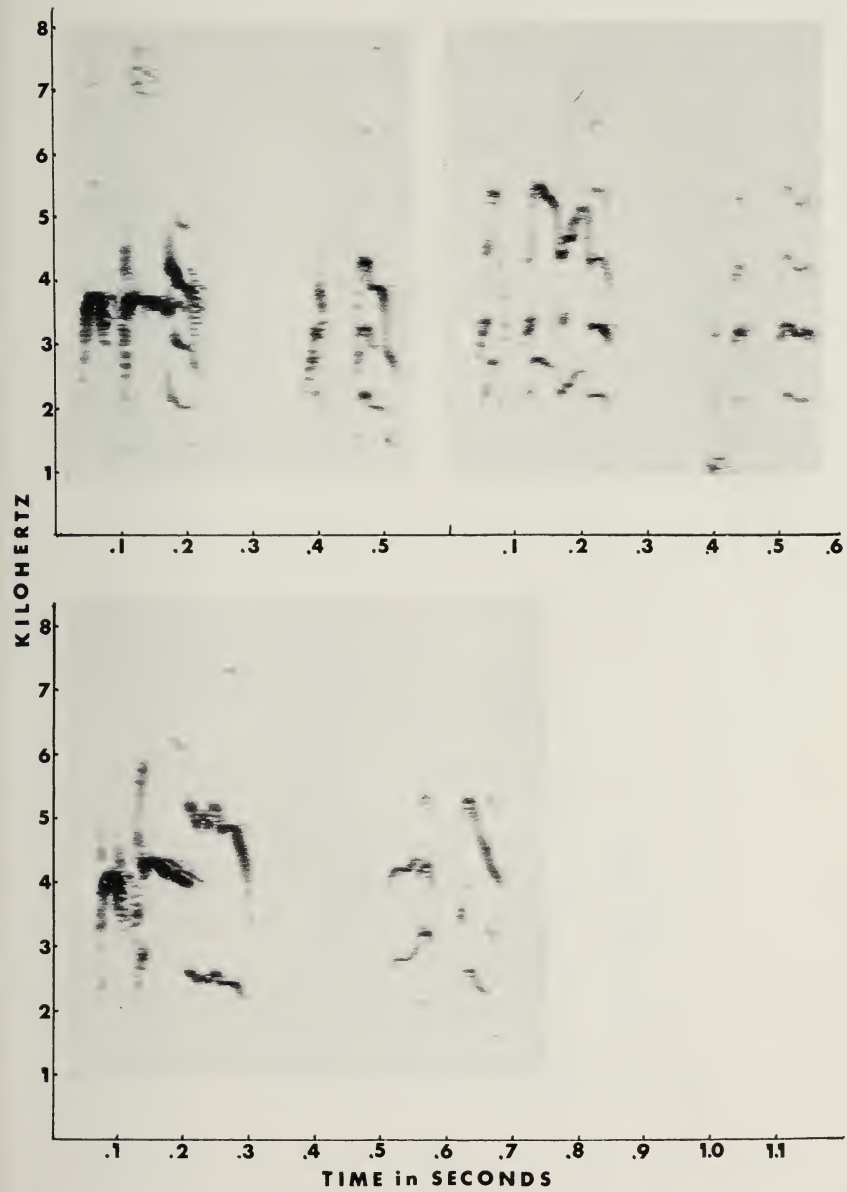

Figure 2. Sonograms of the four-figure call given by three different adult Least Terns.

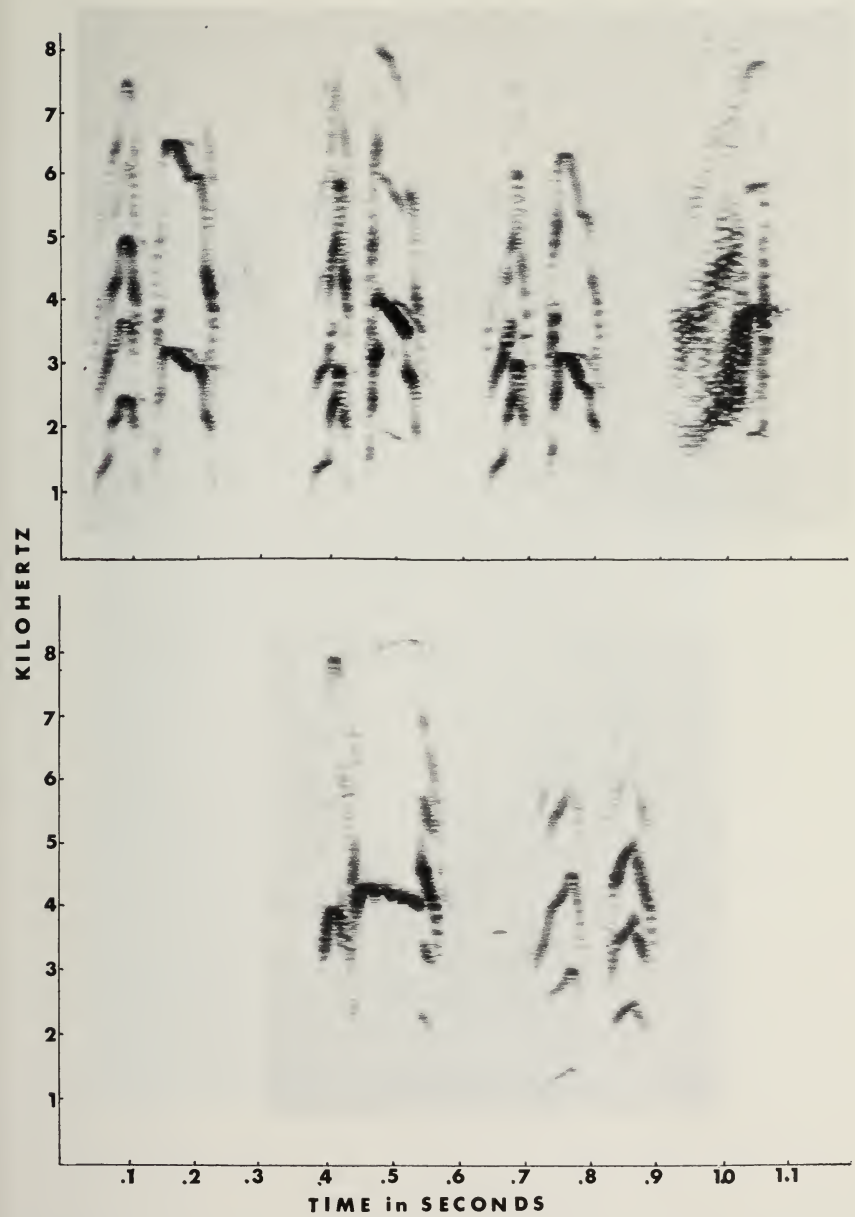

Figure 3. Above: Throaty call used by parents when "talking" to chicks. Below: Four-figure call, or fish-flight call, of an adult.

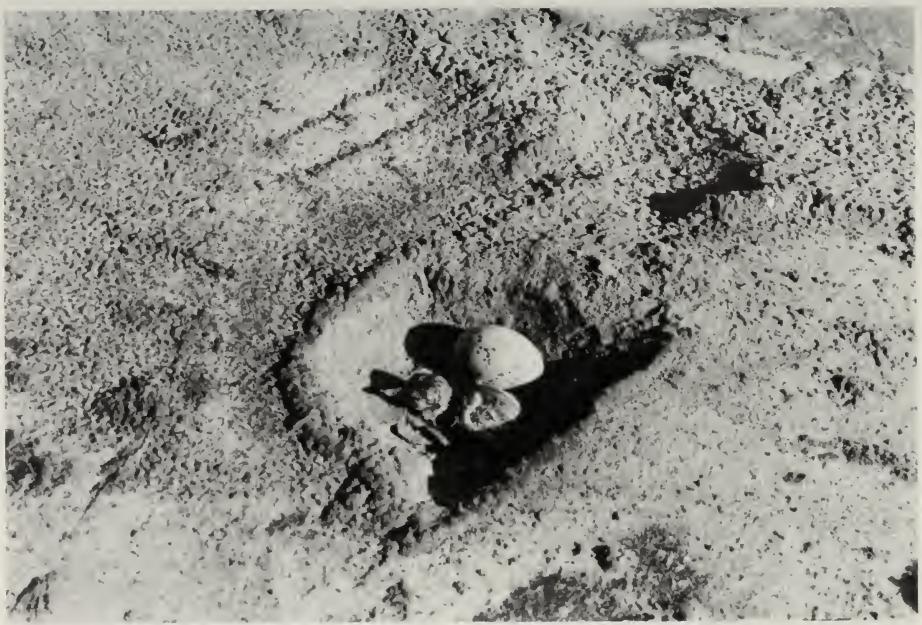

Figure 4. Newly-hatched chick and egg in nest.

Figure 5. A pair of breeding adult Least Terns.

Figure 6. A family group (parents and three chicks). The chick on the left has just been fed.

Table 1
Least Tern Egg Weights and Measurements

Year	Location	No. of Eggs	Weight (g)	Weight Range (g)	Mean Lengths and Widths (mm) (± 2 S.E.)	Range Lengths and Widths (mm)
1969*	Huntington Beach State Park	16	8.63 ± 0.24	8.0- 9.4	31.38 ± 0.48 X 23.38 ± 0.24	29.9-32.9 22.6-24.2
1970	Sunset Aquatic Park	36	8.17 ± 0.22	6.7- 9.1	30.16 ± 0.34 X 22.96 ± 0.22	28.1-32.6 21.4-24.1
1971	Sunset Aquatic Park	43	7.93 ± 0.22	5.5-10.0	30.62 ± 0.40 X 23.34 ± 0.36	28.0-35.7 22.4-25.3
1971	Santa Margarita Lagoon	27	7.80 ± 0.24	6.0- 8.8	30.32 ± 0.66 X 22.63 ± 0.22	27.5-34.7 20.7-23.5
	TOTAL	122	8.09 ± 0.12	5.5-10.0	30.52 ± 0.24 X 23.07 ± 0.16	27.5-35.7 20.7-25.3

*C. T. Collins, unpublished field notes.

and of the European race, *albifrons* (Witherby, *et al.*, 1941; Niethammer, 1942).

Incubation

Incubation begins after the first egg is laid, and both parents participate. Hardy (1957) and Davis (1968) have documented the division of time between male and female parents on the nest, and agree that the female bears the larger burden, generally more than 80 percent of the time.

A persistent error, 135 years in duration, on the length of incubation of Least Tern eggs was traced through the literature by Nice (1954). Incubation time was given in 1786 as 14-16 days by Bechstein, is so listed in Bent (1921), and was not corrected until 1922 by Heinroth (Nice, 1954).

At Sunset Aquatic Park in 1970 and 1971 the duration of the incubation period was verifiable in 41 instances. This was possible when the first egg of a clutch was found, and the second (and perhaps the third) on consecutive days. With the date of laying established, the nest could be watched daily for exact dates of hatching, and the incubation period established. The range was 20 to 25 days, with the peak occurring at 22 days. There were two exceptional cases. In each season a two-egg nest was checked for 28 days before hatching occurred. Since each nest had two eggs in it when found, the date of laying was not known, and it can be said only that the length of incubation was more than 28 days.

Hatching

In 1970 the first egg hatched on 5 June, the last on 31 July. The first egg to hatch was in a nest of three laid 11 days before any other in the colony (see **Egg Laying**). There was a definite peak period (20 June to 28 June) during which 45 percent of the eggs in marked nests hatched. The remainder were fairly evenly spaced throughout July.

Hatching success for the 1970 season was 90 percent (141/157 eggs). Failures fell into 3 categories: 1) Abandonment of eggs during the incubation period—7 eggs, 2) Death during pipping—3 eggs, and 3) Failure of one egg in a clutch to hatch in the expected time—6 infertile or addled eggs.

In 1971 the first egg hatched 15 June, the last 23 July. Half the hatchings took place between 15 and 25 June. Hatching success was 80 percent (42/53). Reasons for failure were: 1) Abandonment during incubation—6 eggs, 2) Death while pipping—1 egg, 3) Failure to hatch at the expected time—3 eggs, and 4) One instance of an egg with a punctured shell (found and removed by me early in the incubation period).

Hatching generally took place in the early morning. During the

1971 hatching period I arrived at the ternery daily at 0600 and newly-hatched chicks were frequently in evidence already, their feathers wet and flat against the body and the egg shell already removed by the parents (Figure 4).

Occasionally an egg would be partially pipped, and when I returned to check a few hours later, the chick would be out and the feathers dry. Death during pipping was a rarity, occurring four times in 186 hatchings (2 percent) during the two seasons of observation.

Post-hatching Period

The first act performed by the adult for the newly hatched chick is removal of the shell, which is picked up and carried a short distance off and dropped. This is done immediately after the chick is free of the shell and before the feathers have begun to dry.

On 16 June 1971 I observed the first feeding of a chick two and one-half hours old. The chick was being brooded by one parent as the other parent arrived with a fish. The bird with the fish called the four-figure call and the chick emerged and was fed. During the next hour of watching, the chick became an active explorer of the immediate neighborhood of the nest.

Chicks stay in the nest only one to two days after hatching. If there is still an unhatched egg in the nest, parents will try to keep chicks from leaving, so that the remaining egg can be incubated. Such efforts did not last more than three days.

When adults fly up, giving warning cries, even chicks less than a day old flatten in the nest hollow and remain immobile even when picked up by a human intruder. After the age of two days, chicks wander freely around the ternery and the parents follow them. I did not see them being brooded after they were a few days old. Sometimes, when chicks wandered away from the ternery, parents landed near them calling, and fluttered or walked towards the ternery as if they were urging the chicks to follow. Seven-day old chicks were found regularly as far as one kilometer outside the nesting area.

Between 7 and 14 days, juveniles show more caution than younger chicks and spend more time quietly hiding. When an

alarm is sounded by adults, older chicks will often run in a zig-zag fashion before flattening. They are *very* fast. They also tend to hide, rather than simply flattening on the ground. Observations of individually marked birds indicated that siblings stayed reasonably close together.

Least Tern chicks, like other terns, are adept swimmers. In one instance a 14-day old chick, caught and weighed on the beach, ran off when released, waded out into the water and swam to the other side of the narrow channel in the marsh.

Growth of Chicks

The following general description of chick development was compiled from my field notes on banded chicks caught on the ternery during the pre-fledging period.

> At hatching, the chick is wet and the feather tracts clearly defined. Within one to two hours the feathers dry and the youngster is covered with down of mottled beige and brown tones which afford excellent cryptic coloration to this ground nesting species. Primary pin feathers are through the skin by the third day. The humeral tract and the secondary feathers of the alar tract soon follow, and begin to erupt from their sheaths when the chicks are five days old. Back feathers are next, and the rectrices lag behind. On 12-day old chicks, the alar tract feathers are half way out of their sheaths and the capital tract has begun erupting. At 15 days the flight feathers are 4/5 developed, the feathered manus measures 100 mm in length. The tail is still in pin feathers. All feather tracts at this age are either in pins or erupted. By the 18th day the tail feathers are well along and the black feathers which will form the eye mask have appeared in the lores. The feathered manus measures 110 mm. Juvenile birds are well covered with contour feathers at this age.

Wolk (1954, 1974) noted the egg tooth present in Least Tern young 12 days of age. I found that it persisted for about two weeks as a dark nub on the tip of the maxilla. LeCroy and Collins (1972) found that in Roseate Terns the egg tooth gradually disappeared after about 10 days, whereas in the Common Tern they found that the egg tooth apparently dropped off by the sixth day.

Encrustations of salt around the nares are seen on chicks one to two days old (Collins, pers. comm.), evidence that salt glands begin functioning at an early age.

Banding of 110 chicks in the 1970 colony and all 42 chicks in

1971, enabled me to plot a composite growth curve for the pre-fledging period combining the data for both years. Chicks of known age captured on each visit to the colony were weighed and the weights of chicks of the same age were pooled (Table 2). The mean weight of 77 newly-hatched chicks was 5.93 g ± 0.09. Growth was rapid, the weight doubled by the fourth day, and trippled by the sixth. At 15 days, the mean weight stabilized at 35-40 g. The oldest juveniles caught were 20 days of age and weighed 39 and 42 g.

Table 2
Weights of Chicks (1970, 1971)
(in grams)

Days After Hatching	*No. of Chicks*	*Mean + 2 S.E.*	*Range*
0	77	5.93 ± 0.09	4.5- 7.2
1	67	7.13 ± 0.15	4.8- 9.0
2	32	8.42 ± 0.24	6.3-11.5
3	15	9.36 ± 0.53	7.0-15.0
4	13	13.81 ± 0.55	9.5-16.5
5	7	13.35 ± 1.09	10.0-17.5
6	7	17.64 ± 0.75	13.5-20.0
7	12	22.92 ± 0.92	18.0-29.0
8	5	24.80 ± 1.46	20.0-29.0
9	5	30.00 ± 1.97	24.5-35.0
10	8	29.43 ± 1.59	19.0-34.0
11	11	31.86 ± 1.12	22.0-36.0
12	8	33.13 ± 1.22	27.0-38.0
13	3	34.33 –	33.0-36.0
14	9	36.67 ± 0.75	34.0-40.0
15	8	39.62 ± 0.73	37.0-44.0
16	0	. . .	. . .
17	5	38.40 ± 0.93	36.0-41.0
18	2	37.50	35.0-40.0
19	0	. . .	. . .
20	2	40.50	39.0-42.0

No post-fledging weight data were obtained. One six-year old bird weighed 47.2 g (Collins, pers. comm.). I found no reports in the literature on weights of New World birds and very few on those in Europe. The Marples (1934) gave the adult weight of one individual in England as 62.25 g which seems remarkably heavy. Heinroth (1924-31) cited 45 g as the weight of a 56-day old fledged juvenile. Mean weights for adults were noted to be 43 g for males and 47 g for females in the Soviet Union (Dement'ev, *et al.*, 1969), the only indication in the literature that there might be a sexual difference in weight.

Fledging

On 5 July 1971, two banded juveniles were making short flights over the Sunset Aquatic Park ternery, 20 days after the first egg hatched. Juvenal plumage was used to differentiate flying young from adults. The juvenile has a brown-flecked cap and a small black eye mask. Only the leading edge of the outermost primary is dark gray, the rest of the primaries are pale gray on the leading edge, white on the inner aspect. The secondary coverts and back feathers are tawny brown with dark edges like the cap. The bill is dark; leg color is orange.

Post-Fledging Period

For several weeks after the last juveniles had fledged, both adults and juveniles used the nesting grounds and surrounding areas for loafing, preening and nighttime roosting, and fished in the adjacent waters. Juveniles were observed fishing, often inexpertly, in company with adults. Feeding by parents continued during this period.

Observations suggest that birds from several terneries intermingle prior to migration. In 1971, 16 days after the first juveniles flew at Sunset Aquatic Park they appeared in other localities.

Departure from the region occurred during the first two weeks of August. In 1970 there were still a few Least Terns in the area in mid-August, but in 1971 all were gone by 13 August.

Survival of Chicks

The usual method of estimating survival is to count juveniles during the post-fledging period. This is best done when the birds are at roost on the nesting ground just before dusk. In 1971, 14 juveniles were counted at one time, out of 42 hatched (33%). In 1970 the percentage was smaller, 11% (15 out of 140).

Because the colony in 1971 was small and every nest marked and every chick banded, more accurate estimates could be made by another method. Chicks were chased and caught every day to obtain growth data. Chicks which were caught at the age of seven days were usually recaptured several more times up to the age of 18 days. It became apparent that those which survived the first critical week had an excellent chance of surviving to the flight stage. In 1971, 21 of 42 chicks hatched were recaptured at an age of one week or older, resulting in an estimated 50% survival rate.

Analysis of survival rate in relation to clutch size yielded the following information for the 1971 season. Of the 21 chicks which survived, one was from a one-egg nest, seven from two-egg nests (which yielded a total of 19 hatchlings) and thirteen were from three-egg nests (which yielded a total of 22 hatchlings). The three-egg nest was optimum for that year, with more than half the fledglings coming from three-egg nests.

Summary

The California Least Tern, *Sterna albifrons browni* Mearns, which breeds on the beaches of southern California, has suffered severely from the loss of its nesting grounds and is now considered an endangered species. A nesting colony in Orange County, California, was observed for two seasons. The demography of the colony was documented including the number of nests, clutch size, and weights and measurements of eggs. Breeding biology and behavior were studied with emphasis given to courtship displays, nesting, incubation, hatching, growth, development and survival of chicks, first flights, vocalizations, and relationships with other species.

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1825 Knoxville Avenue
Long Beach, California 90815

Experiments on the Nesting Behavior of the Least Tern, *Sterna albifrons browni*

Milton E. Davis

Introduction

The Least Tern, *Sterna albifrons*, is the smallest member of the subfamily Sterninae (Laridae: Charadriiformes). It is a species of world-wide distribution in the temperate and tropical zones, and breeds on both coasts of North America and in the interior along the Missouri-Mississippi river system. The North American populations have been divided into three slightly differentiated subspecies, the breeding birds of the Pacific Coast being *S. a. browni*. The Least Tern formerly nested in many localities in Southern California, but urban encroachment and beach development have greatly reduced the available habitat suitable for nesting and the breeding populations in this area have correspondingly declined.

The life history of the Least Tern has been investigated by a number of observers (e.g., Bent, 1921; Hardy, 1957) and some aspects of the thermoregulatory capacities of nestlings were studied by Howell (1959). At the time the present investigation was begun, of which the experiments reported herein are only one part, there were no published experimental studies on the nesting behavior of this species although the accessibility of many of its breeding sites make it a favorable subject for this type of research.

The colony at Huntington Beach State Park in Orange County, California, is often disturbed by humans using the beach for recreation. This disturbance has caused poor breeding success among the terns. Thus it is difficult to obtain complete and/or long-term data on nestings. But the following experiments, performed in May and June 1959 and 1960 (with some additional work in 1965 to 1968) are of interest in themselves and also are of value in suggesting further lines of investigation.

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Methods

Experiments were designed to test the birds' response to the following situations:

1. Alteration of nest site and/or relocation of the nest at various distances from the original site.

2. Displacement of one or more of the birds' own eggs at various distances from the nest.

3. Responses to eggs of various sizes and colors both within the nest and outside it.

Experiments in groups 1 and 2 were also used to investigate the limits of territories of nesting birds.

Field observations and filming of nest site experiments and activities were usually carried out from a blind at least 6 meters from the nest. As the sexes of the Least Tern are indistinguishable externally, it was necessary to capture and mark birds, and, when possible, to determine the sexes later by the roles of the birds in copulation and egg laying. Birds were trapped on the nest using a circular wire mesh trap with an opening about 10 centimeters wide in one side. A bird returning to the nest site would alight near the trap and find the opening by trial and error, usually within one minute. After the bird entered, I approached the trap from the open side and caught and marked the bird with a felt-tip pen. Twenty-six birds were marked in one afternoon by this method and none refused to enter the trap or deserted the nest as a result of disturbance.

Experiments

Nest Alteration

Experiment No. 1: A hole 45 centimeters deep by 30 centimeters in diameter was excavated in the exact location of a nest which

had a clutch of two. The two eggs were placed at the bottom of the hole. The bird returned to the nest site, alighted, and circled the nest rim, apparently with great anxiety. After two minutes it descended into the nest to incubate but remained only 35 seconds. Scrambling to the surface level, the bird again circled the hole, descended again for a period of 12 seconds, and then flew out of the pit. For the remainder of a 20-minute period the bird made nine attempts to incubate the eggs with the total period of each incubation never exceeding one minute. After three hours of observation the bird had not incubated successfully.

Experiment No. 2: At the conclusion of the previous three-hour observation period, a pile of sand about 45 centimeters high was constructed over the exact site of the same nest. The two eggs were placed atop the elevated pile. The returning bird nervously circled the site and alighted on top of the pile only to take to the air after 40 seconds. After a second attempt to brood that lasted only 10 seconds, the bird again took to the air. This dislodged one of the eggs and it rolled down the steep slope. No attempt was made to retrieve the dislodged egg or to incubate it. The behavior of the adult bird was highly confused and it performed a series of circular flights over the nest and occasionally landed near the site but not on the pile of sand.

Nest Relocation

New nests were constructed at locations from 10 centimeters to nearly two meters away from 12 active nests. The eggs from the original nests were placed in the new nests, which were made to look as similar as possible to the old ones and then the old nests were obliterated. Results are given in Table 1. Eleven birds returned to the vicinity of their nests, but only six of them settled briefly on the relocated nests. Bird Number 4 failed to return at all during the three-hour period of observation. The five birds which returned to the nest but failed to settle appeared nervous. They circled the original site on foot, uttering a nervous *zink-zink* while moving the head up and down. In these experiments, 30 centimeters appeared to be the critical distance beyond which nest transfers or relocations were not accepted. During the three-hour

Table 1
Reactions of Adults to Nest Relocation

Bird number	1	2	3	4	5	6	7	8	9	10	11	12
Clutch	3	3	2	3	3	3	2	3	2	2	3	3
Distance (in cm.) of removal	10	10	20	20	25	25	30	30	35	60	90	150
Duration of initial stay on experimental nest	2h	15m	1.3h	*	18m	27m	8s	0	0	0	0	0

*bird failed to return in the 3-hour observation period

observation period only two of the 12 birds first alighted at a distance from the original site. Four birds returned and went directly to the new nest in less than two minutes, and two returned in less than 10 minutes.

Premature Eggs

On five occasions eggs were taken from the nest where they were being incubated and were placed in an empty scrape located within a known territory of a pair that did not yet have eggs; however, a bird had been sitting on the scrape for at least eight minutes before the experiment began. In no case did the birds incubate during my observation period of about three hours. Those birds that returned were cautious of the introduced eggs. After alighting a short distance from the nest, the birds circled the area from 2 centimeters up to 1 meter away, stopping occasionally to preen. This was followed by more circling or by the departure of the bird.

Egg Retrieval

Retrieval experiments were designed to determine, if possible (1) the maximum distance from the nest at which eggs were retrieved, and if this distance is influenced by the position of the egg around the nest; (2) whether the "retrieval area" shows any special relationship to territory; (3) whether the number of eggs already in the nest influences the reaction to eggs outside the nest; (4) whether there is any evidence that eggs are preferentially retrieved from either the right or the left of the nest.

Experiments were conducted on seven nests each containing one or two eggs in an attempt to determine the maximum distance from which eggs are retrieved. Results are summarized in Table 2, and detailed accounts of behavior are given below.

Nest Q (one egg) – the egg was removed and placed 30 centimeters from the rim of the nest. On the return of the bird to the nest site, it approached the egg at its new location and began to build a new scrape around it. At no time did the bird attempt to return the egg to its original scrape.

Table 2
Retrieving Distance of Eggs by Adults with Two-egg Clutches

	Nest												
	Q	*R*		*S*		*T*		*U*		*V*		*W*
Distance of removal from nest (in cm.)	30	30	45	45	60	90	30	30	30*	45	60	90
Retrieving behavior	I	I	I	+	+	–	–	I	I	+	–	–

* egg removed 30 cm. further from relocated site
\+ egg retrieved to original nest
–egg not retrieved
I egg incubated at new site

Nest R (two eggs) – one egg was placed 30 centimeters and the other 45 centimeters away from the nest in a direct line. On its return, the bird approached the egg nearer the nest and began to incubate; however, the attraction of the next egg, which was originally 45 centimeters from the nest and was now 15 centimeters from the bird, was apparently too great. The tern approached the second egg and moved to retrieve it. The movements were continued until both eggs were together at the site 30 centimeters from the original one. The tern then built a new scrape around the two eggs and incubated them without returning to the original nest site. The entire procedure took six minutes. Subsequent observation showed the new site was permanent.

Nest S (two eggs) – one egg was placed 45 centimeters and one 60 centimeters away, respectively, in a direct line from the nest. A parent tern after its return to the site retrieved both eggs to the original nest site in a period of four minutes. The egg closest to the site was retrieved first.

Nest T (two eggs) – one egg was removed and placed 90 centimeters from the nest site, while the other remained in the nest. The parent, on its return, made no attempt to approach or retrieve the displaced egg but instead incubated the one remaining in the nest. Both eggs were then placed 90 centimeters from the original site. The bird returned and stayed at the original empty site and did not attempt to incubate the displaced eggs. Both eggs were then returned to the nest, and incubation was resumed on the bird's return. Then one egg was placed 30 centimeters from the nest, while the bird was off the nest. The bird went to the displaced egg and built a new scrape. A short while (about 45 seconds) later it returned to the original nest and incubated the remaining egg without retrieving the displaced one. Again the bird left the nest, and then retrieved the displaced egg moving it to the original (old) nest site.

Nest U (one egg) – the egg was removed and placed 30 centimeters from the nest. The bird returned and went from nest to egg, where it made a new scrape and began incubating. The egg was removed after three minutes of incubation and placed 30

centimeters from the new nest site. The bird returned and went to the egg at the new location and built a scrape around the egg. This performance was repeated until the bird had traversed a distance of about 2 meters with a total of 7 relocations in 1 hour and 27 minutes. However, when the egg was placed within 45 centimeters of another nest, the territorial owner charged the intruder. If the bird did not retrieve the egg at 30 centimeters, the distance was shortened to 15 centimeters, whereupon the renewal of the nest relocation was continued.

Nest V (two eggs) – one egg was placed 45 centimeters from the nest site. The parent, on its return, retrieved the displaced egg within 11 minutes. The same egg was then displaced 60 centimeters from the nest site. On its return the bird alighted about 40 centimeters from the empty nest, walked directly up to it and settled on it. After a few seconds of head turning and peering, it walked off the nest but returned again within 15-20 seconds. The bird then flew off the nest after about 45 seconds in the direction of the sea. It did not return during the remainder of the observation period.

Nest W – at this nest site the original eggs were removed and one was placed 90 centimeters from the site. The parent bird returned and alighted about 150 centimeters from the nest. The bird circled the nest nervously but made no attempt to retrieve its egg. After 35 minutes, the bird was still circling the area of the nest site and apparently had not noticed the displaced egg.

In eight three-egg nests, one egg was placed 30 centimeters from the nest and two eggs were left in the nest. In seven out of the eight cases the birds returned to the original site for a few seconds, then moved off to retrieve the displaced egg. The average time per retrieval was eight minutes. The eighth bird failed to return to the original nest.

Subsequently an "extra" egg was placed 30 centimeters outside the seven nests which were already holding full clutches of three eggs. Birds on all seven retrieved the "extra" egg, and two birds retrieved a second "extra" egg. In each case, the incubating bird was restless, presumably from attempting the proper placement of its brood patch over so large a number of eggs.

The possible effects of the position of displaced eggs on retrieval behavior were tested in a series of 10 experiments. In each experiment, nests with two-egg clutches were used. In seven cases, the two eggs were removed and placed 30 centimeters from the nest and 30 centimeters apart on both right and left sides of the usual position in which the incubating bird faced, so that the eggs and the nest formed three points of an equilateral triangle. Three variations from this pattern are noted below.

In three of the seven cases where the eggs were moved 30 centimeters, the birds returned and settled on the empty original nest site making no attempt at retrieval. In three others, the birds, on their return to the nests, went directly to the egg to the right of the nest. They made no attempt to retrieve eggs but made new scrapes around the eggs. In the seventh experiment, the bird alighted near the nest, walked up to it and attempted to incubate in the empty scrape. After about 8 seconds, it moved to retrieve the egg on its left, returned to the nest, again went to the egg on its left, returned to the nest, again went to the egg on its left and moved it eight centimeters toward the original nest site. A scrape was made around the egg at this point, 23 centimeters from the original site. Here the bird continued to incubate.

In two of the remaining three experiments, the eggs were placed 45 centimeters from the nest and 45 centimeters apart. One bird went from the nest to the egg at its left and began to move it toward the egg at right. It then made three trips back to the original site, returning each time to the left hand egg and moving it toward the egg on the right until they were adjacent. The tern then made a new scrape around both eggs. Total time elapsed was eight minutes. The other bird followed essentially the same pattern except that it built a new scrape around the egg to the left of the original nest and then eventually moved the right hand egg to this new scrape.

In the tenth experiment, the eggs were 15 centimeters from the nest and 15 centimeters apart. The returning bird alighted and walked around the nest about one meter from it. It then went to the nest and from the nest to the left hand egg, where it made a scrape. It returned to the original site and made repeated visits to

the left hand egg and occasionally to the right hand egg. Finally, the egg on the left was moved to the original site and incubated while the egg on the right was ignored. Total time elapsed was 11 minutes.

This investigator conducted experiments on nine different nests to acertain the responses of birds to eggs of various sizes and colors. The "supernormal" eggs were those of a domestic hen; the "subnormal" eggs were those of a House Finch (*Carpodacus mexicanus*). Colors used were uniform red, yellow, blue, white, natural tan, and white speckled with dark browns and grayish blues.

Experiments were carried out at nests with clutches of one, two, and three eggs. In all cases, the original eggs were removed and experimental eggs introduced. Results are summarized in Table 3.

Table 3
Acceptance of Substitute Eggs

Experimental Series	*Number of Acceptances Among Nine Nests*	
	Chicken Egg ("supernormal" size)	*Finch Egg ("subnormal" size)*
1 Tan	0	0
2 Speckled	9	9
3 White	9	7
4 Dark blue	0	0
5 Light blue	6	3
6 Red	7	6

Experimental series Number 1 – A clutch of two eggs was replaced with an unspotted tan domestic hen's egg, while the nest was unoccupied. The bird returned and approached the nest, but did not attempt to incubate. The total time of observation was about 90 minutes. Experiments on eight additional nests had essentially the same results; the birds never attempted to sit on the large tan egg even though it was in the nest scrape. Instead, they would alight a short distance from the nest and approach to within

15-25 centimeters of the site in a cautious, circling manner. The birds would then walk away from the nest to a distance of about 2 meters. There they would either preen or circle the nest at that distance, occasionally approaching the nest for closer inspection.

Experimental series Number 2 – The tern's single egg was removed and a large hen's egg, artificially speckled with dark brown and grayish blue to simulate the appearance of the original tern egg, was introduced. On its return to the nesting area, the tern alighted about a half meter from the nest, walked up to the nest and without delay began to incubate the egg. Subsequent experiments at eight additional nests using the speckled hen eggs gave essentially the same results – the egg was accepted and incubated in all cases. There were slight differences in the manner of approach by the returning bird. Some birds alighted beside the nest whereas others alighted a meter or so away and walked to it. If the nest was unoccupied, the returning bird alighted close to it; if the mate was incubating eggs, the other alighted some distance away.

Experimental series Number 3 – I introduced one white hen's egg to the nest after removing the tern's one single egg. The bird on its return alighted near the nest, approached the egg, cocked its head, circled around the nest, then entered the nest scrape and pushed up against the egg fully settling on it. The same experimental procedure was carried out on eight other nests, and in all, the birds ultimately, but not immediately, settled on the white hen's egg.

Experimental series Number 4 – I introduced one dark blue (ultramarine) colored hen's egg into a nest from which the tern's eggs were removed. The bird alighted near its nest, circled the site about 10 to 15 centimeters away, but did not attempt to incubate the dark blue egg during 35 minutes of observation. Experiments with dark blue eggs at eight other nests gave similar and always negative results, viz., the birds did not settle on the introduced egg.

Experimental series Number 5 – A light blue (close to pale turquoise) dyed hen's egg was tested next by introducing it into an emptied tern nest. The first bird tested alighted about 15 to 25 centimeters from the site, walked immediately to the nest, but

then tilted its head and peered at the light blue egg. Circling the nest a few centimeters away, the bird continued to peer at the egg. After moving through an arc of about 270 degrees, the bird then settled on the egg. However, at another nest (No. 2) the bird on its return showed similar hesitance and then failed to settle continuously on the egg. It incubated for a few minutes, then got up, peered at the egg, and returned again to incubate. Birds at four other nests did incubate the light blue eggs, but at three nests the terns never settled throughout the 35-minute observation period.

Experimental series Number 6 – I introduced one large red-dyed hen's egg into the nest after removing the tern's own eggs. At one nest, the bird hesitated for about 90 seconds after its return and then settled on the egg after a cautious scrutiny. At another, the bird settled on the egg without delay immediately after it returned, and five other birds gave similar responses. In two cases, birds failed to settle on the red eggs.

Another series of experiments were carried out using the same nine nests about 48 hours after the previous tests were terminated. In each case a single "subnormal" (finch) egg that had been artificially colored was introduced into an emptied tern nest. The same sequence of colors was followed as in the tests with "supernormal" eggs. The total observation time for each sequence was 40 minutes.

Experimental series Number 1 – With a tan colored egg the brooding bird hesitated and failed to incubate on all nine nests. The reactions of the birds after alighting one to two meters from the nest can be described as a restless, peering behavior with nervous circling about 15 to 20 centimeters from the nest. At times the birds would fly away for a few minutes only to return and resume this behavior.

Experimental series Number 2 – An artificially speckled egg was substituted at nine nests and all nine birds began to incubate almost immediately after their return. The returning birds would usually alight 20-25 centimeters from the nest, walk up and settle on the egg without hesitation.

Experimental series Number 3 – A finch egg painted white was substituted at each of the same nine nests. The birds returned,

alighted about 1-2 meters from their nest sites, and in a peering, circling manner they approached the substitute eggs. All but two of the birds incubated at their respective nests.

Experimental series Number 4 – A finch egg dyed dark blue elicited responses very similar to those in experimental series Number 1 with tan eggs. After alighting a short distance from the nest (1-2 meters), the birds performed a restless, peering circling movement and none of the birds attempted to incubate during the 40-minute observation period.

Experimental series Number 5 – In this case a finch egg dyed light blue was substituted in each of the nine nests. The returning birds seemed apprehensive about the substitute eggs, and the familiar circling and nervous peering followed. However, despite some hesitancy and delay, the birds at three nests incubated.

Experimental series Number 6 – A finch egg dyed red was used. The returning birds seemed cautious in approaching their respective nests. In general, the birds were visibly nervous in their settling behavior. After several temporary attempts at incubation, birds at six of the nine nests finally settled on their eggs.

Parent-Young Interaction

Two experiments and an observation suggest that individual chick recognition by the parents may be achieved as early as the third post-hatching day. In these experiments chicks were confined in three feet square enclosures, ten inches high, made of planks.

Experiment Number 1 – A young chick about eight hours old was exchanged with a day-old chick from another pen nearby, while both sets of parents were off the nest. A parent from the first nest flew in from the sea, hovered over the nest, and alighted close by. The substituted day-old chick was in a patch of shade at one side of the scrape. The adult bird went directly to the chick, emitted a *kip-kip* call, scooped out a scrape while still straddling the chick, and began to brood. The chick remained silent during the entire procedure.

Experiment Number 2 – A three-day old chick was exchanged with another chick in a nest that contained three chicks ranging

from three to five days of age; however, the individuals were not marked and the exact age of the removed chick was not known. One of the parents, on returning began to call *kee-zink-ee* while still in the air and still out of sight (because of the walls of the pen) of the nestling chicks. The parent's own chicks came toward the edge of the pen in line with the approaching bird. The third, or exchanged chick, remained in a crouched position. The adult went to the nest scrape on alighting, calling *kip, kip* repeatedly. The bird's own two chicks went to the parent at the nest and were brooded. The exchanged chick remained crouched to one side (about 45 centimeters away) for the length of the observation (3½ hours). No aggressive moves by the other chicks or the adult were seen.

Coasting silently to the study area in my automobile, I observed a frightened adult tern on a scrape give a *kip-kip* call and a young tern about seven days old (juvenal plumage was beginning to show) ran out from a clump of ice plant about 12 meters away. The juvenile at first ran at a constant speed but not directly toward the vocalizing adult, which was not in sight because of the contours of the sand. However, as it emerged over a small sand dune and saw the sitting adult about 4.5 meters away, it immediately turned toward the adult and quickened its pace. At this moment, the adult bird saw the juvenile and immediately walked quietly off its scrape in the direction of the approaching chick. As they simultaneously moved toward each other, the adult bird stopped about two meters from its original scrape. With the young chick still not under it, the parent began to build a scrape in the usual manner. This action lasted for about 20 seconds. The adult then apparently attempted to beckon the chick by giving soft calls which I failed to record accurately in detail. The chick approached hurriedly and disappeared in the scrape beneath the brooding adult.

Discussion

Nest Alteration

Altering the nest to a hole or a mound apparently disrupts incubation behavior. However, conclusions can be drawn from two

experiments in which a highly artificial situation was presented to the bird. Its failure to accept the alteration or to desert suggests that less drastic experimental modifications would be worthwhile. Least Terns characteristically nest on level expanses of sand, and a contoured substrate might be disadvantageous for low sites prevent these small birds from seeing the approach of terrestrial predators and higher sites might be unduly conspicuous. Thus, there may be a threshold of tolerance for relatively elevated or depressed nest sites that could be detected by similar alteration experiments.

Nest Relocation

Relocation of the nest scrape and eggs is usually permanently accepted by Least Terns when the displacement is no more than 30 centimeters. This suggests that, up to certain distances, the eggs provide a stronger attraction than the original nest site. In the Huntington Beach tern population the minimum distance between nests was 75 centimeters. This would allow for a radius of about 40 centimeters from one nest site to the approximate edge of the territory of the next site. It is interesting to note that there is a close correspondence between the minimum radius of nesting territories and the maximum radius of acceptable distance of nest relocation. A Least Tern is about 23 centimeters long, and the bill-tip of an incubating bird would be about 10 centimeters from the center of the nest. Its mate could thus stand bill-tip to bill-tip with it (as the male does when feeding the incubating female) and still be within a 40-centimeter radius around the nest. Conceivably, the birds are strongly attached to an area of this size rather than to the specific definitive nest site, and will, therefore, accept horizontal shifting of the eggs and nest scrape within that area.

Egg Retrieval

In the Least Tern, this behavior pattern is influenced by the number of eggs in the nest and the distance to which the egg is displaced. As previously described in the discussion on nest relocation, a distance of 30 centimeters from the original site

appears to be critical. If there is only one egg in the nest, a parent bird will settle on a displaced egg and build a new scrape around it, if the displacement distance is 30 centimeters or less. If there is more than one egg in the clutch and one egg is displaced and any others are left in the nest, a parent bird will retrieve the displaced egg at distances up to 45 centimeters and in one instance 60 centimeters away.

It is interesting to note that the maximum acceptable nest relocation distance (30 centimeters), the minimum territorial size (radius 40 centimeters around the nest), and the maximum egg-retrieving distance (45 centimeters) do not differ greatly. In fact, the figures are close enough to each other to suggest that nesting Least Terns have a critical "response distance" of 30 to 45 centimeters from the nest scrape, and there is no indication in these experiments that nesting adult birds will respond to eggs beyond those limits.

The acceptance of egg relocations at appropriate distances is sufficiently strong that one bird was "led" for more than 2 meters from its original nest site by repeated short-distance displacements of its egg. Obviously such an experiment could be carried out only in a species such as the Least Tern, which does not nest in dense colonies such that even slight displacements of eggs would impinge on the territories of other individuals.

Position Effects

Results of experiments in which eggs were displaced simultaneously and equidistantly to the right and left of the incubating bird's usual facing direction gave no certain evidence that either direction was more likely to be involved in a response. At displacement distances of 30 centimeters or less, the eggs were retrieved to the original nest. When in two instances both eggs were displaced to the usual limit of retrieving distance (45 centimeters) and were equidistant from each other and the original nest, the parent bird appeared confused and "retrieved" one egg (right or left) to the other egg but not to the original nest.

Eggs of Different Sizes and Colors

Apparently, eggs larger or smaller than those of the Least Tern are acceptable in its nest if the color is acceptable.

Although in each color for which there were some non-acceptances, the smaller eggs were accepted slightly less often than the larger ones. Also my subjective impression was that the birds were generally more hesitant to settle on a smaller egg than a larger one of the same color. A variety of colors was accepted, but some were more acceptable than others and some were not accepted at all. The acceptability of experimental eggs may be summarized as follows:

1. Speckled eggs of both sizes were accepted.
2. Plain white eggs of both sizes were accepted, but larger white eggs were accepted in all cases and smaller ones were accepted in seven out of nine instances.
3. Red eggs were only slightly less acceptable. Seven out of nine birds accepted the larger egg and six out of nine accepted the smaller one.
4. Light blue was moderately acceptable. Six out of nine birds accepted the larger egg and only three out of nine accepted the smaller one.
5. Neither uniform tan nor dark blue eggs were accepted in either larger or smaller sizes.

These data are puzzling in some respects. One would expect the speckled eggs and white, light blue and tan eggs to be accepted. That white and light blue were accepted shows that it is not speckling, at least not entirely, which is the determining factor. The complete unacceptability of tan eggs is baffling. Dark blue and red eggs are completely outside the birds' normal experience. But the fact that red eggs are so frequently accepted is also puzzling. Obviously, further experimentation is needed to clarify the question of color preference.

Parent-young Interaction

My limited data suggest that a parent bird with a chick less than one day old will accept and brood within its nesting territory a chick of similar age from another nest. Although the adult bird

may vocalize, the chick remains silent. Whether the chick responds positively to the adult or passively accepts parental attention was not determined. On the other hand, chicks three to five days old responded immediately to the vocalization of a parent, while a chick of equal age placed with them did not respond. None of the chicks vocalized and the introduced chick was ignored. This might indicate that the parent "recognizes" its own chicks by their response to its vocalization, and that chicks respond only to the voice of their parents once they are active and frequently away from the nest scrape.

If these data should prove to be truly representative of the birds' behavior, the following interpretations may be suggested:

In a species that nests in almost completely open, exposed, and level areas, it may be advantageous (when the parent is absent) for chicks to wander away from the nesting territory at an early age, either to take advantage of a small patch of shade or to hide from potential predators.

The simplest form of parent-young communication effecting a reunion would be for the adult bird to return to the nesting territory and vocalize, and for the chicks to respond specifically to their own parent's calls by running to the adult. Bartsch (1917) gives a graphic description of this type of behavior among Least Terns nesting on the Dry Tortugas, Florida, and my own observations are in accord. In the Least Tern, unlike other terns such as the Common Tern (Palmer, 1941), the chicks are silent. Unilateral vocalizations are probably sufficient to effect recognition in uncrowded nesting colonies which are characteristic of the Least Tern. The silence of the young protects them from predators keeping them inconspicuous until a parent is nearby. In contrast, the Common Tern, nesting in denser colonies, may find reciprocal vocalizations advantageous to allow swift recognition of young by the parent.

Summary

Least Terns are sociable, colonial nesters, but do not crowd together. The minimum nesting territory seems to be a circle with a radius of 40 centimeters, corresponding closely to the 30 to 45 centimeters within which they respond to egg and nest relocations. Adults readily incubate eggs larger and smaller than normal but color and, perhaps, speckling are important. Color preferences are puzzling. Parent-young interactions appear to be well adapted to the loosely colonial nesting strategy of the species.

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2867 Belden Drive
Hollywood, California 90068

Reproductive Behavior of the Least Tern

Robert G. Wolk

Introduction

This observational investigation into the reproductive behavior of the Least Tern, *Sterna albifrons antillarum* (Lesson), was carried out between May and September 1953 and in early May and July 1954 in New York and in April 1956 in North Carolina. The report of the 1953 season's study was incorporated into a Thesis submitted to Cornell University (Wolk, 1954).

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Description of the Areas

A colony on Alder and Meadow Islands in Jones Beach State Park, Nassau County, New York, was studied in 1953. Additional observations were made at the same place the following year. These islands are approximately one kilometer north of Jones Inlet and may be found on the United States Geological Survey topographical map titled "Jones Inlet, New York, Quadrangle" at Longitude West 73°34′ and Latitude North 40°36′.

The islands, each about one-half kilometer square, are mostly tidal marsh. However, sand is provided by continual dredging of the nearby channels. It is in this sand that the Least Terns nest.

Above the high water line, the predominant vegetation is beach grass, *Ammophila breviligulata*, planted to keep the sand dunes in check.

Other common plants growing in the nesting areas are seaside goldenrod, *Solidago sempervirens*, a bulrush, *Scirpus* sp., and jointweed, *Polygonella articulata*.

Both *Ammophila* and *Phragmites* are slowly encroaching on the bare sandy areas which are preferred by Least Terns for the establishment of nests.

Common Terns, *Sterna hirundo,* Black Skimmers, *Rynchops niger,* and Piping Plovers, *Charadrius melodus*, commonly nested in the sandy areas. One nest each of Killdeer, *Charadrius vociferus,* and Black Duck, *Anas rubripes* were found in one of the terneries.

Species nesting on the islands outside the terneries were: Clapper Rail, *Rallus longirostris,* Barn Swallow, *Hirundo rustica,* Long-billed Marsh Wren, *Telmatodytes palustris,* Red-winged Blackbird, *Agelaius phoeniceus*, Sharp-tailed Sparrow, *Ammospiza maritima*.

In 1956, further studies of Least Terns, primarily of their Aerial Behavior, were made while conducting field studies of another species. These observations were made on Radio Island, off Beaufort, Carteret County, North Carolina. This island, also, was a tidal marsh filled in with dredged sand.

Methods

Most of the observations were made from a blind erected in the ternery. The terns were quite tolerant of this structure and often permitted it to be moved to within two or three meters of their nests. Other observations were made from vantage places behind dunes, shrubs, etc.

Nests were marked with numbered and colored stakes of the type used by plant breeders.

Adult birds were banded with Fish and Wildlife Service bands and marked with colored enamel on one side of the throat. This

area of the bird's body can be seen while the bird is on the nest, standing on the ground, or in flight. Pairs were marked with the same color scheme, and mates were separated by marking one on the left side and the other on the right side. Due to the repeated submergence of the terns while feeding, the color faded in about two weeks, and, although mates could still be differentiated, it became increasingly difficult to associate the bird with a nest unless it was on its territory.

Eggs were marked with nail polish or engrossing ink. Either method was found to be satisfactory.

Adults were trapped on the nest with drop traps made of poultry wire. Least Terns were often hesitant about settling on eggs when a trap was set above them, but in all cases the bird eventually incubated under the trap (occasionally even continuing to incubate after the trap was sprung).

Observations during the period of parental care were limited due to the very efficient predation of feral house cats. None of the pairs under intensive study in 1953 reared young successfully.

Ethological terms are used as defined by Tinbergen in 1951, except where stated otherwise.

Names of plants are taken from *Gray's Manual of Botany*, Eighth Edition (Fernald, 1950).

Arrival

On Long Island, most of the birds arrive during the first week of May. During the next four weeks, pairs are formed, nest sites and breeding territories are selected and, by the end of this period, the eggs are laid.

Upon their return, much of the birds' time is spent resting, bathing and preening on the tidal flats and beaches at the periphery of the breeding aera or ternery. Territorial disputes do not occur here but are limited to the vicinity of the potential nest site. The rest of their time is spent in the air, foraging and engaging in aerial displays. These displays represent the early steps of pair formation.

Aerial Displays

Fish Flight

One bird catches a fish which is held in its bill visible to other birds. While flying near other birds in the air and on the ground and giving the Four-note Call with Alarm Calls (see below) another one or two birds (or more) begin to pursue the first, all of them calling excitedly. The pursuit ensues for several minutes and ends abruptly with two or three birds performing an extended Glide with wings held stiffly in a semi-flexed position. There is a rhythmical "crossing-over" of paths during the Glide each bird repeatedly banking towards the other. The terns are silent during this phase of the display and there is a strong orientation to the ground. Occasionally, two displaying birds are observed to land and the fish is transferred from one bird to the other. Presumably copulations occur in some of these cases immediately following the fish transfer.

These flights resemble those of the Common Tern (Tinbergen, 1931 and Palmer, 1941) and other *Sterna* species.

Ground Displays

Copulation

Copulation in the Least Tern was observed repeatedly in and near the nesting area and occurs typically as summarized here.

A male approaches a female with a fish in his bill. Standing alongside her as she crouches silently or vociferously begging and fluttering her flexed wings, he begins a side to side movement of the head. She joins in with this rhythmical wagging but at a somewhat lower intensity. After a period of several seconds or minutes the head wagging gets increasingly faster and the male flutters his wings and mounts the back of the female. At this precise moment, cloacas are brought into contact and the female raises her bill to receive the fish (if it has not already been taken prior to mounting).

Other authors (Hoffman, 1921; Lewis, 1920; Marples and

Marples, 1934) have described parts of the precopulatory behavior in the Least Tern and several have reported on unusual or seemingly atypical procedures (Eisenmann, 1951; Stiles, 1939).

Postures

Bill Up

The Bill Up Posture (a silent pattern) is identical to the "Reckstellung" of the Common Tern as recorded by Tinbergen (1931). The bill is raised high to an angle somewhat less than vertical and the neck is extended upward. The wings are usually, but not invariably, open so that the carpi are held above the level of the head.

Bill Down

This posture is performed by dropping the bill directly forward to a vertical position thereby presenting the black cap to an individual directly in front of the posturing tern. The movement is only of the head, the wings and tail remain in their usual positions.

Breast Low

The tern in this posture holds its bill parallel to the ground, bends forward by lowering its breast and thereby places its body in a more or less horizontal posture. There is a tendency for the posturing bird to face its partner.

Vocalizations

Because vocalization is an integral part of the behavior patterns of gulls and terns, an attempt at a Least Tern "vocabulary" is given. Names ascribed to calls are devised for their usefulness rather than to define the calls' causes or functions.

An extensive discussion of tern calls is given by the Marples (1934: 200). The transcriptions of these sounds is difficult and the results are highly subjective.

The Alarm Call

The Alarm Call, transcribed as *zwreep*, is given when the birds are in the air after having been frightened off their nests or territories and functions as an indication to the others of imminent danger. It stimulates the young to lie motionless on the sand, and consequently, to make use of their concealing coloration.

The Tsip Call

During an alarm, as the birds are circling over an intruder, a high-pitched *tsip tsip tsip*. . . is heard intermingled among the *zwreeps.*

The Extreme Anger Call

This is a loud, guttural *krowkgh!* given at the lowest point of an attack dive. It appears to be a result of even higher intensity threat than the Tsip Call and occurs only rarely.

The Four-note Call

The Four-note Call is certainly the most musical of the Least Tern's calls and perhaps of all tern calls. It is a rapidly-executed *K'ee-you–hud-dut* often repeated two or three times.

It is not rare to hear the Alarm Call given with the Four-note Call in this manner: *K'ee-you–hud-dut, K'ee-you–hud-dut ZWREEP, K'ee-you–hud-dut.*

The Four-note Call is not associated with overt, unmistakable, attack patterns, but the circumstances in which the call occur are rather reminiscent of some circumstances in which the aerial Long Call or Landing Call of other larids (Moynihan, 1955) is apt to appear.

The Kid-ik Call

A Least Tern may be seen flying in from the water with a fish in its bill to feed its mate or young. The call given at this time, provided there is no interference with this activity, is a short *Kid-ik.* The birds have no difficulty in producing their calls while carrying fish in their bills. The function of the *Kid-ik* call is not known, but it is heard while the bird is flying, presumably to or

from a feeding at the nest, and in the following situation: While a downy young is engaged in swallowing food, the parent which fed it will utter this call softly several times. There is no evidence for its releasing a begging reaction in the young for the mere sight or sound of the flying adult is enough.

The Young Call

A loud *K'ee-you* is sounded by the adults when returning to the young. So far as I know, it calls the young to the parent to be fed and/or brooded. The young respond by running toward the sound, by giving the begging call, or by calling *Ti-seep,* or by a combination of these. After a few days, the young will react only to the voices of their own parents.

After four days of age, the young are capable of making a sound more complicated than the peeping they made since (and before) the egg was pipped. This call I have transcribed as *Ti-seep* (soft i). In following the development of the voice of the young, I have concluded that this is actually an immature version of the Young Call given by the adult.

The Brooding Call

As the adult settles on its eggs or young, it utters a very soft, throaty, almost purring, note very difficult to detect. Palmer (1941) makes no mention of a similar sound in the Common Tern, nor does Hawksley (1950) refer to it in the Arctic Tern. However, Goodwin (1953: 30) describes a similar sound associated with what he calls the "Krew call" in the Black Tern, but that note is given by a flying bird under different circumstances.

The Begging Call

This has been adequately described by the Marples (1934) and, for the most part, I have used their notation. The Marples indicate the basic call as a three-note pattern given three times. Several varieties include pitch and rate changes and, in one type, a note of higher pitch is added.

From my observations, I have denoted the basic call as a

definite five-noted pattern repeated as such with the first note somewhat longer than the last as follows: *Twee-dididi-twi.*

The downy young give this call when begging from their parents. It first appears at about the age of five days.

Territory and Social Attack

During the early part of the season, when the Least Terns were establishing their territories, disputes between Least Tern pairs and even neighboring Common Terns occurred rather frequently. Later in the season the birds were noticeably more tolerant of one another. Perhaps the sparse distribution of nests accounted for this in part.

In attacking another tern of the same or another species, which may have landed too close to a Least Tern territory, this smallest of the terns flies up, gives the Alarm Call, and repeatedly makes short dives at the intruder. During these dives the Tsip Call is heard almost continuously with a few *zwreeps* (Alarm Calls) interspersed. The trespasser returns to its own nest and the attacker, after getting in its last *tsip,* returns to its own nest.

Non-tern species seen attacked were: Osprey *(Pandion haliaetus)*, Common Grackle *(Quiscalus quiscula)*, Merlin *(Falco columbarius)*, Red-winged Blackbird, Killdeer, and Herring Gulls *(Larus argentatus).*

The intensity of social attack varies according to the stage of the breeding cycle of most of the pairs of the colony. At higher intensities, the attack is usually as follows: The terns circle and hover over the disturbance. Periodically one bird, flying very deliberately, begins a long dive from the edge of the flock. This bird is silent. Its fellows are giving the Alarm Call and, less frequently, the Tsip Call. As the diving bird approaches its target, it starts "zwreeping" and, as it reaches the lowest point of the dive, it screams the Extreme Anger Call. The feet drop down and are spread apart just as the bird approaches the head of the intruder and all too frequently very accurate defecation, if not physical contact takes place at this point. Immediately after

passing over the target, the bird rapidly climbs vertically, rejoining the flock.

There are shorter dives also, and defecation rarely occurs during these.

This explains the origin of the local names of "little striker" and "striker gull," although I must report that I have never been hit by the feet or bill of this species.

The Nest and Nest Site

Bare sandy areas are the nesting sites most frequently selected by Least Terns. However, at times of overcrowding and perhaps of second nestings, the birds will nest in places sparsely covered with grass.

The Jones Beach colony was rather low in density of nests. Measurements of distances separating six nests on relatively level sand averaged slightly more than six meters.

At Jones Beach the Least Terns are intermediate between the Common Terns and Black Skimmers in their selection of nesting areas. The Common Tern nests were in a range of locations, from thick grass to bare sand. Black Skimmers nested only in bare sand. Intermediate between these but decidedly skewed toward the bare sand type of nest is that of the Least Tern.

The nest is a depression in the sand lined more or less with bits of shell (see Figure 1). Nests on bare sand without any lining at all are not unusual. The Marples (1934: 146) reported two Least Tern nests with a vegetation lining. None of the nests observed on Long Island, New York, or Radio Island, North Carolina, indicated any tendency in this direction.

The building of the nest can be separated into two distinct phases: *scrape-making* and *sideways building.*

Scrape-making is accomplished by a sitting bird's kicking its feet backwards, and rotating its body at short intervals. In this way a shallow, circular depression is formed in the sand. A pair may make several scrapes on their territory before laying eggs in one of them. Both male and female Least Terns may scrape

simultaneously. One member of a pair is frequently seen sitting in a scrape shortly before the eggs are laid. Presumably this is the female who is ready to lay.

After a scrape has been selected for a nest, and one partner is incubating eggs, sideways building movements may be observed. These movements, called twig-tossing by earlier authors (Palmer, 1941; Hawksley, 1950), consist of reaching out with the bill to pick up nest material (in the case of Least Terns, small shells and shell fragments), and depositing it in the nest with a lateral movement of the head. It is not certain if sideways building in the Least Tern takes place before the eggs are laid, as has been reported for the Black-headed Gull *(Larus ridibundus)* (Moynihan, 1953).

Collecting trips for nest material such as have been described for some gulls (Moynihan, 1953; Tinbergen, 1953), were not observed. Neither were short trips on foot for the nest lining. This is most likely due to the availability of the material, for observations have been made of Least Terns nesting where few shells were available and lining their nests in a similar manner (see photograph in Grassé, 1950: 565).

The Marples, though not referring to the species of tern, write that the "false" or "incipient" nests made by the male stimulate scrape-making in the female, and that, in fact, any hollow seems to excite this activity in the female. They suggest that the function of scrape-making by the male is "to excite the breeding instinct of the female. . . " (Marples and Marples, 1934: 116).

Palmer (1941: 71) agrees that the "female is stimulated by the sight of the male's scrapes, for she enters and enlarges them." However, Palmer objects to the Marples' explanation of scrape-making, and states that scrapes and scrape-making stimulate both sexes. "The making of scrapes is an outward expression of an internal drive, and both sexes indulge in it" (1940: 136).

It is possible that the function of scrape-making in the Least Tern can be explained along these lines. My own reaction is that, while scrape-making is closely tied to the selection of a nest site and has implications in pair formation and pair bonding, it functions ultimately to provide a place for the eggs to be incubated.

Several instances of sideways building which were almost certainly displacement activity were observed at Jones Beach. In these situations, the tern involved was quite obviously "uncomfortable." The extreme heat of the sand prevented the tern on one nest from sitting for more than a few minutes at a time, and birds in both cases were incubating or on territory for somewhat longer than usual. A brooding adult tern was observed to respond to a Four-note Call from the air (apparently from its mate) by giving the Young Call. It then began sideways building, and, after a few moments of this, flew off the nest. This is additional evidence for the belief that nest-building is closely related to nest-relief and incubation. There is also some indication that the sideways building movements are not as carefully executed as one might expect them to be in autochthonous nest-building. This fits in well with Tinbergen's (1952) statement that displacement activities are usually incomplete and apparently "irrelevant."

Behavior During Incubation

Nest-relief

The changing over ceremony is subject to considerable variation. This variation is probably caused by the varying degrees of intensity of the drive to incubate. Nest-reliefs were seen where the mere sight of the returning mate was sufficient to stimulate leaving by the incubating partner. On the other hand, instances where a tern found it necessary to push its mate forcibly off the nest were observed. Both extremes were also reported for the Arctic Tern (Hawksley, 1950: 73-74) and the Common Tern (Palmer, 1941: 79).

In general, the ceremonies include a great deal of vocalization, Four-note-Alarm call combinations being most common as the relieving bird flies into the territory. As the relieved bird leaves, the Kid-ik Call is usual. Postures involved are Breast Low, given by the relieving bird to the bird on the nest, and both birds do a lot of Bill Down posturing which is probably an integral part of the changing over procedure. It seems reasonable to assume that the

Bill Down is given at times of fairly low intensity incubation drive and that it may stimulate the sitting bird to get off the nest. It is also possible that the Bill Down Posture is a displacement activity when the incubation or brooding drive has been thwarted to some degree.

The Four-note Call is particularly common during nest-relief, being given by either one or both birds. There is a noticeable increase in the intensity of the call as given by an incubating tern after long periods of uninterrupted incubation.

An interesting aspect of these procedures is what has been termed *bill clapping* or *mandibulation*. This is a series of bill movements reminiscent of the bill clapping of storks and herons but on a much smaller scale. No distinctive sound is produced and its function is probably not threat. Tinbergen (1953: 137) implies a similar action in the Herring Gull *(Larus argentatus):* "In this last phase (settling of the eggs), the bird makes some curious motions of the bill, without producing any sound. However, I do not know what these movements mean." I suggest that these are comfort movements related to cleaning of the bill.

Unlike the Common Tern, as reported by Palmer (1941: 80), or the Arctic Tern as described in the account by Hawksley (1950: 75), the Least Tern actively turns its eggs during incubation.

Feeding Mates

Unlike nest-relief, this is a relatively simple performance and rarely varies.

The Four-note Call is uttered rapidly several times as one member of a pair flies in with a fish. Either one or both birds will give the call. Occasionally the incubating bird will run some distance to meet the incoming bird. The transfer is effected rather quickly, and immediately after, the fish-carrier goes into the Bill Up Posture with wings up. The bird fed then shakes its head in a shiver-like movement (a comfort movement) and returns to the nest, while the fish carrier wastes no time in flying back to the fishing grounds giving the Kid-ik Call as it goes.

Egg Retrieval

The only experimental interference involved with these observations was limited to a few disturbances of the eggs. They are described below:

On 28 June 1953 one egg of the completed clutch of two eggs was placed on the edge of nest 12. The male returned but did not land immediately; instead he flew up again and circled. As it landed, the bird uttered the Tsip Call several times and began to to settle upon the eggs. He attempted to sit on both eggs at once, visibly strained to cover the large area. Finding this not possible, he incubated the egg remaining in the nest depression. After approximately 20 seconds, he stood up and pushed the other egg into the nest with the ventral side of the bill, and incubated both.

Further experiments were attempted on 7 July 1953. One egg was placed about five centimeters from the edge of a nest. The remaining egg was left in its usual position in the nest. The incubating tern returned and stood over the egg in the nest because of the extreme heat of the sand at that time of day. Several minutes later, after some "anxious" movements, the bird stood so that it shaded both eggs. An half hour later, the outside egg was moved experimentally so that the two eggs were about twelve centimeters apart. The tern flew in, landed, and flew off again giving the Tsip Call. Upon landing, it covered the outside egg. It then moved the egg underneath itself with the underside of its bill and looked about in the same "anxious" manner.

Fifteen minutes after landing, it walked over to the uncovered egg, looked at it, and moved to a position so that its body was shading it. Three minutes later it repeated this performance. Several Least Terns flying over the nest and calling the Alarm Call stimulated this bird to fly with them. It returned one minute later and stood over the egg in the nest, after which it moved the other egg into the nest as before.

Later, the same tern was given a Common Tern egg to incubate along with its own two eggs. It readily accepted it and incubated all three with some difficulty.

An additional Common Tern egg was added to these but,

finding it impossible to cover all four eggs, the tern got off them and began sideways building movements with shell fragments. The bird then returned to the eggs and made another attempt to cover them, barely managing to brood three successfully. It rose off the nest, pecked several times at one of its own eggs, and flew off giving the Alarm Call.

When removing the Common Tern eggs to restore the situation to its normal condition, I was vigorously attacked by the agitated bird. It dived at my head several times uttering the Extreme Anger Call at the lowest point of the dive.

Similar results were obtained by Watson and Lashley (1915: 83). Lashley, describing nesting activities in Noddy and Sooty Terns, discusses egg-rolling as follows:

> The bird, returning to the empty nest, misses the egg, looks about, and catches sight of it a few inches away. She starts towards it rapidly, but goes more and more slowly as she approaches, sometimes turning back before reaching it. Perhaps after several such hesitating starts she gets close to the egg, stops as soon as she can reach it with her beak, and rolls it back under her body. In this way the egg is moved for 2 or 3 inches at each trip from the old nest site to the egg. That it is moved in the direction of the old nest site seems to be the result of the fact that the bird always faces away from the latter as she approaches the egg.

Hatching

At the time of hatching, an experienced observer entering the colony will notice the increased intensity in the social attack.

When a parent returns to brood its chicks and finds an eggshell remaining in the nest, it does not immediately remove it. It may brood the chicks for several seconds. Apparently, the adult tern is stimulated primarily by the sight of the object in the nest to pick it up in its bill and fly with it dropping it somewhere off the territory.

If an egg is broken before hatching, the adult on returning to the nest will eat the contents and, in cases of this kind, has been seen to perform sideways building movements with bits of eggshell and egg-caked sand.

Pipped-to-hatching time for seven eggs averaged 2.1 days, and varied from less than one day to four days.

The egg tooth is lost after about three days in the Arctic Tern (Hawksley, 1950: 80), and in about 10 days in the Black Tern (Goodwin, 1953: 54). Each of two captive Least Tern chicks which died on their twelfth day still possessed its egg tooth at that age. No chicks were observed to lose this structure at an earlier age.

Behavior of Parents and Downy Young

After hatching, the parents' time is taken up for the most part with brooding and feeding the young. The length of time between feedings is often as long as it takes the parent bird to fly off the nest to the shore, catch a fish, and return to the nest.

Because of the frequent return of the non-brooding mate to the territory, nest-relief takes place more often.

A typical, but hypothetical feeding is presented below:

> An adult tern (say a male) is brooding two chicks of approximately one week of age. Female flies in with fish calling *K'ee-you*, the Young Call. At this sound, the chicks scramble out from under the male giving the Begging Call, holding their downy wings above their heads, and gaping. The female lands and feeds the first chick to approach it head on and begging. The other chick goes back to be brooded (but occasionally will continue begging from the food-bearing parent, who, if approached by the still-begging chick, will reach out toward it with its empty bill in a feeding motion). While the young bird is maneuvering the fish into a swallowing position, or while it is slowly being swallowed, the female may utter the *Kid-ik* call quietly, as if it were "encouraging" its offspring in its efforts to down the usually oversized morsel. By this time, a changeover has taken place or the female departs to catch fish. The satiated chick, upon swallowing the fish completely will invariably shake its head in a shiver-like motion in the same manner as an adult under like circumstances.

By the time the young can walk or run easily, territory begins to disintegrate. When the young are left alone, both parents having left the nest for some reason, they are free to travel where they will provided they stay away from any adults still on eggs who will attack them. They usually head for the more grassy areas and make scrapes for themselves in the shade of *Solidago* or *Ammophila,* where they pass the time of day until their parents' *K'ee-you* (Young Call) is heard. This stimulates them to come

scrambling rapidly out of the grass begging vociferously all the way. The young terns react only to the voices of their parents.

If one of the adult's brooding drive is strong enough, it utters the Young Call, and makes a brooding scrape. This is done in the same way that a nest scrape is made except that less care is taken to make it deep and circular. The chicks run to the parent and are brooded.

At times the Four-note Call is used in the same manner as the Young Call, and with the same result.

If the chicks are left alone during bad weather, their response to the young call is considerably weakened and their chances of being found again are thereby lessened.

Distraction display has never, to the writer's knowledge, been recorded for terns. Pettingill (1937: 243), however, reports injury-feigning in the Black Skimmer. In this account and one by Bales (1919: 85) quoted by Pettingill, skimmers are described as performing broken-wing displays commonly seen in many shorebirds.

On 6 July 1953, a performance of a Least Tern very closely resembled a distraction display, although it was not of an injury-feigning nature. The field notes for that day are quoted in part as follows:

> The following incident occurred twice today in the vicinity of 4:00 P.M. I was inspecting the two young (each 1 day old) of nest 13, when a tern dived at me in its usual attack. There was little doubt that this was one of the pair from nest 13. After diving at my head once or twice, the bird flew low about 80 feet away but in plain view and landed calling all the while. Its manner of calling was very reminiscent of the way Piping Plovers call an intruder away from their young. On landing, it walked in the opposite direction from its nest, but with its head turned watching me. It then took flight for a few more yards and landed again. The tern finally flew up with the rest of the colony when another bird chased it off its territory.

Summary

Observations of breeding behavior of the Least Tern were made in 1953, 1954, and 1956 in New York and North Carolina.

Fish Flights similar to those of the Common Tern are the typical aerial display. Ground displays are also reminiscent of other *Sterna* terns and are composed of the Bill Up, Bill Down, and Breast Low postures. Copulation was observed repeatedly. The vocal repertoire of the Least Tern is varied and includes eight distinguishable calls. The calls function in all social and sexual interactions including territorial defense and the care of the young.

The nest is a depression in the bare sand lined more or less with bits of shell. Occasionally, nests are made in places with sparse grass. Nest scrapes are made by a sitting bird kicking sand backwards and rotating so that a shallow depression is formed. Sideways building movements may contribute to the completion of the nest.

Incubation is performed by both sexes each taking turns after a brief changing over ceremony accompanied by much vocalization. While incubating, a bird is often fed repeatedly by its mate. Eggs which are found outside the nest are retrieved by the adult or incubated where they are. Incubating adults readily accept eggs of other pairs and of the larger Common Tern.

The egg tooth was retained by wild and captive nestlings of known age to at least 12 days of age.

The young birds move out of the territory and wander around shortly after hatching. One example of what might be termed a distraction display was observed.

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Figure 1. Least Tern nest with marked egg. Jones Beach State Park, Nassau County, New York.

Reproductive Success in Common Tern Colonies Near Jones Beach, Long Island, New York, in 1972: A Hurricane Year

Michael Gochfeld and Darrell B. Ford

Introduction

The Common Tern *(Sterna hirundo)* is one of the most common and characteristic birds of the south shore of Long Island, New York. In the area from Jones Beach State Park to Captree State Park (Nassau and Suffolk Counties), tern colonies have existed recently at several localities. These colonies fluctuate considerably in size and success from year to year. Periodically, certain colony sites are abandoned and new ones occupied. These phenomena are characteristic of Common Tern colonies in general and were documented for Cape Cod, Massachusetts, by the Austins in several reports (e.g., Austin, Sr., 1940; Austin, Jr., 1929, 1932, 1933).

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Colony Locations

In 1972, Common Tern colonies were found at six localities on the Jones Beach barrier beach or adjacent islands. The term Short Beach, formerly referred to the entire beach between Jones Inlet and what is now the Meadowbrook Parkway. The area is now referred to as West End by the Long Island State Park Commission. We use the term Short Beach here to refer to the beach area

near the jetty on the western side of Jones Inlet. The six localities are: (1) Meadow Island in Jones Inlet; (2) near the base of the Short Beach jetty; (3) near West End Beach parking lot 2; (4) at the southern terminus of the Meadowbrook Parkway; (5) near the southern terminus of the Wantagh Parkway; and (6) about one mile west of Cedar Beach.

The first five localities are all in Nassau County, the last is in Suffolk County.

We will summarize briefly the events at the six colonies that were visited in 1972. During the laying and hatching periods most of the colonies were visited two to three times per week, but coverage was infrequent or brief at the Meadow Island and Short Beach jetty colonies. The chief event of the season was the heavy rain and flooding associated with Hurricane Agnes at the end of June. One of us (M.G.) worked in the colonies from mid-May to late July, while the other (D.B.F.) worked mainly from mid-July through September.

Methods

Colony sizes (expressed as the number of nesting pairs) were determined in several ways. In some colonies all nests were marked with numbered sticks as the eggs appeared. The number of nests was thereby determined with considerable accuracy. This, however, disturbs the nesting birds and must be conducted with care. It is also very time consuming. The size of the Meadow Island colony was determined by applying the Corrected Adult Count (Gochfeld, MS.). From outside the colony, the number of adult birds was counted, and this was divided by 1.1 to correct for non-incubating birds. This coefficient produces a good estimate of the number of nests when all of the birds are visible and is, therefore, not useful in dense vegetation. The value of the coefficient was determined from repeated observations at West End Beach where the number of nests was known (Gochfeld, MS.), and the same factor was determined by Nisbet (1973) for Massachusetts colonies. This figure is most applicable in the

second and third week of June after the first laying period (see Cooper, *et al.*, 1970, for a discussion of laying periods) and in mornings or mid-afternoons. Often, at midday and in late evenings, a greater number of birds is present and a higher coefficient would have to be used.

On subsequent visits we noted the status of marked nests and we looked for signs of predation. The West End Beach and Cedar Beach colonies were visited most frequently throughout the season and the estimates of productivity can be stated with some confidence. The results of our observations are summarized in Table 1.

Table 1
Colony Size and Fledging Success for Jones Beach Colonies in 1972

Colony	Number of Nests (to 15 June)		Individuals Banded	Estimate of Number Fledged
	Actual Count	Estimate of Maximum		
Meadow Island	72	100	. . .	. . .
Short Beach Jetty	179	185	54	175-225
West End Beach	1124	1140	1364	1300-1600
Meadowbrook Parkway	21	21	0	0-20
Wantagh Parkway	. . .	600	22	0
Cedar Beach	. . .	1200	1031	1300-1500
Totals	1396	3246	2471	2775-3345

The Colonies

1. LOOP CAUSEWAY (Meadow Island). In 1971, Davis (pers. comm.) estimated 400 to 600 pairs of Common Terns nesting in June. In 1972, the colony was visited only on 20 June (M.G.) shortly before the hurricane. The vegetation (Beach Grass, *Ammophila breviligulata*, and Seaside Goldenrod, *Solidago sempervirens*) which had provided cover for young birds the previous year, had been eliminated by bulldozing and there was essentially no cover available. Only three small aggregates of nests, totaling

72, were found at the periphery near *Phragmites* and other vegetation. Possibly an additional 30 pairs of birds were present. In our experience such small colonies rarely fare well. Moreover, the existence of a large Herring Gull *(Larus argentatus)* colony within 500 meters, enhanced the risk of predation to the terns. No other visits were made. In 1973, no Common Terns nested at Meadow Island, but 400-500 pairs nested on Alder Island, about 500 meters to the west across a channel.

2. SHORT BEACH JETTY. The first nesting at this colony site occurred in July 1970. Two of the birds observed in that nucleus had been color-marked earlier in the season at West End Beach, about 1 km to the east, and it is likely that most of the birds were ones that had failed in previous nesting attempts although some may have been young birds nesting for the first time. In June, 1972, at least 179 nests were found.

A visit immediately after the hurricane revealed that all 139 nests on the berm or flat beach had been destroyed by flooding, while all but 7 of the 40 nests on the small dunes (less than 2 meters high) were intact. Because these nests had been marked with numbered sticks, it was possible to see that sand had piled up 5-10 cm. on the markers. No eggs were found out of nests. The storm winds, occasionally exceeding 60 miles per hour in velocity lasted for about 36 hours.

By 21 July the colony had grown in size substantially. At least part of the influx were birds that had failed in nesting attempts elsewhere. One adult marked in June at Wantagh Parkway was retrapped in July at the Jetty colony. The maximum nest count was 231 nests on 1 August. The growth of the Jetty colony in late summer, involving second nesting attempts, is consistent with observations made by the Austins at Cape Cod (e.g., Austin, Sr., 1946), where there was much movement between colonies after initial nesting failures.

A visit to the Jetty on September 5 revealed many half-grown chicks in the colony. A count of 311 flying-age chicks indicated that nesting success was high. However, some of these flying chicks may have come from adjacent colonies. Chicks marked at

West End were known to have moved across the Jetty colony with their parents after fledging to feed in Jones Inlet. Based on the 266 banded chicks of about three weeks of age, and on the 75% or better fledging rate of three-week old chicks (determined by M.G. on a study plot at West End during the same period), the productivity of the Jetty colony was estimated to be 200 ± 25. This is a conservative estimate. If one subtracts the 139 nests eliminated by the storm from the maximum count of 231, the productivity for 85 nests comes to 2.35 surely an overestimate. For the colony as a whole the most meaningful figure is based on the number of nests found during the first laying period: 200/179 = 1.12/nest.

3. WEST END BEACH. This moderately large colony (varying from 800-1800 pairs over the past decade) is located at what is now officially designated West End Beach 2. Unfortunately this colony has also been referred to as the Short Beach Colony (Gochfeld 1966). It is the oldest continuously occupied ternery active in the Jones Beach area and has existed at essentially the same location since the late 1950's. The colony was located near the southern end of the Meadowbrook Parkway, until the construction of parking and beach facilities rendered that area unsuitable (Arbib and Wolk, pers. comm.).

The colony was studied extensively in 1972. By 15 June, the end of the first laying period, 1020 nests were found and by 20 June the total number of nests marked was 1124. This colony, located more than 300 meters from water and at least three meters above sea level, was not subject to flood damage. Predation, however, was a problem. A large number of chicks in the 4- to 8-day age category disappeared for unknown reasons, although many carcasses were found in rat burrows. Brown Rats *(Rattus norvegicus)* were observed and trapped in the colony and presumably accounted for many of the deaths. Austin, Sr., (1940, 1948) considered rats the most important non-human predators of terns. Other mammalian predators seen in or near the colony were Red Fox *(Vulpes fulva)* and Long-tailed Weasel *(Mustela frenata)*, as well as domestic dogs and cats. Avian predators observed near

the colony were Herring Gull *(Larus argentatus)*, Black-crowned Night Heron *(Nycticorax nycticorax)*, and Short-eared Owl *(Asio flammeus)*. The overall loss was much less than in 1971 when over 80% of the chicks disappeared before one week of age.

Many of the adults whose first nesting attempt failed laid eggs again and the colony remained "active" through August. During the season 1346 young terns, mostly over five days of age, were banded at West End. Spot checks of young flying-age terns resting on parking lots adjacent to the colony revealed that 21 of 165 (12.7%) and 26 of 135 (19.3%) had not been banded. The estimate for the number of young fledged from the first laying period was 650 to 800. Grafton conducted biological studies of terns at West End throughout the summer and estimated that about half the young produced came from the second laying period. The fledging success for the season as a whole was in the range of 1.1 to 1.4 chicks per pair.

4. MEADOWBROOK PARKWAY. At the southern terminus of the Meadowbrook Parkway, close to where terns bred prior to the mid-1950's, a new colony was started in 1972. Twenty-one Common Tern nests were found in mid-June but most of these were abandoned by July. In early July there were eight nests and one young chick. Adult aggression against intruders was very low, as is typical of small colonies in general and of colonies that have suffered disturbance in particular. Some relaying occurred there, however, for on 11 August, Grafton found 31 nests and two young of about 10 days of age. However, half of the nests contained at least one damaged egg, and some nests were abandoned. Herring Gulls and Fish Crows *(Corvus ossifragus)*, both potential predators, nested nearby. The damaged eggs were typical of predation by the latter. Neither of us has observed gulls or Fish Crows preying on Long Island terns in the absence of human disturbance. However, both Fish Crows and gulls have been observed preying on heronries in the area. A small tern colony with a low level of adult aggression would offer little deterence to a determined avian predator. In 1973 nearly 100 pairs of terns nested in this colony.

5. WANTAGH PARKWAY: The colony along the Wantagh Parkway began in July 1971, when over two hundred pairs of Common Terns started nesting there. In early June 1972 it appeared to be a large vigorous colony. There is little vegetation in the colony. The substrate here is land-fill rather than loose sand and it is dotted with stones and bits of wood which seem to enhance its attractiveness to the terns. In addition to the terns, over 60 pairs of Black Skimmers *(Rynchops niger)* were preparing to nest and by 20 June, 47 nests of that species were marked.

By mid-June, 540 Common Tern nests were marked and we estimated the colony size to be 550-600 pairs. The early hatching chicks received an adequate food supply. The adults were quite vigorous in attacking intruders and one would have predicted breeding success for the colony. Then began a series of events which resulted in the total failure of the colony. After heavier than normal rains throughout the spring, Hurricane Agnes on June 22 and 23 produced severe flooding which eliminated about 80% of the nests and severely disrupted the remaining birds. Subsequently, the remaining adults were much more shy and much less vigorous in attacking intruders. After the rains, during late June and early July there were a number of beach parties within the colony area, and the prolonged disturbance prevented the birds from brooding or feeding their young. It seems likely that the aggressive behavior of a large smoothly-functioning colony would have discouraged such parties. The Austins (Austin, Jr., 1933; Austin, Sr., 1946) also noted the decline in aggressive behavior with the decline in size of a colony. In addition, we found several adult terns and an adult skimmer that had been shot and observed tracks of at least one beach vehicle whose driver had evidently tried to destroy nests. By 5 July there were no active nests and only about 30 adults and eight half-grown chicks were found. By 8 July the colony was empty. Austin, Sr., (1940) stated that the causes of tern colony failure in order of importance are 1) human disturbance, 2) rat predation, 3) flooding 4) adverse weather and 5) natural predators. Factors 1, and 4 following upon flooding, interacted at Wantagh Parkway in 1972. One of the most distressing events accompanying tern study is to visit a formerly

crowded and vibrant colony and find it lifeless and still.

For the terns, however, such destruction is not final, for they can go elsewhere and lay a second clutch. D.B.F. had the opportunity to observe extensive emmigration to the Cedar Beach colony and although no marked birds were recognized, it seemed likely that some of these birds came from previously unsuccessful colonies such as the one at Wantagh Parkway. Only banding studies and individual marking of the terns can clarify such movements, but the fact that they occur points to the need to study the colonies in a local area, since inferences drawn from a single colony may be invalid. Significantly, only two pairs of Common Terns attempted to nest at Wantagh Parkway in 1973, while the West End Beach colony had 1700-1800 pairs.

6. CEDAR BEACH. Based on 1088 nests marked, about 1150 pairs of Common Terns nested along one mile of beach in June 1972. Disturbance by beach vehicles, swimmers, and shooters occurred rather frequently, but the birds were sufficiently spread out to tolerate them. One low-situated group of about 40 nests was completely eliminated by flooding during the hurricane. The rest of the colony fared well. Hatching success was good, and the young from the first laying had adequate food. We banded 986 young (somewhat under 50% of the total estimated-as reaching five days of age) from the first and subsequent layings. The season was quite protracted with new nests appearing throughout July, August, and early September. There was also an influx of late-nesting Black Skimmers *(Rynchops niger)*. At least 1300 and perhaps as many as 1500 tern chicks fledged successfully judging from the number of young banded and the proportion of banded to non-banded chicks found dead. At least half of the fledged young were from late nests.

Although it is difficult to calculate a fledging success rate because the colony size grew as the season progressed, an attempt was made as follows. Taking 1400 as the estimate of the number fledging, and knowing that close to half of these came from the first nesting period, the productivity for that period alone was about 0.61 chicks/nest. Productivity for the entire season was

higher, but it is pointless to attempt a better estimate in view of the influx of a large but unknown number of adults.

Discussion

Table 1 summarizes the sizes of the six tern colonies found in the Jones Beach, New York, area in 1972. A total of 3121 nests was found or estimated, probably accounting for more than 95% of the nests actually present in these colonies. Estimates of the number of birds reaching flying age range from 2775 to 3345 giving an overall fledging success of somewhere between 0.889 and 1.072 young per pair. This is based on the number of nests found during the first laying period. Possibly some of the adults that were included in this total moved to some distant colony for subsequent nestings. If these were successful the success estimate given above is low. Nisbet and Drury (1972) studied productivity in Massachusetts tern colonies in 1970 and 1971 and found productivities ranging from 0 to 2.1 chicks per nest for Common Terns (mean 0.92). This value is within the range of our estimates for Jones Beach in 1972. Nisbet (1973) found productivities in previous studies ranging from 0 to 2.0, mainly between 1.1 to 1.5. Nisbet gives the mean productivity for the Austins' studies as 1.07 based on his own conputations. Also, he reported (Nisbet, 1972) that tern productivity in Massachusetts in 1972 was lower than in preceeding years (range 0 to 1.8, mean 0.40). All the above productivities are given as young fledged per pair of adults.

Although the productivity is an important measure of the success and future survival of any wild population, it is often quite difficult to determine. We visited six tern colonies, but can only make good estimates of success in the one that was studied intensively throughout the season (West End Beach) and in the one that failed entirely (viz., Wantagh). However, Nisbet and Drury (1972) discuss a method whereby a good estimate of productivity can be obtained in as few as four or five visits to a colony by fencing off sample quadrats and measuring productivity therein. They emphasize, however, that this method does not work well in colonies where there is much late nesting and they

point out that late nesting is often common. In our experience this varies from year to year. For instance, in 1969 at West End Beach there was essentially no renesting and only two nests were found in early August. The Nisbet-Drury technique would have been very useful in that season. In 1972, as demonstrated above, renesting was the rule in most colonies.

The Short Beach Jetty, West End Beach and Cedar Beach colonies were roughly equivalent in their fledging success. However, their values are all based on the total number of young fledged compared with the initial number of nests (early June). Since many of the fledged young came from later nests that may have belonged to immigrants from other colonies, it is apparent that such estimates are to some extent spurious. Late nesting is difficult to study since birds may move to new colony sites that are difficult to discover. For example, the start of the Short Beach Jetty and Wantagh colonies occurred in mid-summer. Also it is difficult to count the number of nests involved in late nestings, since eggs may be laid continuously and new nests initiated over a period of weeks.

The adverse events operating on Long Island are not isolated. Nisbet (1972) describes how weather, human disturbance and predation took a heavy toll from Common Terns on Cape Cod, where he finds the overall population to be steadily declining compared to the approximately 15,000 pairs estimated in the 1930's and 1940's (Austin, Sr., 1942, Nisbet 1973). In the Jones Beach area the 1972 nesting population of at least 3120 pairs indicates a rather stable population compared with the preceeding four years.

Except for the severe damage caused by heavy rains and flooding, 1972 promised to be a somewhat better than average season. Food availability was generally good, judging by the number of preferred food species *(Ammodytes* and *Menidia)* brought into the colony and by the growth rates of chicks on the West End Beach study area. There was a brief period of food failure in mid-June, before the peak of hatching, and during this period (June 20-26), large numbers of shrimp, and even inedible bits of flotsam were brought into the colony. Massive failure was initiated by flooding. Such failure involving many nests usually

causes a colony of terns to desert as a group and go elsewhere to lay a second time (Austin, Jr., 1933; Austin, Sr., 1946). Frequently such birds join an established colony, such as may have happened at the Jetty and Cedar Beach, but such birds may also form the nucleus of a new colony.

Austin, Sr., (1946) and Austin, Jr., (1932) noted that such movements are regular and are part of the natural response of the terns to nesting failure. Common Terns are also known to show site tenacity within colonies and to return preferentially to colonies they have used previously. It is probably a general rule that birds tend to return to nest in a colony where they have been successful and tend to avoid colonies where they have failed. This would be an important adaptation for breeding success, particularly in view of the instability of the sandy islands on which the birds often nest, but clearly there are other factors which operate in colony and nest site selection and these remain to be studied in detail.

Excessive human disturbance, either directly by modifying the colony site, or by polluting the water, may have accelerated the pace at which existing colony sites have become unsuitable. Observers have noted that sites have a natural cycle in which they become suitable and then unsuitable because of ecological succession. Several workers (e.g., Floyd, 1932; Austin, Jr., 1932, 1933) have noted that excess vegetation offers abundant shelter for rats and is therefore a serious threat to any tern colony. Thus extreme colony loyalty would be maladaptive, for Common Terns (but not Roseates) must be able to abandon a traditional colony when it becomes overgrown.

The adaptive balance between colony loyalty and nest-site tenacity on the one hand and emigration and renesting on the other may be of increasing importance to Common Terns. Although colony fluctuations have always occurred, their rate probably has been increased by human interference. The terns, however, appear to have the ability to make short-term adjustments so that as long as some habitat is available, their continued survival on Long Island and near metropolitan areas can be maintained. The large-scale problems of habitat destruc-

tion and environmental contamination should not distract environmentalists' attention from smaller more readily-controlled threats such as vandalism and damage by beach vehicles ("buggies"). These should be reduced by practical management on local levels.

Summary

1. We visited six colonies on Jones Beach, Long Island, New York, occupied primarily by Common Terns. The total number of pairs present in June 1972 was at least 3121 and probably not more than 3250. Two colonies, West End Beach and Cedar Beach, accounted for about 70% of the nests.

2. A colony at Wantagh Parkway, with at least 575 nests, was eliminated by early July. A combination of storm and flooding, vandalism (including shooting and damage by beach vehicles), and beach parties caused its elimination.

3. Starting about one week after the elimination of the Wantagh Parkway colony, numerous new nests were discovered at West End Beach and Cedar Beach. These probably represented some birds that were renesting in the same colony, some newly-arrived young, and many immigrants from other colonies, perhaps including that of Wantagh Parkway. Such local movements have been documented by the Austins in Massachusetts, and by us in previous years, but no individually-marked birds were involved in the 1972 colony change.

4. The overall fledging success was approximately 0.9 to 1.07 young per pair, almost certainly not exceeding 1.1 per pair. This is much higher than the 0.4 per pair reported by Nisbet for Massachusetts terns in 1972, but is close to values he and others have observed in previous seasons.

5. The ability of Common Terns to return to sites where they previously have been successful in nesting and to abandon sites

after failure, is an important adaptation to the changing environment of the coastal dune substrate and vegetation.

6. Preservation of coastal habitats with a suitable substrate, free of natural predators and human disturbance, is necessary if tern colonies are to continue their existence. Islands are preferable because mammalian predators do not reach them easily but they are often heavily utilized by recreational boaters. Elsewhere, control of vegetation and of rats has proven useful in maintaining an area suitable for terns. Finally, human access to colonies, particularly by means of beach vehicles, should be regulated.

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General Notes:

First Long Island, New York, Nesting Record of the Kentucky Warbler

David Ewert

According to Bull (1964, Birds of the New York area, New York, Harper and Row), in the New York region the Kentucky Warbler *(Oporornis formosus)* is "a very rare migrant and breeder" but was fairly common locally before 1900. The last reported New York nest was found in 1942 at Worthington, Westchester Co., and in recent years the nearest regular breeding area is the Delaware River drainage of Hunterdon Co., New Jersey. On Long Island, possibly territorial males have been reported from the Orient Peninsula, Suffolk Co., and three purportedly different males were seen at Freeport, Nassau Co., on 22 May 1960. One singing male was observed by J. Wunderle, Jr., at what is now Connetquot River State Park, Oakdale, Suffolk Co., on 1 July 1972 (Davis, 1972, Kingbird 22: 193). Except for the two old unverified breeding reports from Bellport and Sayville, Suffolk Co., rejected by Bull (1964), nesting has never been reported before from Long Island.

A Kentucky Warbler nest found on 30 June 1973 at the Kalbfleisch Field Research Station of the American Museum of Natural History in Huntington, Suffolk Co., is apparently the first definite Long Island nest and the only known nesting report for New York State since 1942.

Prior to 1973, Kentucky Warblers were reported from the Kalbfleisch Station on 26 August 1966 when an immature male was banded and on 11 May 1969 when an adult male was banded. Neither bird was observed again. A singing male was seen and sound recorded on 17 May 1973. On 18 and 19 May, I observed what was presumably the same individual at widely separated points over the 100-acre field station. Subsequently, S. Lanyon, W. E. Lanyon, S. Wechsler, J. Wunderle, Jr., and I saw and heard

the male repeatedly in its approximately four-acre territory at the head of a densely vegetated gully near a vernal pond.

Finally, on 30 June 1973, both a male and female were observed carrying food. This date was the first time I saw the female. At that time the bulky nest, containing three fully feathered nestlings and no eggs, was found in a dense tangle of Japanese Honeysuckle *(Lonicera japonica)* about 7.5 cm. above the ground. After being filmed and photographed (Fig. 1) on 30 June and 1 July, the three nestlings fledged on the latter date. The male was mist-netted and color-banded 1 July after responding to playback recordings and the nest was collected following the fledging of the young. The nest is now in the collection of the American Museum of Natural History. The female was observed again 3 July and the male, accompanied by a juvenile undergoing prebasic molt, was seen 18 July about 100 meters from the nest site.

Based on incubation and nestling period data cited in Bent (1953, Life Histories of North American Wood Warblers, U. S. Nat. Mus. Bull. 203: 506), I estimated that incubation began on 9 June. The egg dates of this nest then fall within the 1 to 27 June egg dates of the three other New York nests recorded in Bull (1974, Birds of New York State, Garden City, N.Y., Doubleday-Natural History Press). The fledging date of 1 July is very close to the only other fledging date cited by Bull (1974), viz., 29 June. These few Kentucky Warbler nests from New York show remarkably similar timing.

The area around the nest consisted of a semi-open canopy of Pin Oak *(Quercus palustris)* and Pignut Hickory *(Carya glabra)* with a mid-story of Sassafras *(Sassafras albidum)*, Flowering Dogwood *(Cornus florida)*, Red Cedar *(Juniperus virginiana)* and Maple-leaf Viburnum *(Viburnum acerifolium)* shading a leaf litter covered forest floor densely overgrown with Japanese Honeysuckle, Greenbrier *(Smilax rotundifolia)*, Poison Ivy *(Rhus radicans)* and raspberry *(Rubus* sp.). The area, though relatively small and isolated, approached the typical Kentucky Warbler habitat of well-drained woods in ravines but differed primarily in lacking permanent water.

Fig. 1. Female Kentucky Warbler at nest, 1 July 1973, Kalbfleisch Field Research Station, Huntington, Suffolk Co., N. Y. Photo by W. E. Lanyon.

I wish to thank S. Lanyon, S. Wechsler, and J. Wunderle, Jr. for their field notes. W. E. Lanyon kindly provided the photograph of the nest and read the manuscript. J. Bull allowed me to cite information from his manuscript of *Birds of New York State* and offered helpful suggestions. The observations were made incidental to research funded by the Frank M. Chapman Memorial Fund.

Recent Additions to the Birds of Central Park

Roger F. Pasquier

Since the publication of Geoffrey Carleton's "Supplement to the Birds of Central and Prospect Parks" in 1970 (*Proceedings*, No. 71: 132-154), nine additional species were recorded in Central Park bringing the total to 266. The 1970 "Supplement" included records through the spring migration of 1967; this list includes records through the fall migration of 1974.

Escaped birds are seen regularly in Central Park. Most of them are exotics. A Ring-necked Pheasant *(Phasianus colchicus)* seen on April 30, 1972 is probably best kept in this category also.

The author wishes to thank all those who contributed their records and also John Bull and Geoffrey Carleton, who reviewed this list and made many helpful suggestions.

CATTLE EGRET *(Bubulcus ibis)*
Two seen flying, May 20, 1973 (K. Berlin, D. Edwards).

SNOWY EGRET *(Leucophoyx thula)*
Seen flying over the Park by various observers on four dates in 1974: April 29 (2), May 14 (2), May 17 (1), May 25 (1).

LOUISIANA HERON *(Hydranassa tricolor)*
One flushed from the Azalea Pond in the Ramble, 8 A.M., April 10, 1969 (O. Goelet, Jr.).

GLOSSY IBIS *(Plegadis falcinellus)*
Two seen flying, May 5, 1973 (Mr. and Mrs. W. Bauman). One flying, May 5, 1974 (Pasquier); two flying, May 15, 1974 (D. Edwards).

MUTE SWAN *(Cygnus olor)*
Two on Reservoir, February 4, 1968 (Pasquier). No swans have

been kept on the lakes in Central Park since 1950 (Henry Hope Reed, Curator of Central Park, pers. comm.).

CHUCK-WILL'S-WIDOW *(Caprimulgus carolinensis)*
One, in the Ramble, May 13, 1972 (R. B. Sichel, H. McGuinness, and many others). The bird remained all day, was color photographed by A. Swoger, and compared with a Whip-poor-will *(Caprimulgus vociferus)* also in the Park that day.

SWAINSON'S WARBLER *(Limnothlypis swainsonii)*
One May 11, 1973 (H. McGuinness, P. Polshek, H. D. Hale, and many others). The bird spent the entire day in one section of Japanese Knotweed *(Polygonum cuspidatum)* near the Summer house in the Ramble. This is the third observation for New York State.

BLACK-THROATED GRAY WARBLER *(Dendroica nigrescens)*
A singing adult male, May 24, 1970 (Pasquier, Mr. and Mrs. W. Bauman, and several others). Seen sporadically throughout the day in a grove of trees near East 85th Street. This is the first spring record for the New York area.

WESTERN TANAGER *(Piranga ludoviciana)*
Adult male, color photographed by S. Bahrt, on May 9, 1970; adult male, June 22, 1970 (Pasquier). Both birds were in the Ramble. These are the third and fourth spring records for the New York area.

Report of the Secretary for the Year 1970 - 1971

At the annual meeting of the Society on 10 March 1970, the following officers were elected for the ensuing year:

President	Mr. Richard Plunkett
Vice-President	Mr. Thomas H. Davis, Jr.
Secretary	Miss Helen Hirschbein
Recording Secretary	Miss Helene Tetrault
Treasurer	Mrs. Lois H. Heilbrun
Editor	Dr. Robert G. Wolk

At the regular meeting of 24 March 1970, the Society elected Mrs. Neal G. Thorpe, Mr. Richard A. Jewett, and Mr. John Yrizarry to serve on the Council for a three year term.

There were 16 regular meetings, 3 informal meetings and 1 special meeting held during the year. The programs for the regular meetings were as follows:

24 March 1970	*Birds of the Galapagos Islands*, Mr. James Gulledge
14 April	*Birds of Panama and Costa Rica*, Dr. Eugene Eisenmann
28 April	*Birds of the Spanish Main*, Dr. Ernest Choate
12 May	Symposium: *Long Island Colonial Birds*, Mr. T. H. Davis, Jr., Mr. Harry Greenwald, U.S. Fish and Wildlife Service, and Mr. William Ward, State Conservation Officer
26 May	*Ecology of the Seaside Sparrow at Oak Beach*, Mr. William Post, Jr.
15 September	*Water Birds of Africa and Asia*, Dr. Philip Kahl
22 September	*Birds of the Southwest*, Mr. Harold Wellender
13 October	*Birds of the Llanos*, Dr. Michael Gochfeld, Mr. Michel Kleinbaum, and Mr. Guy Tudor
27 October	*Hummingbird Studies in Central America*, Dr. F. Gary Stiles
10 November	*Population Expansion and Range Extension of the White-tailed Kite*, Dr. Eugene Eisenmann
24 November	*The Wisconsin Glacial Stage and Species Survival in Eastern North America*, Mr. Robert Arbib

8 December	*Comparative Studies of Tropical and Temperate Avifauna*, Dr. James Karr
12 January 1971	Discussion of the Christmas Count, Mr. Ned Boyajian and Mr. T. H. Davis, Jr.
26 January	*Summer Birds of the Canadian Arctic*, Dr. David Hussel
9 February	*Evolution of West Indian Woodpeckers*, Dr. George Wallace
23 February	*Nature Photographs and Color Techniques*, Mr. Arthur Swoger

There was a special "Save Jamaica Bay" meeting in August which included a slide presentation on the proposed Gateway National Recreation Area given by Jerry Wagers of the U. S. Department of the Interior.

Research on the tern colony on Great Gull Island continued actively in 1970. Contributions totalling $923 by members of the Society were appreciated because they permitted us to keep people on the island to protect the colony during the breeding season. Volunteers Erna Hanson, Lilla Hind, Elizabeth Macdonald, Katherine O'Hare, Alice Oliveri, Henry Kemp, and Donen Gleick and family helped string color bands in April which got us off to a good start with the banding.

A number of abnormal young terns were found this year and were sent away for chemical analysis. They were obtained during a production study started in 1969 and which will be continued in 1971.

Dr. Theodora Nelson, former Treasurer of the Society, suggested a number of years ago that the Spotted Sandpiper female may nest with more than one male in a season. Her suspicions were confirmed in 1970. One female on Great Gull Island nested with three different males, leaving the first two on completion of the clutch, and finally sharing incubation of the third nest with the third male.

Under the chairmanship of Mr. Richard Jewett, the field trips continued to be one of our best programs. Mr. Jewett has designed a field trip schedule that certainly will become a model for future committees.

Because of the tremendous rise in interest in conservation, the

Conservation Committee chaired by Mr. Richard E. Harrison, no longer has to fight as much alone as it had to do in the past. We now have no difficulty in getting support from politicians and other organizations. For example, the fight to save Jamaica Bay was won by many forces. The building of a complex of stables in the middle of Central Park was prevented. Among the pending battles is the one against the very damaging open-cut subway construction in the south end of Central Park as planned by the Metropolitan Transit Authority, and the expansion of the Fire Communication Building and the Metropolitan Museum of Art within the Park.

This past December, the Society established the Rare Bird Alert. Anyone dialling a designated number can receive a two-minute, up-to-date report on birds of special interest and where they can be found.

The Society granted funds from the Charles A. Urner Memorial Fund to Mr. William Post, Jr., for a research project on the Seaside Sparrow on Long Island.

Four members of the Society were honored in the past year by the American Ornithologists' Union. Dr. Robert W. Storer was elected President, and Dr. Joseph J. Hickey, Second Vice-President. Drs. Eugene Eisenmann and Wesley E. Lanyon were elected to the Council of the A. O. U. Again we have a book published by a member. Mr. Robert Arbib's *The Hungry Bird Book* is now in print.

Membership in all classes is as follows: 6 Honorary Members, 11 Fellows, 386 Active Members, and 71 Associate Members. Total membership is 474.

Respectfully submitted,
Helen Hirschbein, *Secretary*
9 March 1971

Report of the Secretary for the Year 1971 - 1972

At the Annual Meeting of the Society on 9 March 1971, the following officers were elected for the ensuing year:

President	Mr. Thomas H. Davis, Jr.
Vice-President	Miss Helen Hays
Secretary	Mr. Douglas E. Heilbrun
Recording Secretary	Mr. Richard A. Jewett
Treasurer	Mrs. Lois H. Heilbrun
Editor	Dr. Robert G. Wolk

At the regular meeting on March 23rd, the Society elected Miss Helen Hirschbein, Mr. Guy Tudor and Mr. Michel Kleinbaum to serve on the Council for three years, and Mr. Donen Gleick was elected to fill an unexpired term of one year.

During the year we held 18 regular meetings, 3 informal summer meetings and 2 special meetings. The programs for the regular meetings were as follows:

9 March 1971	*New Zealand Spring*, Dr. Olin S. Pettingill
23 March	*Altitudinal Distribution of Birds in the Peruvian Andes*, Dr. John Terborgh
13 April	*Solving Some Field Problems in Venezuela*, Dr. Wesley Lanyon
27 April	Film: "Signals for Survival: Life History of the Herring Gull"
11 May	*Davis Meets Darwin*, Thomas Davis
25 May	Discussion of the Spring Migration
14 September	Films: "The Baobab Tree" and "The Life of the Kingfisher"
28 September	*Larks and Pipits – Related or Convergent?*, John Bull
12 October	*Great Gull Island*, Miss Helen Hays
26 October	*Changes in the Magnetic Field and Periods of Extinction*, James Hays
9 November	*Ecology and Behavior of Antbirds*, Dr. Edwin Willis
23 November	*Observations at an Ontario Banding Station*, David Hussell

14 December	*Ospreys of Connecticut and Long Island*, Dennis Puleston
28 December	*Ospreys of Seven Mile Beach*, Joseph Jacobs, President of the D.V.O.C.
11 January 1972	Christmas Counts, Roger Pasquier and Tom Love
25 January	*Humphrey and Parkes Revisited or Plumage, Politics and Progress*, Dr. Kenneth C. Parkes
8 February	*The Gannets of Bonaventure Island*, Paul Jeheber
22 February	*Sojourn in Brazil*, Richard E. Harrison

Our Conservation Committee, headed by Richard Harrison, continued its efforts to mitigate threatened depredations against our local environment. For example, the projected stables in Central Park will be much smaller and less damaging than the ones originally planned; a firehouse designed for the Park has been moved elsewhere; the Society took an active part in the struggle to prevent the extension of JFK Airport runways into the Jamaica Bay Sanctuary; and we are supporting the proposal for the Gateway National Recreation Area. Furthermore, because of our efforts, current subway construction in Central Park will not do as much damage as the original plans called for.

The Society's latest *Proceedings* were published and distributed during the year; we are now engaged in preliminary work on the next *Transactions* or *Proceedings*, but its publication date cannot be predicted.

The Great Gull Island Committee under Miss Helen Hays reports high productivity for the terns in 1971; over 3000 young terns were produced in the colony and 800 paper terns were produced in the Museum for the Gull Island Exhibit. For the latter result, thanks are due to volunteers, among them Edith Bull, Grace Donaldson, Bertha Brenner, Kathy O'Hare, Lilla Hind, Mary, Sara and Lauren LeCroy and Alice Oliveri. Three hundred of these terns were sold in the Museum Shop, proceeds accruing to the Gull Island Project. Studies underway of all species nesting on the Island will be continued in 1972.

Our Field Trip Chairman, Richard Jewett, assisted by Jane Plunkett, did an excellent job of planning and carrying out a full schedule of field trips during 1971, and the small printed field trip

schedule was one of our most popular publications. The highlight was a well-attended trip to Bonaventure Island, Quebec, June 19 to 27.

The Society's Rare Bird Alert, begun in December 1970, continues as a much appreciated source of local ornithological information, under the direction of Dr. Paul Buckley.

One of our former presidents, Mr. Robert Arbib, published a well-received book entitled "The Lord's Woods," dealing with the unsuccessful struggle to rescue Woodmere Woods from the real estate developers.

Dr. Jean Delacour of the American Museum was elected to honorary membership; Messrs. Lawrence Grinnell and Irving Kassoy became Life Members.

During the year 30 persons were elected to active membership and five to associate membership. Current membership in all categories is: 7 Honorary Members, 11 Fellows, 361 Active and 63 Associate Members.

Respectfully submitted,
Douglas E. Heilbrun, *Secretary*
14 March 1972

Report of the Secretary for the Year 1972 - 1973

At the Annual Meeting on March 14, 1972, the following Officers were elected:

President	Mr. Thomas H. Davis, Jr.
Vice-President	Miss Helen Hays
Secretary	Mr. Douglas E. Heilbrun
Recording Secretary	Mr. Richard A. Jewett
Treasurer	Mrs. Lois H. Heilbrun
Editor	Dr. Robert G. Wolk

At the regular meeting on 28 March 1972, the Society elected Lee Morgan, Paul Buckley and Roger Pasquier to three-year terms as members of the Council.

During the year we held 18 regular meetings and three informal summer meetings. The programs for the regular meetings were as follows:

14 March 1972	*Ecological Observations along Alaskan Rivers*, Dr. John R. Hough
28 March	*Banding Hawks and Owls and Migrants through the Garden*, Jay Richard Cohen
11 April	*Birds of Tibet*, Charles Vaurie
25 April	*Ecology of Large Herbivores of Africa, a Review of Ecological Specialization*, Allen Keast
9 May	*Orchids and Ornithology*, Benjamin Berliner
23 May	Big Day Reports
12 September	*Birds of Prey*, Heinz Meng
26 September	*Relationships of and among the Shorebirds*, Jon Alquist
10 October	*Africa 72*, Gardner D. Stout, President of the American Museum of Natural History
24 October	*Operation Recovery*, Chandler Robbins
28 November	*Birding in Southern Africa*, Stuart Keith
14 November	*A Comparative Study of Foraging Behavior in Six Species of Migrant Shorebirds*, Mike Baker
12 December	*Ecology of a Tropical Passerine – Turdus grayi*, Eugene Morton
26 December	Film: "The Living Arctic"
9 January 1973	*Philosophical Consequences of the Theory of Evolution*, Dr. Ernst Mayr
23 January	Christmas Bird Counts, Roger Pasquier and Tom Love
13 February	*Spiders*, Dr. John Cook
27 February	*A Trip to Australia and Islands of the South Pacific*, Dr. Robert Cushman Murphy

Our Conservation Committee under the chairmanship of Jane Plunkett wrote letters in opposition to Congressman Pike's proposal to convert Gardiner's Island into a National Park. Jane and Dick Plunkett attended various hearings dealing with conserva-

tion issues, such as the Audubon Society's suit against an organization desiring to build a sports complex on the Hackensack Meadowlands, and the proposed rezoning of Alley Pond Park in Queens to allow the construction of motels. The Committee has also been active in support of the Gateway National Recreation Area.

Dr. Robert G. Wolk, Chairman of the Editorial Committee, reports the receipt of several papers suitable for publication in the Society's next *Proceedings*. Editing of this material will begin at the next meeting of the Committee.

The Society's field trips were held under the vigorous leadership of Field Trip Committee Chairman Richard Jewett, including two pelagic trips during the weekends of August 19 and September 23, and a trip to Cape Ann, Mass. over the weekend of November 24.

The Great Gull Island Committee under Helen Hays continued its valuable long-term activities during the late Spring and Summer. Numerous volunteer assistants were enticed to spend weekends on the Island so that they might contribute to this well-established tern-study project.

Our Rare Bird Alert equipment was moved from Hofstra University to Audubon Society headquarters on East 57th Street and was set up under the joint sponsorship of the Linnaean and Audubon societies, with the taping of information entrusted to Tom Davis. Judging by the high number of incoming calls, the RBA must be the most popular and fruitful source of birding information in the U.S.A.

During the year the Society elected Mr. Walter Sedwitz to Life Membership. Forty persons were elected Active Members and eight Associate Members. Current membership in all categories is: 7 Honorary, 11 Fellows, 24 Life Members, 332 Active Members and 83 Associate Members, for a total of 457.

Respectfully submitted,
Douglas E. Heilbrun, *Secretary*
13 March 1973

Report of the Secretary for the Year 1973 - 1974

At the Annual Meeting of the Society on March 13, 1973, the following officers were elected for the ensuing year:

President	Miss Helen Hays
Vice-President	Mr. Richard Jewett
Recording Secretary	Mr. Roger Pasquier
Corresponding Secretary	Miss Alice Oliveri
Treasurer	Mrs. Lois H. Heilbrun
Editor	Dr. Robert G. Wolk

At the regular meeting on 27 March the Society elected as members of the Council for a period of three years: Mr. Griffin Littell, Mrs. Mary LeCroy and Mr. Donen Gleick, and to fill an unexpired term of two years, Dr. Robert Dickerman.

Following the resignation of Mr. Richard Jewett, Dr. Robert Dickerman was elected Vice-President at the meeting of November 27th.

During the year we held 16 regular meetings and 3 informal summer meetings. The programs for the regular meetings were as follows:

12 March 1973	*Sharks and Porpoises*, Perry Gilbert
27 March	*Learning of Calls in Cardueline Finches*, Paul Mundinger
10 April	*Gulls in the Northeast: Identification and Distribution*, Davis Finch
24 April	*Breeding Ecology of Royal Terns*, Paul Buckley
8 May	*Hidden Spring Farm: Wildlife on a 40-acre Farm 50 Miles West of New York*, Mr. and Mrs. William Riley
22 May	*Bird Navigation*, Donald Griffin
11 September	Film: "Pelican Flyway" produced by Survival Anglia, Ltd.
25 September	*Flower Feeding Ecology of Kenyan Sunbirds*, Frank Gill

9 October	*Parakeets and Other Matters*, Howard Cleaves
23 October	*Birds, Mammals and Plants of the High Arctic, Bathurst Island, N. W. T.*, Stuart MacDonald
13 November	*Anti-predator Mechanisms in Tinamous*, Douglas Lancaster
27 November	*Pollinating Bats*, Donna Howell
11 December	*Franklin's Gulls*, Joanna Burger
8 January 1974	Christmas Bird Counts, Roger Pasquier
22 January	*Meshie – Adaptation by a Young Chimp to a Human Family*, Harry Shapiro
12 February	*How Birds Grow*, R. E. Ricklefs
26 February	*Bird Propagation and Rhea Studies at the Bronx Zoo*, Joseph Bell and Donald Bruning

The report of the Committee on the Great Gull Island Project is as follows:

"Thanks to generous contributions from Society members, the Gull Island Project extended its program this year to include the netting of migrants through the end of October, a step which enables us to continue to expand and revise *The Birds of Great Gull Island*.

"In 1973 we estimated that about 7,000 terns nested. This is a slight increase in the number of breeding birds over preceding years. The team monitoring the colony for the effects of environmental pollution completed a fifth season. The number of abnormal young remained low and the number of thin-shelled eggs has been the same for the last three seasons. All five hybrids between Common and Roseate Terns banded in 1972 were seen early in 1973, but the nest of only one pair was found.

"In 1973 the resident populations of Common Yellowthroats as well as the resident Starlings were color marked by Ron Franck, enabling him to follow individuals of these species in 1974.

"Building repairs were continued. Richard E. Harrison removed the rust and finished painting the metal supports of all the towers we use as blinds. Robert Stephenson repaired the roof of one of the buildings used for sleeping quarters. Ron Franck, with the help of Lauren LeCroy and Tom Van't Hof repaired and tarred

the roof of the Carpenter shop. Don, Betty and Kathleen Duffin, David Duffy, Mary LeCroy, Mat and Grace Cormans, Mark Wellington, as well as others helped in painting the Carpenter Shop, grid markers and eight sets of scaffolding to be used for blinds.

"At the end of the season the eight sets of scaffolding as well as the other gear were taken off the island. Davis Finch volunteered for both November trips and found himself hauling scaffolding, lashing a boat to the top of the museum truck and driving all the equipment to various places in New York and Connecticut where they are stored for the winter.

"Preparations are underway for the 1974 season. – Helen Hays, Chairman, Great Gull Island Committee."

Robert G. Wolk, Editor, reports that work on the *Proceedings* is reaching completion; the articles are all in and some revisions are still being made.

The Constitution Committee under the Chairmanship of Donen Gleick met in December to review the present Constitution and By-Laws of the Society. After a thorough analysis, the Committee deemed it appropriate to revise both documents. Several major changes and a number of minor changes as well as some alterations were necessary to clarify possible ambiguities. Proposed revisions have been drafted and distributed to the members of the Council for review and further suggestions. The proposed new Constitution and By-Laws will be submitted to the membership for consideration.

The Library Committee under Chairwoman Lilla Hind, has put into effect some new rules as of December 1, 1973 to encourage members to return books promptly. The Library Committee made a survey of all books and selected titles to be disposed of to make room for new titles. The books selected for elimination were displayed at the January 8th and 22nd meetings and auctioned off through sealed bids. Funds derived from this auction are being used for the purchase of new books to be selected by the Committee.

The Conservation Committee is reorganizing under its Chairwoman Jane Plunkett and they are busy developing their program.

Our Field Trip Chairman Leon Wittack did some excellent planning for the field trips, including the innovation of appointing a registrar for each trip, thus sharing among the members the responsibility for the work of coordinating the trips.

The Field Card Committee under its Chairman Guy Tudor is altering the Field Card to conform with the changes that have been accepted by the A.O.U. and a new card will be ready for printing very soon.

The Field Work Committee chaired by Guy Tudor did some fine work on the Connetquot River area breeding census and inaugurated a new June bird count.

Niko Tinbergen, a Fellow in our Society, received one of the Nobel Prizes this year.

We were saddened to learn of the deaths of several members during the year: Dr. Robert Cushman Murphy; Dr. Edward R. P. Janvrin, who left a generous bequest to the Society; Herbert Hale, in whose name family and friends made contributions to the Society; and Mrs. John Y. Dater, Jr.

During the year, 52 persons were elected to active membership and 6 to associate membership. The membership in all classes is as follows: 342 Active, 80 Associate, 25 Life, 5 Honorary and 10 Fellows – a total of 462.

Respectfully submitted,
Alice Oliveri, *Secretary*
12 March 1974

Treasurer's Report for the Year Ending 28 February 1973

Funds on hand March 1, 1972		$8,589.25
Income:		
dues	$2,148.00	
contributions	7.75	
contributions to Rare Bird Alert	220.00	
sales of publications	292.05	
ticket sales '72 annual dinner	748.00	
interest on savings	356.75	
TOTAL	$3,772.55	$3,772.55
Disbursements:		
meetings including '72 annual	$1,545.61	
annual dinner '72	741.08	
annual dinner '73	75.50	
News-Letter: printing	317.81	
mailing and postage	387.09	
additional printing costs	194.62	
additional postage	82.30	
bulk mailing fees '72, '73	60.00	
office supplies and miscellaneous expenses	121.68	
memberships and subscriptions	173.70	
Rare Bird Alert	611.46	
TOTAL	$4,310.85	$4,310.85
Funds on hand March 1, 1973		
checking account		
First National City Bank	$ 541.49	
Charles A. Urner Memorial Fund		
Union Dime Savings Bank	1,085.81	

Revolving Publications Fund		
Emigrant Savings Bank	6,423.65	
TOTAL	$8,050.95	$8,050.95

Note: $10.00 from News-Letter subscription into general operating budget, $282.05 from sales of other publications (field cards, $78.80; Transactions VII, $48.00; Transactions VIII, $23.00; Proceedings 71, $104.00; reprint, $18.00; back Proceedings, $10.25) into revolving publications fund.

Rare Bird Alert begun in December 1970

total expenses	$1,030.74
contributions	734.50

$ 296.24 balance paid by Linnaean Society. Expense of maintaining service assumed by National Audubon Society September 1972; the Linnaean Society, though, owns the equipment and continues to produce the tapes.

Lois Heilbrun, *Treasurer*
Irving Cantor
Griffin V. Littell, *Auditors*

Treasurer's Report for the Year Ending 28 February 1974

Funds on hand March 1, 1973		$8,050.95
Income:		
dues	$2,532.00	
contributions	9.00	
contributions in memory of Hale	340.00	
sales of publications (see note)	292.40	
ticket sales '73 annual dinner	1,510.01	
ticket sales '74 annual dinner	96.00	
sale of library books	90.76	
sale of addressing machine	25.00	
refund sales tax (3 years)	80.46	
miscellaneous	10.45	
interest on savings	401.23	
TOTAL	$5,387.31	$5,387.31
Disbursements:		
meetings including '73 annual	$1,445.07	
annual dinner '73	1,459.79	
annual dinner '74	89.50	
News-Letter: printing	396.90	
mailing and postage	446.75	
additional printing costs	194.00	
additional postage	50.57	
office supplies and miscellaneous expenses	194.07	
Editorial committee	112.00	
Great Gull Island committee	49.48	
memberships and subscriptions	125.50	
DVOC exchange program	45.25	
TOTAL	$4,608.88	$4,608.88

Funds on hand March 1, 1974		
checking account		
First National City Bank.....	$ 705.99	
Charles A. Urner Memorial Fund		
Union Dime Savings Bank....	1,143.70	
Revolving Publications Fund		
Emigrant Savings Bank	6,979.69	
TOTAL.....	$8,829.38	$8,829.38

Note: $24.00 from News-Letter subscriptions and sales into general operating budget; $268.40 from sales of other publications (field cards, $66.40; Transactions VII, $72.00; Transactions VIII, $16.00; Proceedings 71, $100.00; reprints, $9.00; back Proceedings, $5.00) into revolving publications fund.

Lois Heilbrun, *Treasurer*
Irving Cantor,
Robert O. Paxton, *Auditors*

In Memoriam

Thomas G. Appel, 1973
John H. Baker, 1973
Warren G. Blazer, 1972
Harold F. Burns, 1971
T. Donald Carter, 1972
Richard R. Chamberlain, 1971
Allan D. Cruickshank, 1974
Sterling de G. Foote, 1970
Thomas C. Desmond, 1972
Benjamin Gilbert, 1970
Herbert D. Hale, 1973
Marion C. Ingersoll, 1972
Edmund R. P. Janvrin, 1973
Claire B. Kelly, 1973
Robert Cushman Murphy, 1973
Margaret Morse Nice, 1974
Mrs. Harry Scherman, 1973
Joseph J. Shapiro, 1972
Erwin Stresemann, 1972
Mrs. Leif C. Strom, 1970

Memorials

John H. Baker 1894-1973

John H. Baker, president of the Linnaean Society from 1933 to 1935 and treasurer from 1925 to 1929, died at the age of 79 on 21 September 1973 in Bedford, Massachusetts.

Born in Cambridge, Massachusetts, in 1894, he became an investment banker after graduating from Harvard in 1915. He served as president of the National Audubon Society for 25 years until his retirement in 1959. During that time he was instrumental in the development of Audubon nature centers and summer camps. He was a former chairman of the advisory committee on fish and wildlife to the Secretary of the Interior, board member of the National Parks Association and a member of the advisory committee on conservation to the Garden Clubs of America.

Richard R. Chamberlain 1910-1971

Dick Chamberlain, a member of our Society from 1956, and of its Council from 1961 to 1964, was born in Maplewood, New Jersey, and practiced medicine in that state until his untimely death. He received his M.D. at the University of Virginia, interned at the Hospital Center at Orange, New Jersey, where he ultimately became President of the Medical Staff and Chairman of the Medical Board. He was devoted to the cause of having medical schools produce more family physicians and spent much of his energy and enthusiasm in that effort, serving as chairman of the Section of General Practice of the New Jersey State Medical Society and of the American Medical Association, president of the New Jersey Academy of General Practice, director of the American Academy of General (now Family) Practice, member of the council of the New Jersey Academy of Medicine and Secretary of the Essex County Medical Society. In 1932 he married Marjorie ("Tommy") Parsons, who shared his hobby of bird-watching. Of their three children, the eldest, Ann, did graduate work in ornithology before her marriage. Despite his extremely active

career in medicine, Dick managed to get afield when time permitted, and to be a useful member of the New Jersey Audubon Society and the Montclair Bird Club, as well as of the Linnaean Society of New York. He was notable for his sense of humor and his exceptionally vital personality.

Eugene Eisenmann

Allan D. Cruickshank 1907-1974

Allan Dudley Cruickshank was born in St. Thomas, Virgin Islands, on 29 August 1907, of a Scotch father, Charles Burr (Cruickshank), and a French mother, Hermine (Anciaux). His family moved to New York City when he was two. Here he spent a happy boyhood on Sedgwick Avenue in The Bronx, roaming the reaches of Van Cortlandt Park where his first great find was the nest of a King Rail in the swamp. As a member of the Evander Childs High School Naturalists' Club he took part in his first published Christmas Bird Count (18 species) in 1923. Thus began an activity in which he was to become increasingly prominent over a 50-year period.

In 1924, he helped form The Bronx County Bird Club with other high school boys (R. A. Herbert, J. J. Hickey, Irving Kassoy, Phillip Kessler, J. F. and R. G. Kuerzi, J. F. Mathews, and F. J. Ruff; soon joined by R. T. Peterson) who quickly changed Christmas count methodology. In successive years, their species totals ran 49, 67, 83, 73, 86, 93, 85, 83, and 97, most of these representing the highest species totals seen each year in the Northeast. Invariably Cruickshank produced the longest one-party list.

Cruickshank secured his B.S. in 1931 at New York University; on its University Heights campus he was a member of the track and field team (a javelin medalist in the Junior AAU National Championship in 1928), president of his junior class, and president of the student council. For a time, he worked for a wine importer, later for the American Museum of Natural History helping unpack

the Rothschild Collection upon its arrival in New York, and then as a lecturer to school groups on Long Island. He joined the Linnaean Society of New York in 1926, and served the Society as Recording Secretary in 1935-36, a Council Member in 1936-38, Treasurer 1938-39, and President 1939-41. His major contribution to the ornithology of our region was his authorship of "Birds Around New York City" published in 1942. He was elected a Fellow of the Society 10 years later.

Allan became associated with the National Audubon Society in 1935. For 22 years he was an inspiring teacher at the National Audubon Camp in Maine. He was a superb portrait photographer of birds, his collection ultimately numbering some 40,000 pictures taken throughout the United States. A popular lecturer on the Audubon Screen Tours, he once estimated that he had lectured to nearly 3 million people. His contributions to conservation education were thus incalculable.

For the years 1954-71, Cruickshank served as the efficient and much-admired editor of the Audubon Christmas Bird Counts, in the last year handling 963 counts contributed by 18,798 people. Upon his retirement he was replaced in this activity by an editorial committee of 27. One of his personal satisfactions in these later years was his leadership of the count around Cocoa, Florida, which often led the nation in total species. He was the author of "Wings in the Wilderness," "Hunting with the Camera," "A Pocket Guide to Birds," and "Summer Birds of Lincoln County, Maine," and with his wife, Helen Gere Cruickshank, of "1001 Questions about Birds." His superb photographs illustrated his wife's "Flight into Sunshine" and many other publications. At the time of his death, he was at work on a major account of "The Birds of Brevard County, Florida."

He received the Arthur A. Allen Medal in 1972 and with his wife the John Burroughs Medal in 1949 and the medal of the Société Provancher d'Histoire Naturelle in 1950. He died in Florida on October 11, 1974, after a short illness. He is survived by his wife in Rockledge, Florida, a brother, Douglas in Boulder, Colorado, and a sister, Lena (Mrs. Alexander) Seedorff in Los Angeles, California.

In the 52 years that I knew Allan Cruickshank, I never heard him make an intemperate remark. He was, throughout his life, an unabashed extrovert, the ever-enthusiastic birder who never lost his youthful zest for birds or for life. His friends will long remember him.

Joseph J. Hickey

Thomas C. Desmond 1887-1972

Former State Senator Thomas C. Desmond of Newburgh, New York, died at the age of 85 in Boston. Mr. Desmond, a member of the Society since 1929, served in Albany from 1931 to 1959. He was senior member of the legislature on his retirement. His widow, the former Alice R. Curtis, survives.

Herbert D. Hale 1930-1973

Herbert D. Hale was a man of charm, wit, and grace who was liked and admired by all who knew him. Especially devoted to Central Park for the last 15 years, he spent many hours there every day of each spring and several times a week during the other seasons as well. Because he covered the Park so regularly and with such perseverance, he sighted many birds which otherwise might have gone unrecorded, thereby giving us a better understanding of each year's migration. The Ramble will seem more a locality and less a community now that he is gone. Friends of Mr. Hale have made financial contributions to the Society in his memory.

Roger F. Pasquier

Edmund R.P. Janvrin 1884-1973

Dr. E. R. P. Janvrin, a Fellow of the Linnaean Society and a member of that organization for 55 years, died in a hospital near his summer home at Old Lyme, Connecticut, in his ninetieth year.

He was born in New York City in 1884 and lived there for most of his life.

Dr. Janvrin was a physician by vocation and was attached to the staff of Bellevue Hospital for many years. He was graduated from Princeton University in 1905 and from the College of Physicians and Surgeons (Columbia University) in 1909. In addition to his very busy private practice, Dr. Janvrin was for years Attending Physician at Bellevue and also Associate Professor of Medicine at the College of Physicians and Surgeons.

From an early age Dr. Janvrin was a naturalist, particularly in the fields of ornithology, entomology, and botany. He amassed an extensive collection of tiger beetles (Cicindelidae) which was given to the American Museum of Natural History after his death. He was best known in ornithological circles for his contributions of bird records, in the form of observations, to Ludlow Griscom's *Birds of the New York City Region*, published in 1923 by the American Museum. In fact, Griscom appointed Janvrin as one of four members of a committee to assist in the preparation of Griscom's book. Janvrin, in his more active years, was probably best remembered as a frequent visitor to the Long Beach area on the south shore of Long Island where he acquired an expert knowledge of the birdlife of that region. His sighting of an Eared Grebe there in 1938 was the first for the state. He was also a lifelong birder in Central Park.

In his earlier years, Dr. Janvrin was very active in the affairs of the Linnaean Society and held nearly every office. He was elected a member in 1918 and only *two* years later was elected to the post of Secretary! He served as the Secretary until 1922 and in 1924 became Vice President for two years and was elevated to the presidency in 1926 for two years. Interestingly, he was elected the Treasurer of the Society in 1931 and served in that position until 1935. For his contributions to ornithology and his services to the Society, he was elected a Fellow in 1965, an honor long overdue. He attended meetings frequently until very shortly before his death.

John Bull

Robert Cushman Murphy 1887-1973

Dr. Robert Cushman Murphy, an Honorary Member of the Society, died on 20 March 1973.

In 1936 the American Museum of Natural History published his two-volume work, *Oceanic Birds of South America*. It immediately became a classic in ornithology and will remain such, so long as the study and appreciation of birds is a field of human activity.

Dr. Murphy was the author of other important contributions to ornithology and related fields. Many of them were devoted to his favorite group of birds – the petrels and albatrosses. In recent years, with the aid of his wife, Grace Barstow Murphy, he had labored to protect the world's vanishing wildlife, symbolized for him by the great whales, whose slaughter he had witnessed and deplored as a youth.

Shortly before his death Dr. Murphy lectured to the Linnaean Society about a trip to the Pacific Science Congress in Australia and he was in his office regularly thereafter. Thus his sudden death caused as much shock as though he had been decades younger.

Dean Amadon

Margaret Morse Nice 1883-1974

Margaret Morse Nice, an Honorary Member of the Society since 1937, died in Chicago on 26 June 1974 at the age of ninety. Recipient of the American Ornithologists' Union Brewster Medal in 1942, she authored three *Transactions of the Linnaean Society*. The most recent, Volume VIII (1962), described her studies of many years on the behavior of young rails. The earlier works, still classics of ornithological field work, were "Studies in the Life History of the Song Sparrow" (*Transactions* IV, 1937, and *Transactions* VI, 1943). In addition, she was the author of several books and many scientific papers. For a more detailed biographical account, see the forthcoming article by Trautman in *The Auk*.

Erwin Stresemann 1889-1972

With Erwin Stresemann ornithology has lost one of its greats. He was an Honorary Member of the Linnaean Society since 1938 and visited the Society during several of his visits to the United States. Stresemann headed the Department of Ornithology at the Berlin Zoological Museum from 1921 to 1965 and held at the same time a teaching position at the University of Berlin. Among the 27 Ph.D.'s which he guided through their graduate work are some of the best-known German ornithologists. The most extraordinary characteristic of Stresemann was the breadth of his interests and of his encyclopedic knowledge. His *Handbook of Ornithology (Aves)* was, when it appeared in the period from 1927 to 1934, the most complete and most authoritative summary of our knowledge of any group of organisms. Even though now very much out-of-date in detail it still is a most useful source of information for those who can read German. Stresemann had his greatest impact as a pioneer of the new systematics in ornithology, but he has also been a leader in zoogeographic research and in the study of avian plumages and molts.

Those who knew Stresemann only from his formidable research output were invariably surprised when meeting him for the first time. There was nothing of the retiring closet naturalist about Stresemann. He was a warm, often exuberant and thoroughly magnetic personality. With his great charm he made friends readily and managed to keep in contact with them through his witty and stimulating correspondence. Among his many talents was that of being able to write occasional poems with the greatest of facility.

Stresemann more than any other ornithologist was responsible for breaking down the barrier between ornithology and zoology. He held the view that birds were not only a source of enjoyment, but also one of the most suitable materials for the study of biological phenomena. Through his personal encouragement and through the efforts of his students, ornithology played an increasingly large role in evolutionary biology, in zoogeography, in ecology, in environmental physiology, and in ethology. Through-

out his life he stressed the international aspects of ornithology, particularly in his well-known *History of Ornithology* (1951). The Linnaean Society has lost one of its most distinguished members.

Ernst Mayr

Constitution and By-Laws of The Linnaean Society of New York (as amended)

Constitution

Section 1. *General Organization*

Article 1. This Society shall be composed primarily of persons living in the New York City area who are interested in the natural sciences.

Article 2. It shall consist of Life, Supporting, Active, Associate and Honorary Members, and Fellows.

Article 3. Only Active, Supporting and Life Members, and Fellows shall be entitled to vote, to hold office, to serve on the Council, and to transact business. Associate Members and Honorary Members, in addition to the foregoing classes of members, may attend meetings, serve on committees and take part in the scientific discussions of the Society; but Associate and Honorary Members shall not be entitled to serve on committees dealing with the business or organizational affairs of the Society, nor shall they be chairmen of committees or entitled to vote as members of committees. All members not in arrears of dues shall be entitled to receive without charge the various publications of the Society issued during the period of membership unless the Council shall otherwise provide on the basis of cost or class of membership.

Article 4. The officers of the Society, who shall be elected annually, shall be a President, a Vice-President, a Secretary, a Recording Secretary, a Treasurer, and an Editor. With the exception of the Treasurer and Editor no officer shall hold the same office more than two consecutive full terms, but shall again be eligible for election one year after the expiration of a second consecutive term. The officers, together with nine members at large, shall form a board called the Council which shall manage the Society. Councilors shall be elected for a term of three years, in such manner that the term of three councilors shall expire every year.

The current officers and elected councilors shall be called current elective Council members. A quorum for a meeting of the Council shall be a majority of the current elective Council members. Any former President of the Society who is a Member of the Society in good standing shall be entitled to attend Council meetings and to vote as a member of the Council.

Any former President who is qualified to participate in Council meetings and who wishes notice of them shall annually so advise the Secretary in writing.

Article 5. By-Laws for the more particular regulation of the Society shall be made from time to time.

Article 6. This Constitution may be amended by a three-fourths vote of the Active, Supporting and Life Members, and Fellows present at any regular meeting of the Society, provided written notice of the proposed change and of the meeting at which the proposed change is to be acted upon has been sent to each Active, Supporting and Life Member, and Fellow at least 30 days previously.

Article 7. Dues for each class of membership and the time for their payment shall be set forth in the By-Laws.

Section 2. *Of Members.*

Article 1. Active, Supporting and Life Members shall be persons who have shown an interest in some branch of natural science.

Article 2. Associate Members shall be persons interested in some branch of natural science (a) residing 50 miles or more from the Society's regular place of meeting and unable to attend meetings of the Society regularly; or (b) regularly enrolled as full-time students for an entire academic year at an established institution of learning. Persons holding Associate Membership as students shall be obliged to advise the Treasurer on or before the first day of February of each year as to their current and prospective status as students; they may be dropped from membership by the Treasurer if satisfactory evidence of such status is not supplied. Nothing herein shall preclude a student or a

person residing 50 miles or more from the Society's regular place of meeting from being elected to any other class of membership.

Honorary Members shall not exceed ten in number, and shall be persons eminent for their attainments in one or more of the natural sciences.

Any Member may be elected a Fellow in recognition of distinguished service to the Society.

Article 3. All classes of Members shall be chosen by majority vote of those Active, Supporting and Life Members, and Fellows present at a regular meeting of the Society, after having been nominated at a preceding regular meeting and approved by the Council.

Article 4. Any member may be expelled from the Society, upon recommendation of the Council, by a three-fourths vote of the Active, Supporting and Life Members, and Fellows present at any regular meeting, provided written notice of the proposed action and of the meeting at which such action is proposed to be taken has been sent at least 30 days previously to each Active, Supporting and Life Member, and Fellow and to the member involved.

Section 3. *Of Officers and Their Duties.*

Article 1. The President shall preside at meetings of the Society and of the Council, preserve order, regulate debate, and conduct all proceedings in accordance with accepted parliamentary usage.

Article 2. The Vice-President shall have charge of the archives of the Society; shall, with the advice and assistance of the President and Secretary, plan and prepare the programs for meetings of the Society; and shall perform the duties of President in his absence.

Article 3. The Secretary shall give notice to persons of their election as members, and to committees of their appointment; shall give notice of all regular meetings of the Society; shall call special meetings when directed by the President; shall give notice to all members of the Council of all Council meetings; shall inform

officers of all matters requiring their attention; shall conduct the correspondence of the Society and prepare all letters to be written in its name, retaining copies of them; shall, as directed by the Council, make all arrangements for the Annual Meeting of the Society; and shall assist the President and Vice-President in planning the programs for meetings of the Society.

Article 4. The Recording Secretary shall take and preserve correct minutes of all meetings of the Society and of the Council and shall preserve and compile in systematic order field notes presented by Members.

Article 5. The Editor, with the assistance of Associate Editors who may be appointed from time to time by the President, shall edit and supervise all publications of the Society and shall arrange for their exchange and distribution.

Article 6. The Treasurer shall collect all money due; shall pay all bills against the Society as authorized by the Council; shall keep a correct account of all receipts and expenditures; and shall make a detailed report of the same at the Annual Meeting.

Article 7. Officers shall be nominated by majority vote of the Council and elected at the Annual Meeting by a majority vote of the Active, Supporting and Life Members, and Fellows present. The slate of officers nominated by the Council shall be announced at the first meeting in February each year. Any other Member may be nominated if such nomination is subscribed in writing by 15 persons who are Active, Supporting or Life Members, or Fellows and is received by the President or Secretary at any time prior to the second meeting in February. Any office, other than that of President, becoming vacant during the year shall be filled at the next meeting of the Society in the same manner, except that the Council need not announce its nomination prior to the meeting and other nominations may be made from the floor. If the office of President becomes vacant during the year, the Vice-President shall become President. Persons who succeed to the office of the President, Vice-President, Secretary or Recording Secretary as the result of a vacancy shall remain eligible for election to two consecutive full terms in accordance with Article 4 of Section 1.

Section 4. *Of the Council and its Duties.*

Article 1. The Council shall review and take action on all nominations of candidates for membership. It shall make such recommendations as it sees fit on new business initiated by Members. Its recommendations shall be presented by the Secretary at the next regular meeting of the Society. A majority vote of the Active, Supporting and Life Members, and Fellows present at that meeting shall be sufficient to ratify recommendations made and actions taken by the Council.

Article 2. The Council may at any of its meetings initiate any new business promoting the general interests and welfare of the Society, and a majority vote of the members attending such meeting shall be sufficient for ratification. The prior authorization or approval by a majority of the councilors, given at a meeting of the Council, shall be necessary for any appropriation of funds of the Society in excess of $50.00.

Article 3. The Council shall nominate a slate of officers for the coming year at its January meeting.

Article 4. The Council shall hold regular meetings for the transaction of general business. Special meetings may be called by the President or upon the request of any three councilors.

Article 5. A sufficient number of councilors shall be chosen at the first regular meeting after the Annual Meeting to fill existing vacancies. Councilors shall be nominated by a committee to be appointed by the President at the Annual Meeting, such committee to consist of three Active, Supporting or Life Members, or Fellows of the Society who are not members of the Council. This shall not be construed as precluding additional nominations from the floor. If the number of nominations exceeds the number of vacancies, the election shall be by written ballot. Those nominees receiving the largest number of votes of Active, Supporting and Life Members, and Fellows present shall be elected. If for any reason a councilor does not complete his term of office, his successor for the remainder of the term shall be chosen at the next regular meeting by nomination from the floor and election as prescribed above.

Section 5. *Of Meetings.*

Article 1. A meeting shall be held annually for the election of officers and for other general purposes. At this meeting the Secretary shall present a report upon the publications, meetings, membership, and other general business of the Society, and the Treasurer shall report on the financial affairs of the Society. Prior to the Annual Meeting the President shall appoint a committee of two Active, Supporting or Life Members, or Fellows, neither of whom shall be a member of the Council, to audit the accounts of the Treasurer.

Section 6. *Miscellaneous.*

Article 1. No substantial part of the activities of the Society shall be the carrying on of propaganda or otherwise attempting to influence legislation, or the participation or intervention in (including the publishing or distribution of statements) any political campaign on behalf of any candidate for public office.

Article 2. No officer, director, member or employee of the Society may receive any pecuniary profit from its operations or upon its dissolution, except reasonable compensation for services rendered in effecting one or more of its purposes.

Article 3. In the event of voluntary dissolution of the Society or in the event of dissolution due to such other circumstances as are permitted or required by law, the funds and assets of the Society then belonging to it shall, after proper payment of liabilities, be distributed in accordance with the law then applicable to charitable organizations qualified under Section 501(c)(3) of the Internal Revenue Code of 1954 (or corresponding provisions of any subsequent law).

Article 4. The Society shall at no time carry on any activities not permitted to be carried on (a) by an organization exempt from federal income tax under Section 501(c)(3) of the Internal Revenue Code of 1954 (or corresponding provisions of any subsequent law) or (b) by an organization, contributions to which are deductible under Sections 170(c)(2), 2055(a) or 2522(a) of the Internal Revenue Code of 1954 (or corresponding provisions of any subsequent law).

Section 1. *Of Members.*

Article 1. Members shall pay dues as follows: Active Member – Eight ($8.00) dollars; Associate Member – Three ($3.00) dollars; Supporting Member – Twenty ($20.00) dollars; Life Member – Two hundred ($200.00) dollars. Honorary Members and Fellows shall not pay dues. Persons elected as Active, Associate and Supporting Members in the months of December, January and February shall pay dues at one-half the regular rates set forth above until the following March.

Article 2. Dues of Active, Associate and Supporting Members are payable annually no later than the first regular meeting in March, except that dues of newly elected Members shall be payable upon election to membership. Dues of Life Members are payable in no more than four consecutive annual installments; upon full payment no further dues are payable.

Article 3. By a majority vote of the current elective Council members, a person who has been an Active or Supporting Member of the Society for at least twenty-five years may be elected a Life Member and thereafter shall not be required to pay dues.

Article 4. Upon written application to the Treasurer, subject to the approval of a majority of the current elective Council members and if the applicant is not in arrears of dues for a previous year, (a) a Member who for a full year is absent on a scientific expedition or is engaged in military service may be excused from the payment of dues for that year; (b) an Active Member who is regularly enrolled as a full-time student for an entire academic year at an established institution of learning may have his status changed to that of Associate Member, provided his application is received or or before the first day of February of the year for which the change of status is sought and provided it is accompanied by the annual dues of an Associate Member for that year.

Article 5. Any Member who shall neglect to pay his regular dues shall be dropped from the roll of Members after having been sent notification to that effect in writing by the Treasurer.

Section 2. *Of Meetings.*

Article 1. The Annual Meeting shall be held the second Tuesday in March.

Article 2. Regular meetings shall be held on the second and fourth Tuesdays of each month from September to May inclusive, except as otherwise provided by a majority vote of the Council.

Article 3. Informal meetings shall be held on the third Tuesday of June, July and August, except as otherwise provided by a majority vote of the Council.

Article 4. Thirty-five Active, Supporting and Life Members, and Fellows shall constitute a quorum for the transaction of business at any regular meeting.

Article 5. The following items of business shall be transacted at each regular meeting in any order prescribed by the presiding officer:

1. Reading of minutes of the previous meeting by the Recording Secretary.
2. Reading of correspondence received by the Secretary.
3. Proposal of candidates for membership.
4. Election of members.
5. Committee reports.
6. Business (a) Unfinished; (b) New.
7. Presentation of program.
8. Presentation of field notes.
9. General discussion.
10. Adjournment.

Section 3. *Of Changes of By-Laws.*

Article 1. The By-Laws of the Society may be amended by a three-fourths vote of the Active, Supporting and Life Members, and Fellows present (a) at any one regular meeting provided written notice of the proposed change and of the meeting at which the proposed change is to be acted upon has been sent to each Active, Supporting and Life Member, and Fellow at least 30 days prior thereto, or (b) at any two regular meetings held on the second Tuesday of two successive months provided such change

has been recommended by a vote of eleven of the current elective Council members.

Section 4. *Of Committees.*

Article 1. A Conservation Committee shall be appointed annually by the President to advise, inform and represent the Society on conservation and environmental matters.

Article 2. An Editorial Committee, with the Editor acting as chairman, shall be appointed annually by the President to read and prepare papers for the Society's publications. Such Committee shall, from time to time, publish with the consent of the Council an issue of the Society's *Proceedings*, which shall contain the annual reports of the Secretary and Treasurer, reports of pertinent Committees, general notes, and scientific papers. The Editorial Committee shall also recommend to the Council, for inclusion in the Society's *Transactions*, publication of extensive papers that are submitted to it from time to time and which, by reason of their length, are disbarred from the ordinary channels of scientific communication. Upon recommendation by the Council, the publication of a volume of the *Transactions* shall be subject to the approval of a majority of the Active, Supporting and Life Members, and Fellows present at a regular meeting of the Society. The Society shall also publish a newsletter which shall contain brief articles, announcements and items of general interest to its Members and which shall appear at least six times a year. The editor of the newsletter shall be a member of the Editorial Committee.

Article 3. A Field Work Committee may be appointed annually by the President to encourage and conduct constructive field work in the New York City region and to promote the discussion of local faunal problems at meetings of the Society.

Article 4. A Field Trip Committee may be appointed annually by the President to arrange field trips for Members and guests of the Society.

Article 5. The President may, with the consent of the Council, appoint such additional committees as may be necessary or

advisable from time to time to conduct the affairs of the Society or further its interests.

Section 5. *Of Funds and Prizes.*

Article 1. The Society shall administer a fund to be known as The Charles A. Urner Memorial Fund, the principal and interest of which is to be used for the promotion of field ornithology in New Jersey, New York and Connecticut, and for the publication of studies made in said areas. The Treasurer is authorized to accept contributions to this Fund from Members and other interested persons.

Article 2. The Treasurer is authorized to accept from Members and other interested persons contributions to a revolving publication fund, the income and principal of which is to be devoted primarily to the publication of the *Proceedings* and *Transactions.*

Membership List, December 1974

*Life Member †Supporting Member

HONORARY MEMBERS

1943 Delacour, Dr. Jean, American Museum of Natural History, New York, N.Y. 10024
1941 Pinto, Dr. Oliverio, Dept. de Zoologia, Caixa Postal 7172, Sao Paulo, Brazil
1956 Salomonsen, Dr. Finn, Zoologisk Museum, Krystalgade, Copenhagen K, Denmark
1938 Tinbergen, Dr. Niko, Dept. of Zoology, University Museum, Oxford, England
1954 Wetmore, Dr. Alexander, Smithsonian Institution, Washington, D.C. 20560

FELLOWS

1938 Amadon, Dr. Dean, American Museum of Natural History, New York, N.Y. 10024
1938 Arbib, Robert S., Jr., 226 Guion Dr., Mamaroneck, N.Y. 10543
1939 Bull, John, American Museum of Natural History, New York, N.Y. 10024
1940 Eisenmann, Dr. Eugene, American Museum of Natural History, New York, N.Y. 10024
1924 Hickey, Dr. Joseph, 5517 Dorsett Dr., Madison, Wisconsin 53711
1932 Mayr, Dr. Ernst, Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts 02138
1934 Nelson, Dr. Theodora, 315 E. 68 St., New York, N.Y. 10021
1927 Peterson, Dr. Roger Tory, Neck Road, Old Lyme, Connecticut 06371
1948 Wachenfeld, Mrs. William A., 787 East Clarke Place, Orange, New Jersey 07050

ACTIVE MEMBERS

1974 Aamir, Ali, c/o ILO Liaison Office, 345 East 46 St., New York, N.Y. 10017
1973 Allis, Captain Frederick A., 316 North Mountain Avenue, Montclair, New Jersey 07043
1972 Alson, Lawrence, 232 West 22 St., New York, N.Y. 10011
1972 Alson, Mrs. Lawrence, 232 West 22 St., New York, N.Y. 10011
1971 Anderson, Robert D., 44 West 69 St., New York, N.Y. 10023
1970 Applebaum, Mrs. Edmund, 40 West 77 St., New York, N.Y. 10024

1931 Archbold, Richard, Archbold Biological Station, Route No. 2, Box 380, Lake Placid, Florida 33852
1968 Arias, Manny, 2355 East 12 St., Brooklyn, N.Y. 11229
1970 Armstrong, Dr. Donald, 301 West St., Harrison, N.Y. 10528
1968 Armstrong, Ethel J., 22 East 89 St., New York, N.Y. 10028
1935 Astle, William O., 45-64 158 St., Flushing, N.Y. 11354
1949 Austin, Cyrus, 200 East 66 St., New York, N.Y. 10021
1968 Bahrt, Sidney, Pembrook, Maine 04666
1973 Baker, Berry, 77 East 12 St., New York, N.Y. 10003
1928 Baldwin, Roger N., 282 West 11 St., New York, N.Y. 10014
1973 Barber, Ray, 295 Washington Ave., Brooklyn, N.Y. 11205
1956 Barr, Alfred H., Jr., 49 East 96 St., New York, N.Y. 10028
1954 Baur, Paul, Knollwood Road Extension, Elmsford, N.Y. 10523
1954 Baur, Mrs. Paul, Knollwood Road Extension, Elmsford, N.Y. 10523
*1959 Beatty, C. Francis, Quaker Hill, Pawling, N.Y. 12564
1968 Beckerman, Mrs. Harold L., 3103 Fairfield Ave., Bronx, N.Y. 10463
1970 Bell, Joseph, New York Zoological Society, 185 St. and Southern Blvd., New York, N.Y. 10460
1960 Bergendahl, Mrs. Earl, 120 Sweetfield Circle, Yonkers, N.Y. 10704
1963 Berlin, Kenneth, 44 East 67 St., New York, N.Y. 10021
1973 Besson, Victor, 133-01 Booth Memorial, Flushing, N.Y. 11355
1970 Bingham, Robert, The New Yorker Magazine, 25 West 43 St., New York, N.Y. 10036
1970 Bisk, Dr. Frank, 2940 Mott Ave., Far Rockaway, N.Y. 11691
1973 Black, Joan S., 66 East 93 St., New York, N.Y. 10028
1973 Blair, Jean, 116 E. 73 St., Apt. 10, New York, N.Y. 10021
1974 Blatt, Dr. Arthur, 137 Devoe Ave., Yonkers, N.Y. 10705
1972 Bloch, Gerald C., 21 East 87 St., New York, N.Y. 10028
1968 Bock, Mrs. Monica, 505 E. 79 St., New York, N.Y. 10021
1972 Bonagura, Joan, 140 W. 86 St., New York, N.Y. 10024
1972 Bonny, Elizabeth M., 3 Casco Terrace, Falmouth, Maine 04105
1969 Bottesch, Marla, 210 West 21 St., New York, N.Y. 10011
1964 Bourque, Mrs. Ronald V., 2440 East 29 St., Brooklyn, N.Y. 11235
1973 Boyle, Catharine A., 425 West 23 St., New York, N.Y. 10011
1970 Brandt, David, 105 Ashland Pl., Brooklyn, N.Y. 11201
1969 Breakstone, Raymond, 278 Devoe Ave., Yonkers, N.Y. 10705
*1957 Brenner, Mrs. Bertha, 15010 Haslemere Ct., Silver Spring, Maryland 20906
1973 Brown, Mrs. John A., 404 Riverside Dr., New York, N.Y. 10025
1974 Bruning, Donald, N.Y. Zoological Society, 185 St. and Southern Blvd., Bronx, N.Y. 10460
1969 Bruun, Dr. Bertel, 52 East 73 St., New York, N.Y. 10021
1974 Buchholz, Mrs. Elinor B., 96 Hicks St., Brooklyn, N.Y. 11201
1954 Buckley, Dr. Paul A., 372 South St., Carlisle, Mass. 01741
1973 Buckley, Mrs. Paul A., 372 South St., Carlisle, Mass. 01741
1955 Burden, Charles E., 37-28 80 St., Jackson Heights, N.Y. 11372
1971 Byrom, Walter F., 173 West 78 St., New York, N.Y. 10024

1973 Campbell, Francis D., Jr., c/o American Numismatic Society, Broadway at 155 St., New York, N.Y. 10032
1938 Cant, Gilbert B., 445 E. 68 St., New York, N.Y. 10021
1940 Cantor, Irving, 251 East 32 St., New York, N.Y. 10016
1970 Cantor, Mrs. Irving, 251 East 32 St., New York, N.Y. 10016
*1932 Carleton, Geoffrey, Elizabethtown, N.Y. 12932
1960 Carruth, Gorton, Jr., 354 Hardscrabble Rd., Briarcliff Manor, N.Y. 10510
1970 Caufield, Stanley, 153 Highview Ave., Staten Island, N.Y. 10301
1974 Chang, Stephen, 545 West 111 St., New York, N.Y. 10025
1966 Chapin, Mrs. James P., 419 West 119 St., New York, N.Y. 10027
1970 Chapple, Martha S., 170 West End Ave., New York, N.Y. 10023
1971 Chuckrow, Vicki, 10 West 74 St., New York, N.Y. 10023
1971 Clahr, Dr. Abraham, 175 E. 74 St., New York, N.Y. 10021
1974 Clark, Luanne, 136-39 41 Ave., Flushing, N.Y. 11355
1968 Clark, Margaret E., 54 E. 8 St., New York, N.Y. 10003
1974 Clayton, Christina E., 182 Garth Rd., Scarsdale, N.Y. 10583
*1910 Cleaves, Howard H., 8 Maretzek Court, Staten Island, N.Y. 10309
1968 Coheleach, Guy, 12 Fenimore Lane, Huntington, N.Y. 11743
1970 Cohen, Dr. Donald, 300 East 33 St., New York, N.Y. 10016
1970 Cohen, Mrs. Donald, 300 East 33 St., New York, N.Y. 10016
1974 Cohen, Judith H., 160 Parkside Ave., Brooklyn, N.Y. 11226
1967 Collins, Mrs. Elizabeth L., 65 West 95 St., New York, N.Y. 10025
1972 Conklin, Elinor B., 235 West 102 St., New York, N.Y. 10025
1968 Cook, Nancy, 520 West 122 St., New York, N.Y. 10027
1973 Cope, Wilma M., 428 Lakeview Rd., Bellmore, N.Y. 11710
1970 Copeland, Mrs. Joseph J., 351 Bedford Ave., Mt. Vernon, N.Y. 10553
*1940 Cormier, Francis, 3320 Peninsula Rd., Oxnard, Calif. 93030
1973 Cormons, Matthew J., 311 Hudson Ave., Tenafly, N.J. 07670
1971 Cormons, Mrs. Matthew J., 311 Hudson Ave., Tenafly, N.J. 07670
1974 Costa, Joseph, 397 Linden St., Brooklyn, N.Y. 11227
1973 Daniels, George G., 306 Taconic Rd., Greenwich, Conn. 06830
1939 Darrow, Harry N., 1470 Midland Ave., Bronxville, N.Y. 10708
1972 Davidson, Mrs. Arthur J., 1 University Place, New York, N.Y. 10003
1964 Davis, Fred Bunker, 201 East 21 St., New York, N.Y. 10010
1961 Davis, Thomas H., Jr., 94-46 85 Rd., Woodhaven, N.Y. 11421
1952 Deed, Robert F., 50 Clinton Ave., Nyack N.Y. 10960
1970 de la Torre, Julio A., 98 Millport Ave., New Canaan, Conn. 06840
1974 Delendick, Thomas J., 2985 Botanical Sq. 3S, Bronx, N.Y. 10458
*1967 Dempsey, Stephen B., Jamaica Water Supply Co., 161-20 89 Ave., Jamaica, N.Y. 11432
1943 Denham, Reginald, Carnegie House, 100 West 57 St., New York, N.Y. 10019
1964 Devlin, John C., West View Lane, South Norwalk, Conn. 06854
1970 Dickerman, Dr. Robert W., Cornell Univ. Medical College, 1300 York Ave., New York, N.Y. 10021

1973 Di Costanzo, Joseph, 280-18 St., Brooklyn, N.Y. 11215
1960 Dignan, Adrian, 98 Hillside Ave., Freeport, N.Y. 11520
1974 Di Lucia, Gilbert, 333 Sixth Ave., New York, N.Y. 10014
1972 Di Orio, Robert Vincent, 75-05 210 St., Bayside, N.Y. 11364
†1974 Drennan, Mrs. Susan R., 110 Bleecker St., New York, N.Y. 10012
1968 Drescher, Harold J., 90 Riverside Dr., New York, N.Y. 10024
1966 Dubois, Charlotte, 9 Willow St., Princeton, N.J. 08540
1970 Duffy, David C., 318 Quincy House, Harvard College, Cambridge, Mass. 02138
1969 Dwight, Ronald A., 243 West 98 St., New York, N.Y. 10025
1970 Easton, Henry J., 120 Gale Place, Bronx, N.Y. 10463
*1944 Eckelberry, Don R., 180 Woodsome Rd., Babylon, N.Y. 11702
1969 Edwards, David H., 323 W. 75 St., New York, N.Y. 10023
1973 Elliott, Sarah Mc Carn, 333 East 34 St., New York, N.Y. 10016
1974 Ellis, Mrs. Marian C., 180 East End Ave., New York, N.Y. 10028
1972 Erikson, Henry, 116 Pinehurst Ave., New York, N.Y. 10033
1972 Erikson, Mrs. Henry, 116 Pinehurst Ave., New York, N.Y. 10033
1937 Eynon, Dr. Alfred E., 5 Beach Rd., Verona, N.J. 07044
1973 Farrand, John, Jr., American Museum of Natural History, New York, N.Y. 10024
1958 Farrel, Franklin, III, Northrup Rd., Woodbridge, Conn. 06525
1972 Feldhusen, Elizabeth A., 891 Union St., Brooklyn, N.Y. 11215
1937 Flynn, Michael, 218 Shady Lane, Lexington, Kentucky 40503
1970 Fogarty, Judith I., 102 East 22 St., New York, N.Y. 10010
1974 Ford, Ann, Wilson Point, South Norwalk, Conn. 06854
1974 Franck, Ronald, 59 Bradley Rd., Scarsdale, N.Y. 10583
1970 Freed, Phillip J., 134-35 166 Pl., Jamaica, N.Y. 11434
*1921 Friedman, Ralph, 14 E. 75 St., New York, N.Y. 10021
1972 Friton, Walter, 3065 Grand Concourse, Bronx, N.Y. 10468
1962 Fuhrmann, Dr. John B., P.O. Box 191, Flemington, N.J. 08822
1958 Fullerton, Sylvia J., 1030 S. Park St., Halifax, Nova Scotia, Canada
1974 Gallagher, Michael, 70 La Salle St., New York, N.Y. 10027
1944 Garrity, Devin Adair, 682 Forest Ave., Rye, N.Y. 10580
*1923 Garvan, Mrs. Francis P., 740 Park Ave., New York, N.Y. 10021
1954 Gavan, Gordon, 203 East 72 St., New York, N.Y. 10021
1961 Ghertler, Monte, 131 Riverside Dr., New York, N.Y. 10024
1973 Girards, Christina, 355 E. 72 St., New York, N.Y. 10021
1968 Gleick, Donen, 1070 Park Ave., New York, N.Y. 10028
1961 Gochfeld, Dr. Michael, American Museum of Natural History, New York, N.Y. 10024
1964 Gochfeld, Robert, R.F.D. 1, Lexington Ave., Mohegan Lake, N.Y. 10547
1974 Goddard, Margaret, 333 East 68 St., New York, N.Y. 10021
1968 Goelet, Ogden, Jr., 251 East 32 St., New York, N.Y. 10016
1970 Gold, Gerald, 73 Irma Drive, Oceanside, N.Y. 11572
1957 Goldman, Dr. Sanford G., 1070 Park Ave., New York, N.Y. 10028
1958 Goldwasser, Mrs. Martin, 24 Willow St., Brooklyn, N.Y. 11201

†1974 Gore, Uta, 2727 Palisade Ave., Riverdale, N.Y. 10463
1968 Gosling, Bryan H., 160 W. 96 St., New York, N.Y. 10025
1950 Grant, Robert H., 1604 Marconi Rd., Belmar, N.J. 07719
1956 Grant, Mrs. Robert H., 1604 Marconi Rd., Belmar, N.J. 07719
1964 Greenwood, Edith M., 524 Beach 137 St., Belle Harbor, N.Y. 11694
1972 Grindrod, Peter J., 83-33 Austin St., Kew Gardens, N.Y. 11415
*1928 Grinnell, Lawrence I., 710 Triphammer Rd., Ithaca, N.Y. 14850
1974 Gussman, Mrs. Muriel T., 108 West 15 St., New York, N.Y. 10011
1951 Guthrie, Henry B., 169 E. 70 St., New York, N.Y. 10021
1973 Haight, Catherine, 250 E. 87 St., New York, N.Y. 10028
1953 Hallett, George H., Jr., 430 E. 57 St., New York, N.Y. 10022
1974 Hammond, Mrs. Dorothy D., 225 East 73 St., New York, N.Y. 10021
1968 Hansen, Erna, 444 E. 20 St., New York, N.Y. 10009
1969 Hansen, Lillian, 127 East 61 St., New York, N.Y. 10021
1935 Harriot, Samuel C., 200 W. 58 St., New York, N.Y. 10019
1973 Harris, William, 223 Woodland Ave., New Rochelle, N.Y. 10805
1973 Harris, Mrs. William, 223 Woodland Ave., New Rochelle, N.Y. 10805
1948 Harrison, Richard Edes, 313 East 51 St., New York, N.Y. 10022
1953 Harte, Dr. Kenneth J., 64 Estabrook Rd., Carlisle, Mass. 01741
*1954 Hartshorne, James Mott, 108 Kay St., Ithaca, N.Y. 14850
1974 Hasselbrack, Judith A., 21 Claremont Ave., New York, N.Y. 10027
1970 Hayden, Julie, 78 West 11 St., New York, N.Y. 10011
1958 Hays, Helen, American Museum of Natural History, New York, N.Y. 10024
1955 Heilbrun, Douglas E., 143-08 Roosevelt Ave., Flushing, N.Y. 11354
1950 Heilbrun, Mrs. Douglas E., 143-08 Roosevelt Ave., Flushing, N.Y. 11354
1970 Heilweil, Lorraine, 140 W. 86 St., New York, N.Y. 10024
1968 Hein, Rosemary R., 31 Ridgedale Ave., Madison, N.J. 07940
1968 Heineman, Andrew D., 300 Park Ave., New York, N.Y. 10022
1962 Hennessy, Prof. Wesley J., Three Crieff Lane, New City, N.Y. 10956
1948 Herbert, Mrs. Richard, Liston Front Range Lighthouse, Middletown, Del. 19709
1948 Higgins, Thomas F., Box 493, Stony Brook, N.Y. 11790
1972 Hill, David O., 950 Edwards, Parsippany, N.J. 07054
1968 Hind, Lilla M., 311 East 50 St., New York, N.Y. 10022
1961 Hirschbein, Helen, 296 Cedarhurst Ave., Cedarhurst, N.Y. 11516
1953 Hirshberg, Eliot P., 470 Park Ave., New York, N.Y. 10022
1972 Hirshberg, Mrs. Eliot P., 470 Park Ave., New York, N.Y. 10022
1960 Hiss, Priscilla, 22 East 8 St., New York, N.Y. 10003
1973 Hoffman, Fred, 1380 First Ave., New York, N.Y. 10021
1956 Hoffman, John E., 54 Parkway Dr., Roslyn Heights, N.Y. 11577
1974 Hoffman, John L., 420 E. 23 St., New York, N.Y. 10010
1968 Hollander, Sherman, 55 West 14 St., New York, N.Y. 10011
1959 Horn, Herman, 453 F.D.R. Drive, New York, N.Y. 10002
1971 Horowitz, Ira, 315 West 19 St., New York, N.Y. 10011

1958 Horowitz, Joseph, 16 Maple Drive, Pelham, N.H. 03076
1974 Horowitz, Mitchell, 115 Laurel Lane, Lawrence, N.Y. 11559
1970 Houlihan, Patricia, 65 West 68 St., New York, N.Y. 10023
1939 Jacobson, Dr. Malcolm A., 5 Emerson Rd., Brookville, N.Y. 11545
1971 Jaimes, Mrs. Odette, 35-63 79 St., Jackson Heights, N.Y. 11372
1961 Jay, Frances, 155 E. 72 St., New York, N.Y. 10021
1958 Jenkins, Mrs. John W., 8 Peter Cooper Rd., New York, N.Y. 10010
1968 Jewett, Richard, 127 Western Ave., Altamont, N.Y. 12009
1957 Johnson, Herbert, 38 Dogwood Rd., Rocky Point, N.Y. 11778
1971 Johnson, J. C., 330 E. 56 St., New York, N.Y. 10022
1954 Johnson, Dr. Robert A., Rte. 11 Box 188, Bloomington, Ind. 47401
1973 Kaminsky, Gilbert, 19 East Van Cortlandt Ave., Bronx, N.Y. 10468
1973 Kane, Richard, Scherman Sanctuary, P.O. Box 693, Bernardsville, N.J. 07924
*1925 Kassoy, Irving, 804 S. Ashburton Rd., Columbus, Ohio 43227
1970 Katz, Mrs. Judith, 215 E. 73 St., New York, N.Y. 10021
1971 Katz, Margaret, 372 Central Park West, New York, N.Y. 10025
1954 Keil, Julius J., 286A Tabor Rd., Cranbury, N.J. 08512
1957 Keith, George Stuart, American Museum of Natural History, New York, N.Y. 10024
1956 Kellogg, Dr. Peter Paul, 115 Dearborn Place, Ithaca, N.Y. 14850
1914 Kieran, John F., 25 Norwood Ave., Rockport, Mass. 01966
1972 Kitchen, Herman W., Unit One Film Prod., Inc., 723 Seventh Ave., New York, N.Y. 10019
1974 Klein, Helene, 28 East 10 St., New York, N.Y. 10003
1974 Klein, Marion, 163 West 17 St., New York, N.Y. 10011
1970 Klein, Mrs. Murray, 500B Grand St., New York, N.Y. 10002
1960 Kleinbaum, Michel, 42-42 Colden St., Flushing, N.Y. 11355
1964 Koeppel, Dr. Richard, 64 West 83 St., New York, N.Y. 10024
1959 Kole, Shepard, 4807 Constitution Ave., Colorado Springs, Colorado 80915
1974 Kotch, John, 126-20 25 Ave., College Point, N.Y. 11356
1950 Kreissman, David, 665 Westminster Rd., Brooklyn, N.Y. 11230
1971 Krinsky, Robert D., 370 First Ave., New York, N.Y. 10010
1969 Kruger, Mrs. Otto, 344 West 72 St., New York, N.Y. 10023
1974 La Budde, Joan A., 386 Clinton St., Brooklyn, N.Y. 11231
1968 Langner, Saul, 80 Central Park West, New York, N.Y. 10023
1968 Langner, Mrs. Saul, 80 Central Park West, New York, N.Y. 10023
1962 Lanyon, Dr. Wesley E., American Museum of Natural History, New York, N.Y. 10024
1973 Lapsley, Kevin Scott, 43 Orchard St., Elmwood Park, N.J. 07407
1969 Larson, Max, 35-34 77 St., Jackson Heights, N.Y. 11372
1969 Larson, Mrs. Max, 35-34 77 St., Jackson Heights, N.Y. 11372
1969 Laul, Violet T., 49 Grove St., New York, N.Y. 10014
1968 Lauro, Anthony J., 9 De Soto Rd., Amityville, N.Y. 11701
1974 Lawlor, Catherine T., 102-40 67 Rd., Forest Hills, N.Y. 11375
1968 Leck, Dr. Charles F., Dept. of Zoology, Rutgers College, New Brunswick, N.J. 08903

1966 LeCroy, Mrs. Mary, 116 South Buckhout St., Irvington, N.Y. 10533
1970 Levandowsky, Michael, 945 West End Ave., New York, N.Y. 10025
1973 Levin, David Paul, Sage Graduate Center 437, Cornell University, Ithaca, N.Y. 14850
1959 Levine, Emanuel, 585 Mead Terrace, South Hempstead, N.Y. 11550
1943 Levine, Norman, 300 E. 40 St., New York, N.Y. 10016
1973 Levinson, Henry W., 16 East 96 St., New York, N.Y. 10028
1957 Licking, Robert S., 29 Chapel Ave., Brookhaven, N.Y. 11719
1960 Lindquist, Willis, 302 W. 22 St., New York, N.Y. 10011
1970 Liner, Mrs. Eunice, 303 West 66 St., New York, N.Y. 10023
1974 Linshaw, Dr. Michael, 1269 First Ave., New York, N.Y. 10021
1968 Littell, Griffin, IBM Dept. 663, Parson's Dr., Franklin Lakes, N.J. 07417
1968 Longyear, Mrs. Peter R., 300 Riverside Dr., New York, N.Y. 10025
1962 Lovejoy, Thomas E., III, World Wildlife Fund, 910 17 St. N.W., Washington, D.C. 20006
1972 Lowe, Dana C., 190 Park Ave., Merrick, N.Y. 11566
1973 Lyman, Charles, 310 First Ave., New York, N.Y. 10009
1973 Lynch, Maureen, 43 East 67 St., New York, N.Y. 10021
1969 Macdonald, Mrs. Elizabeth, 330 East 43 St., New York, N.Y. 10017
1969 MacDonald, Patricia, 26 East 84 St., New York, N.Y. 10028
1968 Machado, Jose A., III, 7 Gracie Square, New York, N.Y. 10028
*1946 Mackenzie, Dr. Locke, 829 Park Ave., New York, N.Y. 10021
*1963 Macomb, J. de Navarre, Jr., 588 Arbor Vitae Rd., Winnetka, Ill. 60093
1974 Madden, Sheila, 628 East 20 St., New York, N.Y. 10009
1972 Maguire, Edward J., 3224 Grand Concourse, New York, N.Y. 10458
1962 Mailey, Jean E., 151 East 82 St., New York, N.Y. 10028
*1937 Manning, Elizabeth S., 503 So. Los Robles Ave., Pasadena, Calif. 91106
1973 Manrique, Daniel, 1-4 Hudson Harbour, Edgewater, N.J. 07020
1973 Manrique, Mrs. Daniel, 1-4 Hudson Harbour, Edgewater, N.J. 07020
1971 Marx, Russell J., 300 Edwards St., Roslyn, N.Y. 11577
1944 Mathewson, Hope, 82 State St., Brooklyn, N.Y. 11201
1970 Mayer, Mrs. Bernard, 258 Riverside Dr., New York, N.Y. 10025
1962 McCauley, Harry, 2106 N.E. 56 Court, Ft. Lauderdale, Fla. 33308
1958 McGaw, Lisa, 392 Central Park West, New York, N.Y. 10025
1974 McGee, Linda P., 158 West 81 St., New York, N.Y. 10024
1970 McGuinness, Hugh, 22 East 8 St., New York, N.Y. 10003
*1937 McKeever, Christopher K., Water Mill, N.Y. 11976
1973 McKeough, Mary, 10 Cathedral Ave., Hempstead, N.Y. 11550
1973 McKitrick, Mary, 875 West End Ave., New York, N.Y. 10025
1967 McPhillips, Brian, 330 Third Ave., New York, N.Y. 10010
1961 Meritt, James K., 809 Saratoga Terrace, Turnersville, N.J. 08012
1970 Meyer, Dr. Paul, 160 Lee Ave., Yonkers, N.Y. 10705
1972 Miller, Leonard J., 4643 Waldo Ave., Bronx, N.Y. 10471
1965 Mills, Mrs. Edward, 1391 Madison Ave., New York, N.Y. 10029

1974 Misfud, Clotilde, 38 West 69 St., New York, N.Y. 10023
1973 Mitchell, Betsy, 168 Plymouth St., Portland, Maine 04103
1963 Morgan, Lee, 4 Windsor Lane, E. Northport, N.Y. 11731
1956 Mudge, Eugene T., 1063 Fort Salonga Rd., Northport, N.Y. 11768
1944 Nagler, Robert, 17a Curzon St., London W 1, England
1974 Nathan, Bernard, 311 East 72 St., New York, N.Y. 10021
1969 Neibling, Dorothy Irene, 89-21 183 St., Hollis, N.Y. 11423
1974 Neidich, Carole L., Tackapausha Museum, Washington Ave., Seaford, N.Y. 11783
1972 Neuberger, Gretel J., 300 E. 33 St., New York, N.Y. 10016
1970 Newell, Mrs. Norman, 135 Knapp Terrace, Leonia, N.J. 07605
1974 Newman, Barbara, 311 East 72 St., New York, N.Y. 10021
1973 Nichols, Mrs. C. W., 45 Sutton Place South, New York, N.Y. 10022
1969 Nimkin, B. W., 31 Monroe Ave., Larchmont, N.Y. 10538
1973 Nixon, Marian R., 400 Central Park West, New York, N.Y. 10025
*1937 Norse, William J., Winhall Hollow Rd., S. Londonderry, Vt. 05155
1962 O'Hare, Katherine R., 351 East 52 St., New York, N.Y. 10022
1969 Oliveri, Alice, 35-04 24 Ave., Astoria, N.Y. 11103
1962 O'Malley, Brother E. Austin, FSC, Manhattan College, Bronx, N.Y. 10471
1972 O'Malley, Mrs. Patricia, 255 West 12 St., New York, N.Y. 10014
1969 Oresman, Stephen B., 7 Cross Road, Darien, Conn. 06820
1974 Orgel, Jeremy, 33 Stonybrook Rd., Westport, Connecticut 06880
1952 Parkes, Dr. Kenneth C., Carnegie Museum, 440 Forbes Ave., Pittsburgh, Pa. 15213
1968 Pasquier, Roger F., 235 E. 73 St., New York, N.Y. 10021
1968 Paxton, Dr. Robert O., 560 Riverside Dr., New York, N.Y. 10027
1971 Pearlman, Claudia, 100 West 12 St., New York, N.Y. 10011
1972 Pelzl, Henry W., P. O. Box 389, New York, N.Y. 10024
1950 Pessino, Catherine, American Museum of Natural History, New York, N.Y. 10024
1957 Peszel, Theodore J., P.O. Box 231, Bronx, N.Y. 10451
1970 Petit, Alain Joseph, 300 West 109 Street, New York, N.Y. 10025
1938 Pettit, Theodore S., 546 Somerville Rd., Somerville, N.J. 08876
1966 Phelps, William H., Jr., Almacen Americano, Apartado 2009, Caracas, Venezuela
1974 Pion, M. James, 58-19 251 St., Little Neck, N.Y. 11362
1961 Plunkett, Richard L., 150 West 82 St., New York, N.Y. 10024
1965 Plunkett, Mrs. Richard L., 150 West 82 Street, New York, N.Y. 10024
*1939 Poor, Hustace H., 36 Baldwin St., Hudson, Ohio 44236
1937 Pough, Richard H., 33 Highbrook Ave., Pelham, N.Y. 10803
1968 Poundstone, Dr. R. B., 129 No. Ridge St., Port Chester, N.Y. 10573
1968 Poundstone, Mrs. R. B., 129 No. Ridge St., Port Chester, N.Y. 10573
1969 Powers, Dr. C. Donald, 99 East Shore Dr., Babylon, N.Y. 11702
1960 Price, Dr. John M., 45 North Dr., Great Neck, N.Y. 11021

1963 Raices, Mrs. Emanuel E., 720 Fort Washington Ave., New York, N.Y. 10040
1972 Rayfield, Susan, 347 W. 84 St., New York, N.Y. 10024
1964 Raymond, Olney M., 129 Lincoln Pl., Brooklyn, N.Y. 11217
1973 Reder, Anna M., 78-02 82 St., Glendale, N.Y. 11227
1948 Reed, Mrs. D. Paul, 140 E. 83 St., New York, N.Y. 10028
1968 Reed, Henry Hope, Jr., 78 W. 82 St., New York, N.Y. 10024
1969 Reichbart, Mrs. Ruth G., 41 East 42 St., New York, N.Y. 10017
1963 Reilly, J. Porter, 8 Stuyvesant Oval, New York, N.Y. 10009
1947 Reith, Marie, 120-05 Long St., Jamaica, N.Y. 11434
1974 Renshaw, Brenda, 415 E. 64 St., New York, N.Y. 10021
1965 Riley, William, Route 1, Box 223, Pittstown, N.J. 08867
1965 Riley, Mrs. William, Route 1, Box 223, Pittstown, N.J. 08867
1964 Robben, Thomas J., 21 La Salle Dr., New Rochelle, N.Y. 10801
1968 Robison, David V., 129 Byrdcliffe Rd., Woodstock, N.Y. 12498
*1911 Rogers, Charles H., East Guyot Hall, Princeton University, Princeton, N.J. 08540
*1934 Rose, George, 119 Sixth St., Garden City, N.Y. 11530
1974 Rosenthal, David, 20 Manitou Rd., Westport, Conn. 06880
1974 Rosenthal, Mrs. David, 20 Manitou Rd., Westport, Conn. 06880
1969 Rosenthal, Mrs. Ernest, 401 First Ave., New York, N.Y. 10010
1956 Rosin, Axel, 691 West 247 St., New York, N.Y. 10471
1960 Rudner, Lillian, 245 E. 72 St., New York, N.Y. 10021
1973 Ruppert, Mrs. Charles, RFD 3, Lloyd Harbor Rd., Huntington, N.Y. 11743
1954 Ryan, Dr. Henry F., 79 Ashland Ave., Pleasantville, N.Y. 10570
1945 Ryan, Richard, 233 Prospect St., E. Orange, N.J. 07017
1969 Salomon, Mrs. Julian, 1 Sky Meadow, Suffern, N.Y. 10901
1972 Salzman, Eric, 29 Middagh St., Brooklyn, N.Y. 11201
1973 Santora, Mrs. C., 226 Dix Hills Rd., Huntington Stn., New York 11746
1973 Sassone, Leslie, 76-08 25 Ave., Jackson Heights, N.Y. 11370
1966 Scalera, Lydia, 283 Ave. C, New York, N.Y. 10009
1974 Schacke, Harro P., 555 Elizabeth Ave., Newark, N.J. 07112
1964 Schaeffer, Frederick S., 84-55 Daniels St., Jamaica, N.Y. 11435
1960 Schaughency, Charles B., Delwood Road, RR2, Box D 1, Chester, N.J. 07930
1972 Shechtman, Max, 1576 Taylor Ave., New York, N.Y. 10460
*1971 Scher, Lillian, 105 Ashland Pl., Brooklyn, N.Y. 11201
1960 Schiff, Seymour, 603 Mead Terrace, South Hempstead, N.Y. 11550
1971 Schmid, Charles R., Box 32, Provincetown, Mass. 02657
1967 Schreffler, Cecile, 525 W. 236 St., Riverdale, N.Y. 10463
1958 Schultz, Lucille, 311 East 50 St., New York, N.Y. 10022
1974 Schwabacher, Edith, 50 Sutton Place S., New York, N.Y. 10022
1953 Schwarting, William J., 9716 Stateline Rd., Leawood, Kansas 66206
*1931 Sedwitz, Walter, 525 W. 235 St., New York, N.Y. 10463
1948 Sheppard, Mildred C., 22 Grove St., New York, N.Y. 10014
1972 Shields, Lillian, 49 West 32 St., New York, N.Y. 10001

1974 Shor, Betty Ann, 309 West 57 St., New York, N.Y. 10019
1969 Short, Dr. Lester L., American Museum of Natural History, New York, N.Y. 10024
1962 Sichel, Richard B., 176 East 77 St., New York, N.Y. 10021
1972 Sides, Virginia V., 1161 York Ave., New York, N.Y. 10021
1973 Silk, Mrs. George, 27 Owenoke Park, Westport, Conn. 06880
1974 Simpson, John, 40 East End Ave., New York, N.Y. 10028
1958 Singer, Arthur B., 30 Hightop Lane, Jericho, N.Y. 11753
1973 Single, Eric, 635 N. Broadway, Upper Nyack, N.Y. 10960
1967 Siphron, Joseph Rider, 50 East 72 St., New York, N.Y. 10021
1973 Slodden, Graham C., 803 Carroll St., Brooklyn, N.Y. 11215
*1946 Sloss, Richard A., 1300 Seawane Dr., Hewlett Harbor, N.Y. 11557
1951 Sloss, Mrs. Richard A., 1300 Seawane Dr., Hewlett Harbor, N.Y. 11557
1959 Smithe, Frank B., 7 Center Dr., Douglaston, N.Y. 11363
1953 Sobol, Eva, 1819 Ave. L, Brooklyn, N.Y. 11230
1969 Soffer, Dr. Richard L., Bonny Brook Trail, W. Norwalk, Conn. 06850
1970 Sohmer, Martin, 25 Lefferts Ave., Brooklyn, N.Y. 11225
1973 Souther, John, 24 Richmondville Ave., Westport, Conn. 06880
1974 Stafford, Peary D., Jr., 68 Bank St., New York, N.Y. 10014
1933 Staloff, Charles, 555 Kappock St., Riverdale, N.Y. 10463
1972 Steinfeld, Mrs. Gerhard 20-84 28 St., Astoria, N.Y. 11105
1959 Stepinoff, Si, P.O. Box 513, Riverdale Station, Bronx, N.Y. 10471
1950 Sterling, Joshua, 49 Wellington Ct., Brooklyn, N.Y. 11230
1967 Stillman, Mrs. Margaret R., 17 East 89 St., New York, N.Y. 10028
1970 Stinchcomb, Carl, 1158 Fifth Ave., New York, N.Y. 10029
1970 Stinchcomb, Mrs. Carl, 1158 Fifth Ave., New York, N.Y. 10029
1971 Stoddert, Katharine H.B., 203 East 76 St., New York, N.Y. 10021
1952 Story, Bradford F., 177 East 75 St., New York, N.Y. 10021
1963 Stout, Gardner D., American Museum of Natural History, New York, N.Y. 10024
1947 Sullivan, Dr. William J., 132 Pondfield Rd., Bronxville, N.Y. 10708
1964 Swayer, Esther K., 1131 East 4 St., Brooklyn, N.Y. 11230
1964 Swoger, Arthur, 90 University Place, New York, N.Y. 10003
1945 Teale, Edwin Way, Trail Wood, Hampton, Conn. 06247
1963 Tetrault, Helene, 20 Commerce Street, New York, N.Y. 10014
*1933 Thomas, Allen M., 26 Glenhaven Circle, Saco, Maine 04072
1965 Thompson, Edward V., 117 Norfolk St., Bangor, Maine 04401
1967 Thorpe, Robert B., Box Q, Mont Clare, Pennsylvania 19453
1967 Thorpe, Mrs. Robert B., Box Q, Mont Clare, Pennsylvania 19453
1960 Tilger, Grace, 1845 Hering Ave., Bronx, N.Y. 10461
1962 Tozzi, Peter, Jr., 525 East 82 St., New York, N.Y. 10028
1965 Trimble, Benjamin, 2703 Pine Lake Apts., Oak Ave., Lindenwold, N.J. 08021
1970 Trowbridge, Harry, 226 Naples Terrace, Bronx, N.Y. 10463
1973 Trummer, Vera, 52-30 39 Dr., Woodside, N.Y. 11377

1923 Tucker, Mrs. Carll, P.O. Box 549, Mt. Kisco, N.Y. 10549
1961 Tudor, Guy, 380 Riverside Dr., New York, N.Y. 10025
1972 Vail, Donald B., 94 Sherwood Rd., Ridgewood, N.J. 07450
1933 Van Deusen, Hobart M., American Museum of Natural History, New York, N.Y. 10024
*1944 Vaurie, Dr. Charles, American Museum of Natural History, New York N.Y. 10024
1974 Wall, John W., 76 Brambach Rd., Scarsdale, N.Y. 10583
1968 Walldov, Elizabeth E., 118 Riverside Dr., New York, N.Y. 10024
1959 Ward, Cornelius J., 804 S. Ocean Ave., Freeport, N.Y. 11520
1972 Warsaski, Dr. Abraham, 7 West 96 St., New York, N.Y. 10025
*1953 Weir, Dr. Andrew B., 239 East 79 St., New York, N.Y. 10021
1974 Weissman, Berna B., 15 Laurel Hill Rd., Dobbs Ferry, N.Y. 10522
1971 Wellander, Harold, 135 Vanderbilt Blvd., Oakdale, N.Y. 11769
1974 Wellington, Mark E., 300 Pelham Rd., New Rochelle, N.Y. 10805
1969 Wesley, Elizabeth, 41 W. 89 St., New York, N.Y. 10024
1955 Wheat, Maxwell C., Jr., 333 Bedell St., Freeport, N.Y. 11520
1971 White, Vera G., 215 East 17 St., New York, N.Y. 10003
1945 Wiley, Farida A., American Museum of Natural History, New York, N.Y. 10024
1961 Williams, Mrs. David A., 80 Bar Beach Rd., Port Washington, N.Y. 11050
1972 Wittack, Leon A., 43 West 86 St., New York, N.Y. 10024
1962 Wolf, Estelle, 311 East 71 St., New York, N.Y. 10021
1952 Wolk, Dr. Robert G., Nassau County Museum, Seaford, N.Y. 11783
1969 Wright, Nancy, 210 West 21 St., New York, N.Y. 10011
1973 Yachnes, Dr. Irving, 8301 Ridge Blvd., Brooklyn, N.Y. 11209
1955 Young, Charles F. J., 38 West 4 Street, Locust Valley, N.Y. 11560
1944 Yrizarry, John, 22 Chester Court, Brooklyn, N.Y. 11225
1973 Yrizarry, Mrs. John, 22 Chester Court, Brooklyn, N.Y. 11225
1972 Zelazinski, Marie T., 101-06 160 Ave., Howard Beach, N.Y. 11414
1974 Zepko, George W., Box 966, Middletown, Conn. 06457

ASSOCIATE MEMBERS

1969 Alden, Peter, 375 A Harvard St., Apt. 1A, Cambridge, Mass. 02138
1947 Alfred O. Gross Ornithological Library, Biology Dept., Bowdoin College, Brunswick, Maine 04011
1970 Allan, John H., Box 282, Quogue, N.Y. 11959
1941 Alperin, Irwin M., 216 New Mark Esplanade, Rockville, Md. 20850
1943 Archard, Helen L., 2560 County St., Somerset, Mass. 02726
1966 Bader, Dr. Frank E., 314 Fairway Circle, Columbus, Ohio 43213
1967 Banvard, Theodore J., 9517 Cable Drive, Kensington, Md. 20795
1961 Barton, Roger, Mt. Salem Farm, R.D. 1, Box 228 A, Pittstown, N.J. 08867
1961 Berliner, Dr. B. C., 40 Duncaster Rd., Bloomfield, Conn. 06002
1972 Biderman, John, College of the Atlantic, Bar Harbor, Maine 04609

1967 Birkenstein, Mrs. George, Tenerias 45, Apto. 246, San Miguel Allende, Gto., Mexico
1943 Blazer, Mrs. Warren G., 2758 Kelton Ave., Los Angeles, Calif. 90064
1972 Brownstein, Richard, 161 Lexington Ave., Buffalo, N.Y. 14222
1949 Burckhardt, Dr. Dieter, Adlerstrasse 12, CH 4052, Basel, Switzerland
1974 Cannell, Peter F., 160 East 72 St., New York, N.Y. 10021
1968 Chelimer, David, 614 Randolph Place, Seattle, Washington 98122
1967 Cord, Mrs. Don, Box 486, Southampton, N.Y. 11968
1949 Cort, Ambrose, Jr., 239 Benham Rd., Groton, Conn. 06340
1961 Cutler, David A., 1110 Rock Creek Dr., Wyncote, Pa. 19095
1962 Davenport, Mrs. Allan, Box 323, Jamestown, R.I. 02835
1972 Deitch, Donald G., 233 East 69th St., New York, N.Y. 10021
1972 Dumont, Mrs. Helen, Wilmington, Vermont 05363
1968 Edwards, N. Davanaugh, P.O. Box 177, Redding Ridge, Conn. 06876
1964 Enders, Frank, Jr., Dept. of Zoology, University of Texas, Austin, Texas 78712
1963 Erickson-Brown, J. P., Breezy Creeks, RR 1, King, Ontario, Canada
1971 Ewert, David N., American Museum of Natural History, New York, N.Y. 10024
1974 Fisk, Mrs. Bradley, 17101 SW 284 St., Homestead, Fla. 33030
1974 Gingert, Arthur, Miles Wildlife Sanctuary, West Cornwall Rd., Sharon, Conn. 06069
1945 Goldstein, George, 24 Wildwood Ave., Salamanca, N.Y. 14779
1972 Haeni, Frank R., 382 Washington St., Norwich, Conn. 06360
1961 Heath, Fred A., 630 Raymond Ave., Santa Monica, Calif. 90405
1972 Hemmerick, Mrs. Myrna, P.O. Box 203, Setauket, N.Y. 11733
1951 Katsaros, Peter, Pine Hill Road, Pleasant Valley, N.Y. 12569
1973 Kibbe, Douglas P., 368 Main St., Newfield, N.Y. 14867
1971 Kibler, Lewis, Box 540, RD 2, Jamestown, N.Y. 14701
1967 Kinkead, Eugene, Colebrook, Conn. 06021
1972 Kiviat, Eric, P.O. Staatsburg, N.Y. 12580
1971 Kleinbaum, Georges, 42-42 Colden St., Flushing, New York 11355
1966 Knox, Samuel D., Darling Hill Farm RFD 1, Stonington, Conn. 06378
1927 Kuerzi, Richard G., Box 633, Folkston, Georgia 31537
1974 Lauro, Brook, 9 DeSoto Rd., Amityville, N.Y. 11701
1973 Lehman, Paul, 8 Cambridge Ct., Larchmont, N.Y. 10538
1966 Lohrer, Fred Edward, Archbold Biological Station, Rt. 2, Box 180, Lake Placid, Florida 38852
1969 Love, Thomas F., 1830 NE 25 Ave., Portland, Oregon 97212
1962 Mannix, Capt. James P., 9924 Fairfax Sq., Apt. 108, Fairfax, Va. 22030
1973 Martin, Phillip D., 9 Applegarth St., Newton Centre, Mass. 02159
1973 Mc Cormack, Mrs. Jean, 36 Hy-Vue Dr., Newburgh, N.Y. 12550
1954 Mitchell, Harold D., 238 W. Royal Parkway, Williamsville, N.Y. 14221
1943 Palmer, Dr. Ralph S., New York State Museum, Albany, N.Y. 12224

1955 Petersen, Erik O., 10574 118 Terrace North, Largo, Fla. 33540
1971 Polshek, Peter Max, 42 West 9 St., New York, N.Y. 10011
1967 Post, William, Jr., Urbilinda Vista 30, Lajas, Puerto Rico 00667
1941 Raynor, Gilbert S., Schultz Road, Manorville, N.Y. 11949
1962 Rigerman, Alan W., 18105 N.W. 8 Pl., Miami, Fla. 33169
1970 Rimberg, Saul, 10 East 43 St., Brooklyn, N.Y. 11203
1952 Rimsky-Korsakoff, V. N., 3029 Rodman St., Washington, D.C. 20008
1960 Rising, Gerald R., 295 Robinhill Dr., Williamsville, N.Y. 14221
1968 Rook, George C., 841 Fourth Ave. North, St. Petersburg, Fla. 33701
1974 Rosenthal, Warren, 20 Manitou Rd., Westport, Conn. 06880
1943 Ross, R. Dudley, 5 Windflower Dr., Newark, Del. 19711
1943 Ross, Mrs. R. Dudley, 5 Windflower Dr., Newark, Del. 19711
1965 Russ, Nancy, Box 275, Peterborough, New Hampshire 03458
1939 Sabin, Walton B., 652 Kenwood Ave., Slingerlands, N.Y. 12159
1943 Scott, Frederic R., 115 Kennondale Lane, Richmond, Va. 23226
1970 Silverman, Joan, 1045 Vigo St., Gary, Ind. 46403
1943 Small, Arnold, 608 N. Camden Drive, Beverly Hills, Cal. 90210
1972 Smart, Robert W., Millbrook School, Millbrook, N.Y. 12545
1956 Smith, Neal G., Smithsonian Tropical Research Inst., P.O. Box 2072, Balboa, Canal Zone
1971 Sonneborn, Dr. David W., Medical College of Virginia, Richmond, Va. 23219
1939 Spofford, Dr. Walter R., Aguila Rancho, Portal, Ariz. 85632
1937 Stephenson, Dr. O. K., Jr., New Bloomfield, Penn. 17068
1937 Storer, Dr. Robert W., University of Michigan, Museum of Zoology, Ann Arbor, Michigan 48104
1971 Tamp, Mrs. Vivian A., The Corner House, P.O. Box 724, Stockbridge, Mass. 01262
1970 Thacher, Mrs. Peter S., 29-E Chemin de Grange Canal, 1208, Geneva, Switzerland
1968 Trimble, Mrs. Benjamin, 2703 Pine Lake Apts., Oak Ave., Lindenwold, N.J. 08021
1956 Van Cleve, G. Bernard, 304 So. Winebiddle St., Pittsburgh, Pa. 15224
1970 Veit, Richard B., 169 East 94 St., New York, N.Y. 10028
1960 Ward, Rodman, 55 Selborne Dr., Wilmington, Del. 19807
1953 Weiss, Mrs. Stuart, 442 Spring Street, Manchester, Conn. 06040
1938 Whitman, F. Burton, Jr., Mere Point Rd., R-3, Brunswick, Maine 04011
1928 Wilcox, Le Roy, Speonk, New York 11972
1921 Williams, Laidlaw O., Rt. 1, Box 128, Carmel, Calif. 93921
1928 Woodelton, Mrs. Roy, 33 South Shore Trail, Sparta, N.J. 07871

Editorial Committee

Members who participated in editing this issue of the *Proceedings* were: Dean Amadon, Robert S. Arbib, Jr., John Bull, Julio De La Torre, Eugene Eisenmann, Helen Hays, Mary LeCroy, Robert O. Paxton, Richard Plunkett. The Committee wishes to thank those who assisted in other ways: Robert W. Storer, Jack Foehrenbach, Dorothy Lauber, Carole L. Neidich.

ROBERT G. WOLK, *Editor*