BREEDING BIOLOGY OF GREAT BLUE HERONS AND COMMON EGRETS IN CENTRAL CALIFORNIA

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Information available in the ornithological literature about breeding biology of the Great Blue Heron (*Ardea herodias*) and the Common Egret (*Casmerodius albus*) is fragmentary at best. Breeding behavior preceding and during pair formation of the Great Blue Heron has been described by Bent (1926), Cottrille and Cottrille (1958), and Meyerriecks (1960). Miller (1943) comments on some aspects of breeding biology of the Great Blue Heron in the Philadelphia region but his data suffer from lack of quantification. In fact, the recurrent themes in the most complete summary to date of information about this species (Palmer 1962) are "quantitative data lacking," and "more information needed."

Studies of the Common Egret are even more limited than those of the Great Blue Heron. Little has been added to knowledge of its reproduction since Bent (1926) wrote its life history. Gersbacher (1939) reports on clutch size and breeding behavior in Tennessee. Meyerriecks (in Palmer 1962) summarizes current information and Teal (1965) reports on nesting success in Georgia.

Quantitative data on incubation period, nest attentiveness, and rates of feeding the young have been non-existent. The number of young fledged in any given heronry, population fluctuations from year to year, and factors affecting nesting success are largely unknown. This study has produced basic information about reproduction in Great Blue Herons and Common Egrets nesting at Audubon Canyon Ranch, California, in 1967 and 1968, and quantitative data about behavior at the nest of Great Blue Herons.

Audubon Canyon Ranch is a sanctuary situated on the central California coast just north of San Francisco. Here the wooded western slope of Bolinas Ridge descends to Bolinas Lagoon, a shallow, tidal estuary which serves as a major feeding ground for both herons and egrets. They build their nests in the tops and upper branches of the coast redwoods (*Sequoia sempervirens*) that grow to a height of 80–100 ft in the bottom and on the north-facing slope of a steep and narrow canyon. From an observation point constructed on the south-facing slope of the canyon, observers can look over the tops of the nesting trees and study the breeding birds. Nests are about 100–200 yards from the overlook, and the birds appear to be undisturbed by the presence of observers. All observations were taken from this overlook.

None of the other Ardeidae have been observed nesting at Audubon Canyon Ranch to date, although a few Snowy Egrets (*Leucophoyx thula*) perched briefly in the heronry in both years of the study. Black-crowned Night Herons (*Nycticorax nycticorax*) and Snowy Egrets commonly feed in the lagoon, and Green Herons (*Butorides virescens*) are occasionally seen there also.

METHOD

Each nest, when established, was plotted and numbered on a panorama of the heronry. Twice weekly, or more often when necessary, observers then kept a chronological record of activity on each nest. Observations were made with 7× binoculars and 20× spotting scopes. In 1967, observations started on 25 March and continued until 12 September. The heronry was observed on 57 days of that year, for a total of about 110 hr. Observations were taken on 83 days in 1968 for a total of approximately 210 hr, 6 January–4 September.

In 1968, in addition to regular recordings on the status of all the nests, a team of observers recorded activity on seven heron nests on the following four days during the nesting season: 19 March, 05:50–17:50 PST; 2 April, 05:35–18:35 PST; 22 April, 05:10–19:90 PST; and 2 June, 05:30–20:30 PDT. Daily records were also taken during certain critical periods to determine laying and hatching dates.

GREAT BLUE HERON

ONSET OF NESTING ACTIVITY

Great Blue Herons breeding at Audubon Canyon Ranch are largely if not entirely migratory. About 23 individuals wintered in Bolinas Lagoon in 1968, but it is not known whether they remained for the nesting season. The first breeding herons perched in the heronry about 1 February 1968, and by 10 February ten of the old nesting sites were occupied, four by pairs and six by single birds. Territorial defense, bill clapping, twig presentations, and an unsuccessful attempt at copulation occurred on this day. The popu-

lation in the heronry had increased to 69 birds by 20 February and copulations were seen on three nests. The first eggs were seen on 24 February. One nest had two eggs in it so laying probably started about 21 February. The last breeding herons to arrive occupied their nests about 13 March.

Sudden flights of all or most of the herons in the nesting area were seen on several occasions before incubation started. Cottrille and Cottrille (1958) saw similar flights in a heronry in Michigan and attributed them to human disturbance. The flights at Audubon Canyon Ranch could not be related to human or other disturbance, however; rather they seemed to be socially induced.

NESTS

Great Blue Heron nests are exposed platforms built mainly of dry twigs. Fresh material plucked from branches near the nests is sometimes added during incubation. Most nesting material is obtained nearby, although one heron flew across the lagoon from the northwest into the heronry carrying a twig in its bill. Nests remaining intact from the previous year are repaired and re-used; some heron nests are apparently many years old and quite stable. There is a tendency for heron nests to predominate in the eastern end of the heronry, while egret nests predominate in the western end, and the species are mixed in the center. Distance between nests is determined largely by the structure and spacing of the nesting trees. Where suitable sites are available in close proximity, territorial defense by the breeding birds keeps nests at least as far apart as opposing adults can extend their necks and bills.

In 1967, 139 nests of both species were plotted; in 1968, 163 nests were plotted. The additional nests in 1968 were placed almost entirely within the original boundaries of the heronry, thus increasing the density of the nesting population without appreciably extending the boundaries of the heronry. It could probably accommodate considerably more nesting pairs as there are unused trees on the periphery as well as additional sites within its present boundaries.

In both years a few sites were occupied briefly by adults but eggs were not laid. Some nests were re-occupied after an early failure by another pair of adults. One nest in 1967 was used unsuccessfully by a pair of herons, then by a pair of egrets, and finally by another pair of herons, this time successfully. Some nests suffered loss of eggs or young

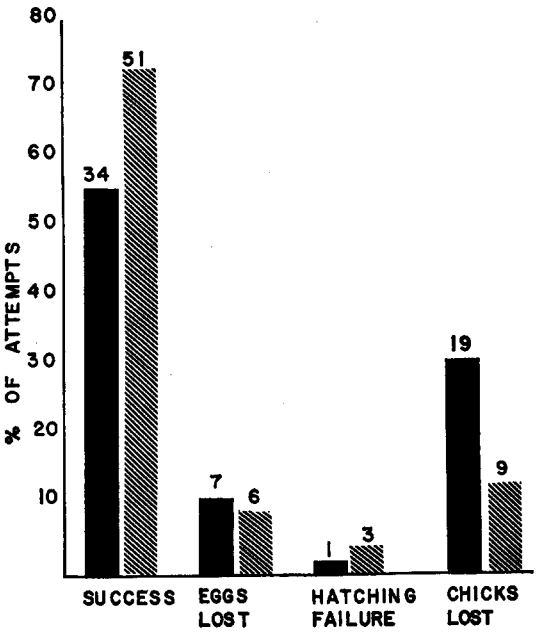

FIGURE 1. Fate of Great Blue Heron nesting attempts in 1967 (solid bars) and 1968 (hatched bars). Figures above bars are numbers of nests.

and a new attempt was started within a week of the loss without an apparent break in occupancy. Meyerriecks (in Palmer 1962) states that the Green Heron starts a new nesting attempt after loss of eggs or young early in the season. Observations at Audubon Canyon Ranch suggest that this is also true of the Great Blue Heron.

ESTIMATE OF BREEDING PAIRS

The number of breeding pairs was estimated by charting the progress of each nest and determining which nests were abandoned early and which were started late and were probably second attempts. In 1967, 59 heron nests were charted, 12 were abandoned early in the season, and 9 were started late and assumed to be second attempts; 50 breeding pairs were assumed to be in residence. The greatest number of nests known to be occupied at one time was 49. In 1968, 68 heron nests were plotted, 8 were abandoned early, and 6 were started late and judged second attempts. I estimated 62 breeding pairs for 1968. The greatest number of nests known to be occupied simultaneously in that year was 60.

NESTING SUCCESS

In 1967, 69 young herons were fledged in the 53 nests with known results, an average of 1.3 young per nest. Assuming that six nests with unknown results fledged an average of

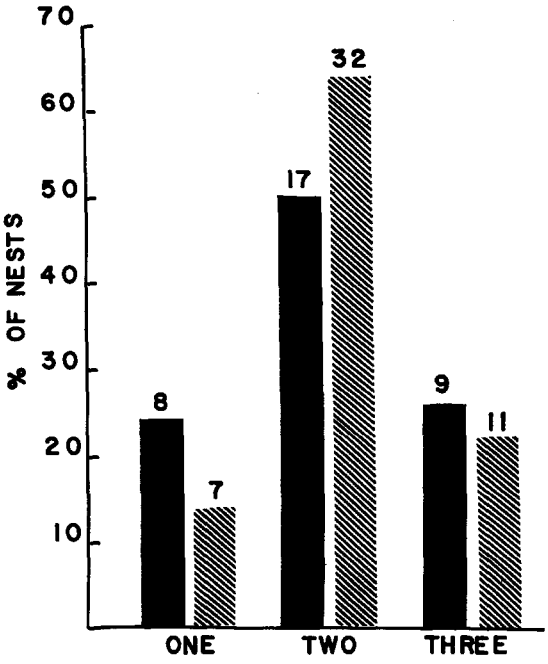

FIGURE 2. Percentages of successful Great Blue Heron nests in 1967 (solid bars) and 1968 (hatched bars) fledging one, two, and three young. Figures above bars are numbers of nests.

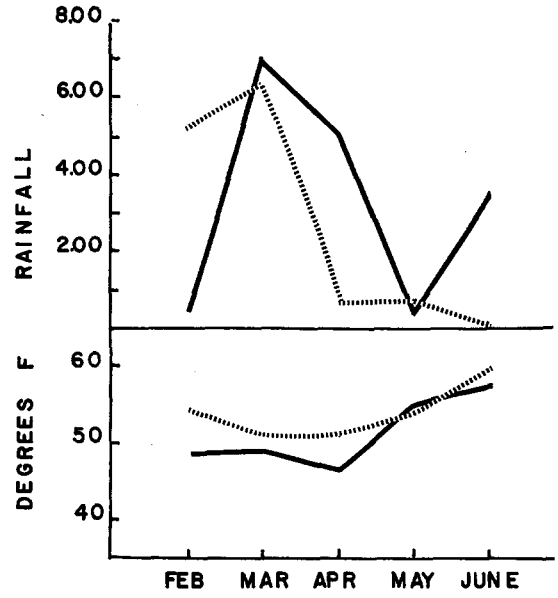

FIGURE 3. Monthly rainfall (inches) and average mean daily temperatures for the nesting seasons of 1967 (solid line) and 1968 (broken line).

one per nest, 75 young herons were raised in 1967, and the estimated 50 breeding pairs fledged 1.5 per pair. In 1968, 104 young were known fledged and the number fledged per breeding pair was 1.7. In 1967, 76 per cent of the breeding pairs were able to raise at least one young heron; 82 per cent were able to do so in 1968.

In comparing differences in success of nesting attempts for the two years, I have used all attempts reaching the egg-laying stage, and included, as separate attempts, early failures in continuously occupied nests. There was a higher per cent of successful attempts in 1968 and a correspondingly lower per cent of attempts losing nestlings (fig. 1). There was also a higher per cent of successful nests able to fledge two young and a lower per cent fledging only one (fig. 2). Percentages of attempts losing eggs and hatching failures were about the same in both years.

The evidence suggests that unfavorable weather contributed heavily to greater nestling loss in 1967. Since temperatures and precipitation were not recorded at Audubon Canyon Ranch, I have used records taken at the Point Reyes National Seashore headquarters situated 11 mi. NW of the heronry and affected by approximately the same weather conditions. April 1967 showed the lowest average mean daily temperature for any month during the nesting season in either year and high precipitation (fig. 3). It is also probably significant that only nine days in that month were free of rain. This period of rain and cold started at the time the first heron nestlings were hatching and persisted for the first few weeks of their lives. In 1967, 10 nesting failures due to nestling loss, or 53 per cent of the 19 nests that failed for this reason, occurred within the same period. First hatchings in 1967 undoubtedly suffered from exposure to cold and rain during nest relief and feeding. In addition, even a moderate storm must certainly have impaired feeding success of the adults, thus reducing the amount of food offered the nestlings with consequent high mortality.

DURATION OF THE NESTING SEASON

In 1968, laying started on 21 February and the peak in number of nests with eggs was reached about 15 March (fig. 4). Although observations were not started until 25 March in 1967, it was possible to determine the course of nesting activity prior to that date by extrapolating back. Laying appears to have started at about the same time in 1967 but the number of nests with eggs reached a peak about a week later than in 1968. Late rises in the curve of nests with eggs for both years reflect second nesting attempts. The last clutch in 1967 was started on 13 July.

Most nestlings hatched during the last week in March and the first three weeks in

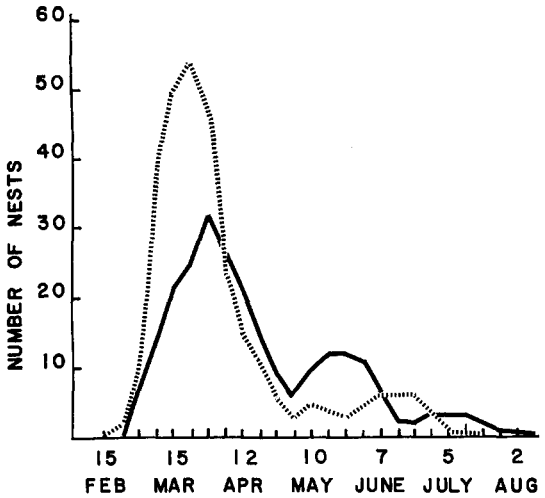

FIGURE 4. Great Blue Heron nests with eggs in 1967 (solid line) and 1968 (broken line).

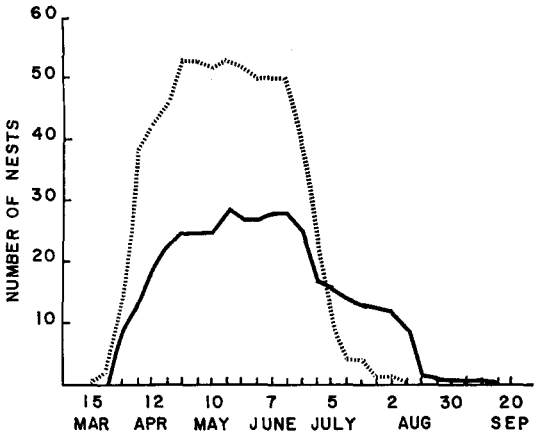

FIGURE 5. Great Blue Heron nests with young in 1967 (solid line) and 1968 (broken line).

April. In 1968 the number of nests with young had reached its peak by 26 April (fig. 5). In 1967, however, early loss of broods followed by hatchings from second attempts delayed the peak until the middle of May. Most fledglings left the heronry between the third week in June and the middle of July. Nestlings from second attempts were cared for through August, and in 1967 a young heron remained on the nest until 12 September. In August of 1967, young nestlings were apparently abandoned in two nests, possibly because the adult nesting impulse did not persist long enough to raise the young to maturity.

LAYING INTERVALS

Seven heron nests were observed daily to determine laying and hatching dates as accurately as possible. Three of these had three-egg clutches and four had four-egg clutches. In most cases the time of day of laying and hatching could not be determined. It is clear, however, that the most likely interval between layings is two days. In one nest three days elapsed between the first and second layings, and in another nest three days elapsed between the third and fourth layings. Witherby et al. (1939) report similar intervals between layings for the Grey Heron (*Ardea cinerea*).

INCUBATION

Bent (1926) states that the incubation period for the Great Blue Heron is 28 days but he does not define incubation period. Using the definition of incubation period as the elapsed time between laying of the last egg in a clutch and last hatching when all eggs hatch (Nice 1954), the incubation periods for the four nests in which all eggs hatched were 25, 28, and 29 days on two nests. First and second hatchings usually occurred within 24 hr of each other, indicating that full incubation did not begin with the laying of the first egg. Incubation began before the laying of the last egg, however, since hatching was asynchronous. The intervals from first hatching to last hatching when all eggs hatched were five to eight days.

In 107 hours of observation on nests with complete clutches, the herons averaged 54 min/hr incubating, with a range of 36–60 min. The longest continuous period a heron incubating a full clutch was seen to remain standing was 13 min.

Of the 25 eggs in the seven nests, 21, or 84 per cent, hatched. Unhatched eggs remained in the nest for a week or so and then disappeared.

Both adults shared in incubation and after laying had started, nests were never seen unattended. In all-day observations on five nests during incubation, nest relief occurred once on two nests, three times on one nest, and not at all on two nests. The Great Blue Heron is reported to feed at night (Miller 1943; Bent 1926), and it is possible that nest relief may also occur at night.

Before the clutch was complete, both members of the pair were frequently together at the nest, copulations occurred on the nests, and numerous twig presentations were seen. Twigs presented immediately after copulation were always brought by the male and presented to the female who then placed them in the nest. On completion of the clutch, the incubating bird was usually alone at the nest

except during nest relief. On one nest, however, twig presentations were seen 12 days after the clutch was complete and late in the afternoon on that day the male attempted copulation. The female was unreceptive and the attempt was unsuccessful. Twig presentations were also seen on two nests after part of the clutch had hatched.

Some nest building was undertaken by incubating birds who reached out, broke fresh twigs from adjacent branches, and placed them in the edge of the nest. Adult herons also worked on nest maintenance and repair throughout the incubation period and for at least a week after the eggs hatched. Typically the incubating bird rose, preened, probed the central part of the nest, or grasped one of the long twigs at the edge of the nest with its bill, shoved it into better position, then settled in one or two minutes. It sometimes rolled the eggs by pushing one or more with its bill. As the egg rolled, any other eggs in contact with it rolled also. Frequency of egg rolling was variable. It sometimes occurred several times within an hour, sometimes not at all for several hours. The average was once every two hours for both incomplete and complete clutches.

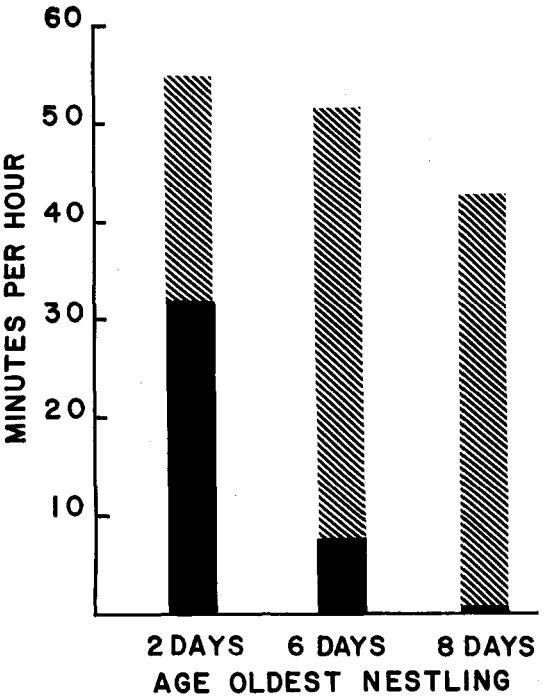

FIGURE 6. Average minutes per hour Great Blue Herons brooded chicks in sun (solid section) and shade (hatched section).

NEST ATTENTIVENESS

Nestlings were constantly attended by an adult until they were about 21 days old. When the chicks were between 21 and 28 days, they were left unattended for part of the day. In one nest in which the oldest nestling was 28 days, an adult was absent for 4.5 of 14 hr. In another nest in which the oldest chick was 25 days old, the adult was absent 9.5 of 14 hr. After the chicks passed the age of 28 days, adults were seen at the nest only when feeding the young.

BROODING

Newly hatched nestlings were brooded by the adults for decreasing amounts of time during the first week. The average number of minutes per hour spent brooding decreased steadily for the first eight days (fig. 6), but the amount of time spent brooding in early morning and late afternoon shade diminished only slightly, whereas there was a marked decrease in brooding when the nest was in full sun. Brooding was seen on chicks older than eight days only three times: once on a cold day on 10-day-old chicks; once when the nest was still in early morning shadow on 19-day-old chicks; and once on 19-day-old chicks on a cold day. Since the spring of 1968 was very warm and sunny, few observations were taken on cold days. It seems probable that more brooding would have been seen on chicks older than eight days had there been more cold weather. Lowe (1954) reports that Grey Heron nestlings are still brooded attentively at ten days of age.

FEEDING OF THE YOUNG

Descriptions in the literature of feeding of Great Blue Heron nestlings are somewhat contradictory. According to Bent (1926) and Cottrille and Cottrille (1958), the parent birds feed newly-hatched nestlings by regurgitating soft food directly into their bills. However, Meyerriecks (in Palmer 1962) states of the Great White Heron (*Ardea occidentalis*), which is known to interbreed with the Great Blue Heron and is considered conspecific by some, "food regurgitated by parent onto floor of nest first week to 10 days." Cottrille and Cottrille state that later nestlings thrust their bills into the bills of the adults. Chapman (1908) states that he did not see young birds thrust their bills into the adults' bills nor adults put their bills into those of the young. All accounts agree that older nestlings grasp the bill of the adult preliminary to feeding and that food is then deposited into the nest.

Adult herons observed at Audubon Canyon

Ranch fed nestlings of all ages by regurgitating food, usually fish, into the bottom of the nest. Nestlings less than 24 hr old were seen to direct vigorous pecks at food in the nest and swallow partially digested chunks almost as large as their own bills. The size of food regurgitated varied widely, from fish larger than the chicks to heaps of small unidentifiable items. Some of the food was obviously soft and fell apart quickly when pecked by the chicks, some was firm and appeared freshly caught. There was no consistent relationship between size or condition of food and age of nestlings. At several feedings of nestlings less than two weeks of age, a previously undescribed variation in the feeding pattern was seen in which the adult held the fish in the tip of its partly opened bill before dropping it into the nest and the nestlings pecked at the fish from both sides. Fish were usually deposited tail first and, if not too large, swallowed whole, head first. The adults re-swallowed any food remaining in the nest.

Adults preparing to feed young chicks leaned over until the tip of the bill almost touched the bottom of the nest. Elapsed time from the moment the adult leaned over until regurgitation was estimated to be about 2 min for most feedings. While the adult's head and bill were down, newly hatched nestlings pecked excitedly at the bill, the bottom of the nest, and often each other. By the end of the second week, nestlings grasped the adult's bill crosswise momentarily when the adult leaned over. By the end of the third week, they reached up, grasped the adult's bill, scissors fashion, and attempted to force it to the bottom of the nest. At one feeding, food was seen to pass directly into the nestling's bill as it tugged on the adult's bill; this must be considered a rare occurrence, however. From the age of three weeks until departure from the nest, nestlings continued to grasp the adult's bill crosswise and pull it until the adult regurgitated.

FREQUENCY OF FEEDING

Data obtained in all-day observations indicated a relationship between frequency of feeding and age of nestlings, nestlings being fed most often in the first week of life. At the age of two days, chicks in one nest were fed 10 times in 13 hr. In another nest chicks six days old were fed six times in 13 hr. All-day observations were obtained on nine nests with young between the age of one week and age of first flight. Frequency of feeding in these nests ranged from one to six times during the daylight hours. Four times was the most common. Observations on two nests in which the fledglings were between 63 and 69 days and flying but still being cared for by the adults yielded two feedings per nest during the 15-hr period. Thus there may be a drop in feeding frequency during the fledgling period.

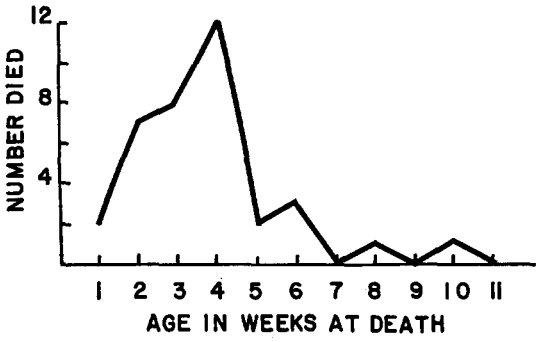

FIGURE 7. Age at death of Great Blue Heron nestlings ($n = 36$ chicks).

Although the chicks were fed more frequently during the first week, the adults did not make more trips from the feeding grounds to the nest during this time. In nests with very young nestlings, a succession of feedings took place over a time span of several hours after the adult returned from the feeding grounds. For example, an adult arrived on nest 28 in which the chicks were one and two days old at 07:33; it fed the nestlings at 07:35, 09:53, 10:56, 13:10, 14:50, and 15:15 before it was relieved at 16:09, about 9 hr after it had arrived.

The frequency with which adults relieved each other at the nest increased somewhat after hatching. Frequency of nest relief during daylight hours on seven nests with nestlings 2–28 days old, ranged from one to five times, with two times the most common.

NESTLING MORTALITY

In 1967, 45 per cent of the nestlings known to have hatched died. This agrees with Miller's (1943) estimate of nestling mortality in excess of 40 per cent. In 1968, nestling mortality in 10 nests, including the special study nests and three others for which an unquestionably accurate count of hatchings was determined, was 30 per cent. This is admittedly a very small sample but it is consistent with the lower per cent of nesting failures due to loss of the brood in 1968 (fig. 1), and the lower per cent of nests fledging only one (fig. 2).

Age at death of 36 nestlings from both years was determined (fig. 7), excluding

nestlings apparently deserted late in the season. Highest mortality occurred between the third and fourth weeks, probably because competition for food had its greatest impact at this time. Three or four newly hatched nestlings could feed from one fish, but as they grew larger a single nestling was able to gulp relatively large fish whole. Smaller, weaker chicks were often prevented from getting any food at all for several feedings and so perished.

Two nestlings died in their eighth and tenth weeks in the same nest in 1967. Circumstances suggest disease or parasites as the cause rather than starvation.

DEVELOPMENT OF THE YOUNG

Some information was also obtained on behavior development of the chicks. Preening of the natal down was seen as early as six days. During the first two weeks of life, the chicks were unable to stand on their feet and supported themselves by keeping the tarsi stretched out flat on the bottom of the nest. At 14 days they could stagger to their feet and by 21 days could walk firmly across the nest. Nestlings left alone between the ages of 21 and 28 days were seen to threaten egrets flying over by standing, partly opening their wings, extending their necks, raising their crests, and squawking. Nestlings continued to defend the nest until abandoning it. After the age of four weeks, preparation for flight became a prominent behavior pattern. Nestlings at this age frequently stood on the edge of the nest repeatedly flapping their wings. Starting at about age seven weeks, nestlings took short jump flights of 6–10 ft from the nest to adjacent branches and back again. They also sometimes jumped vertically from the center of the nest flapping their wings, or stood clinging to a branch, flapping until the branch rose with the force of the wing beats. At the age of 60 days some of the young took sustained flights around the heronry or out toward the lagoon. Others were apparently as late as 69 days at the age of first long flight. They typically returned to the nest for two or three weeks after the first long flight and continued to be fed by the adults. Nestlings as old as 11 weeks were seen being fed at the nest. Adult herons were seen standing on two nests soon after the fledglings had left, suggesting that, on some nests at least, the adults continued to arrive for feeding until they found it empty.

Nestlings abandoned the nest between the ages of 64 and 91 days. The average age of nestlings on departure from 29 successful first attempts was 81 days. Nestlings from late hatchings were younger on departure than nestlings from first attempts. The average age on departure from seven second attempts was 67 days. None was older than 71 days. There was no apparent relationship between size of brood and length of time in the nest.

Nestlings of 18 days were seen vibrating the gular pouch to promote cooling. They assumed the typical Great Blue Heron sun bathing posture, in which the wings were rotated out and away from the body and the inner surface of the wings exposed to the sun and air, at age 27 days. Young from the age of 29 days occasionally seized the long twigs in the periphery of the nest and readjusted them with the typical "tremble-shoving" movements of the adult. As the young practiced flight they often voiced a soft "frahnk-frahnk-frahnk" on landing in the nest or even on a branch, a call similar to the adult greeting as it approaches a nest containing young. Two observers noted behavior which indicated that nestlings recognize an approaching parent before it lands on the nest. In both cases, the young, aged about nine weeks, scrambled back into the nest from adjacent branches and started begging for food while the adult was still flying at some distance from the nest, so far in fact, that the observer was still unaware of its approach. Lowe (1954) reports similar behavior in nestling Grey Herons.

COMMON EGRET

ONSET OF NESTING ACTIVITY

Like the Great Blue Herons, Common Egrets breeding at Audubon Canyon Ranch are migratory. They begin to appear on the lagoon about the middle of February and start to perch in the heronry during the first week in March. In 1968 a pair of egrets was observed copulating on a branch on 9 March. Twigs for the first egret nest were placed about 12 March, and on 16 March it had one egg in it. A week later 24 egret nests had been established, many with eggs in them. The last new egret arrivals established nests about 18 April 1968.

NESTS

The egrets built their nests of dry twigs as the herons, but their nests tended to be smaller and somewhat more flimsy. They sometimes used abandoned heron nests or built on a site used by herons the previous year. Egret nests were sometimes abandoned, the nesting material used by other birds, and

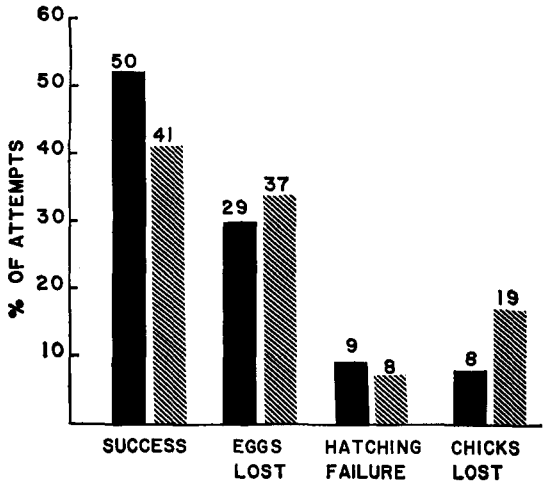

FIGURE 8. Fate of Common Egret nesting attempts in 1967 (solid bars) and 1968 (hatched bars). Figures above bars are numbers of nests.

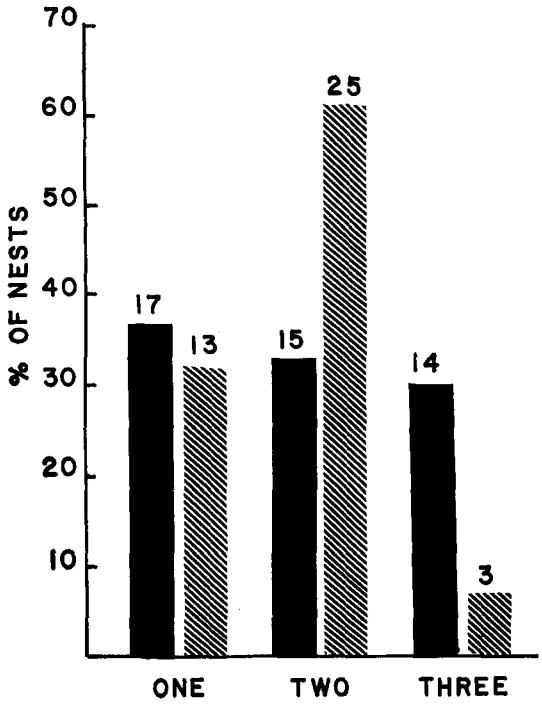

FIGURE 9. Percentage of successful Common Egret nests in 1967 (solid bars) and 1968 (hatched bars) fledging one, two, and three young. Figures above bars are numbers of nests.

new egret nests subsequently built on the site. New nesting attempts were started in some nests within a few days of loss of eggs or nestlings, apparently by the same breeding pair.

NESTING SUCCESS

In 1967, 93 Common Egret nests were plotted; 23 of these were unsuccessful and abandoned early, and 21 were assumed to be second attempts. The number of breeding pairs was estimated at 70. Sixty-nine nests were known to be occupied at one time. In 1968, 114 egret nests were plotted, 43 were unsuccessful and abandoned early, and 40 were late starts. Breeding pairs were estimated to be 74. The maximum number of nests known to be occupied simultaneously was also 74.

In 1967, 89 young were fledged in nests with known results and it was estimated that 101 egrets were fledged in all nests. In 1968, 72 fledglings were counted in nests with known results and it was estimated that 83 were raised from all nests. The number of young raised per breeding pair was estimated at 1.4 in 1967 and 1.1 in 1968.

Of the estimated 70 breeding pairs in 1967, 76 per cent were able to fledge at least one young egret; 63 per cent of the estimated 74 breeding pairs in 1967 were able to do so.

Greater nestling loss was the principal reason for the decline in nesting success in 1968. The percentage of nesting attempts losing nestlings was greater (fig. 8) and the percentage of successful nests able to fledge three dropped sharply (fig. 9). The average number of young fledged from known successful nests dropped from 2.1 in 1967 to 1.75 in 1968. Reasons for the higher mortality in 1968 are unknown.

NESTLING MORTALITY

Of the 110 egret nestlings counted in 1967, 21 (19 per cent) died before fledging. In 1968, 126 egret nestlings were seen; of these 54 (43 per cent) died. Teal (1965) found nestling mortality in Georgia to be 15 per cent.

In analyzing age of egret nestling mortality, nestlings apparently abandoned in the nest late in the season were excluded. Nestlings for both years were included, but, since many more died in 1968 than in 1967, if special factors influenced mortality in 1968, the results reflect them. There was a sharp rise in nestling mortality between two and three weeks of age (fig. 10). Competition for food is probably a major factor in nestling loss, and its effect is probably greatest at this age.

DURATION OF THE NESTING SEASON

Egret nest construction and egg laying in 1967 was considerably later than in 1968 (fig. 11). Meyerriecks (in Palmer 1962) states of the Common Egret: "Construction of nests at any time of day, inhibited by high

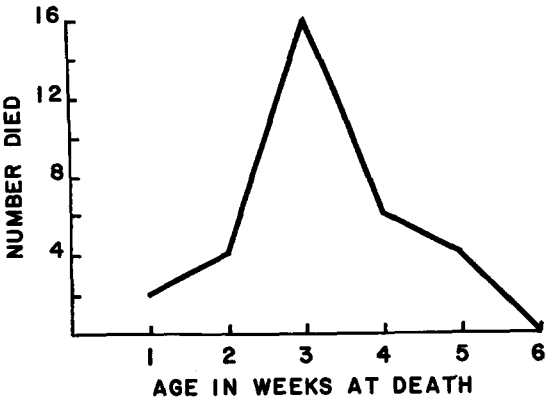

FIGURE 10. Age at death of Common Egret nestlings ($n = 39$ chicks).

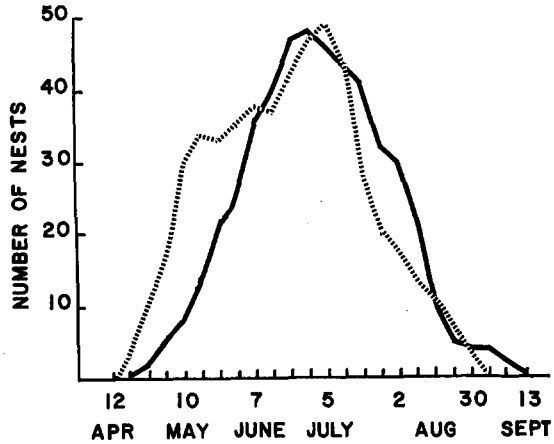

FIGURE 12. Common Egret nests with young in 1967 (solid line) and 1968 (broken line).

winds, heavy rain, or low temperatures." All of these unfavorable weather conditions occurred in 1967 from 28 March through 30 April (fig. 3). Thus nest construction and egg laying were apparently delayed by the persistent rains and relatively cold weather in April 1967, and the number of nests with eggs reached its peak six weeks later than in 1968. Late rises in the curves of nests with eggs for both years reflect late starts after early nesting failures.

Although the peak number of nests with eggs was six weeks earlier in 1968, the peak number of nests with young was a week later (fig. 12). The larger number of nesting failures due to loss of young in May 1968 resulted in second attempts with hatchings in late June and early July. Nevertheless, further loss of late broods resulted in termination of the season about two weeks earlier in 1968. The last fledgling egret abandoned the nest about 15 September 1967; in 1968 the last fledgling egret departed about 1 September.

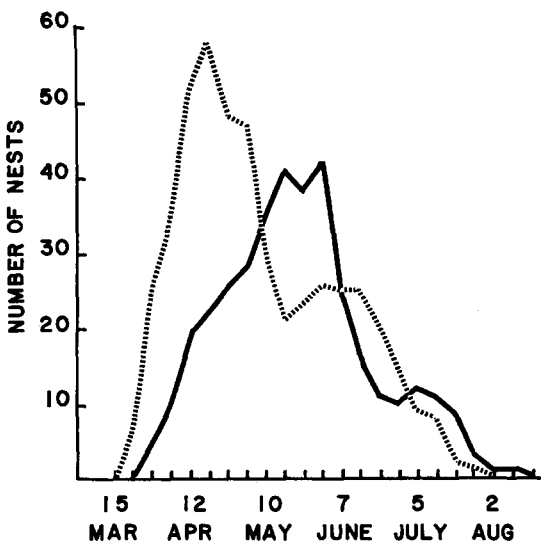

FIGURE 11. Common Egret nests with eggs in 1967 (solid line) and 1968 (broken line).

SUMMARY

Nesting success of Great Blue Herons and Common Egrets was determined for 1967 and 1968 at Audubon Canyon Ranch in California. Fifty breeding pairs of Great Blue Herons estimated to be in residence in 1967 raised 1.5 young per pair. In 1968, 62 estimated breeding pairs raised 1.7 young per pair. Adverse weather in 1967 was held responsible for reduced nesting success. Nestling mortality was 45 per cent in 1967 and 30 per cent in 1968. Greatest loss was between three and four weeks of age.

On heron nests studied in detail in 1968, the incubation period ranged from 25 to 29 days. The herons incubated a full clutch an average of 54 min/hr and brooded the chicks decreasing amounts for the first week.

Heron nests were never seen unattended during incubation and for three weeks after hatching. Nestlings were left alone except for feeding after they were 28 days old.

During incubation adult herons relieved each other on the nest about once in the daylight hours. After hatching, nest relief occurred from two to five times.

Heron nestlings of all ages were fed by regurgitation into the nest. Feedings occurred six and ten times per day on two nests in the first week, then decreased to about four times a day until the fledgling period. Fledglings were fed twice daily.

Fledgling herons took their first long flight at about 60 days and abandoned the nest permanently between 64 and 91 days of age.

Seventy breeding pairs of egrets were estimated for 1967 and they raised about 1.4 young per pair. In 1968, 74 breeding pairs were estimated, and they raised about 1.1 per pair. Diminished success in 1968 was due to nestling loss but the reasons for this were unknown. Nestling mortality was 19 per cent in 1967 and 43 per cent in 1968. Greatest loss occurred between two and three weeks of age.

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