

**Article VII.** —A CONTRIBUTION TO THE LIFE HISTORY OF  
THE AMERICAN FLAMINGO (*PHÆNICOPTERUS RUBER*),  
WITH REMARKS UPON SPECIMENS.

By FRANK M. CHAPMAN.

INTRODUCTORY.

It is a well-known fact that the Flamingo is a locally abundant bird in the Bahamas and that it breeds in certain islands of this group. Few writers on Bahaman birds, from Catesby to the present day, fail to mention this bird, but, so far as I am aware, there exist in scientific literature but two descriptions of an occupied nesting ground of Flamingos in the Bahamas; the first, by C. J. Maynard, the second by Sir Henry Blake.

On May 14, 1884, Mr. Maynard visited a rookery estimated to contain "in the neighborhood of 2000 nests, and," he states, "in all of these we found only some fifty sets of two eggs, and three in one case only." Mr. Maynard adds that when he got within about two hundred yards of the rookery the birds began to "pour out." Several were shot as they left the rookery and a few more were secured as, from time to time during the day, the birds "singly" and in "small groups" returned to reconnoitre, but the rookery was not reoccupied during the day of Mr. Maynard's stay.

Mr. Maynard gives a detailed description of the Flamingos' nests, and states that "as we came up to the rookery we had seen hundreds of birds sitting on their nests with their legs doubled under them, not hanging down as is usually represented." Mr. Maynard published the results of his observations in 'The Florida Naturalist' (1884, No. 1) and in his 'Birds of Eastern North America' (1896, pp. 103-113). He was, I believe, preceded in his discovery of the correct attitude of the Flamingo when sitting upon the nest only by H. H. Johnston (Ibis, 1881, p. 174) and Abel Chapman (Ibis, 1883, p. 397; 1884, pp. 88, 89, pl. iv), who had made similar observations in regard to the European Flamingo (*Phœnicopterus roseus*).

Sir Henry Blake, while governor of the Bahamas, visited an occupied Flamingo nesting ground June 7, 1886, when the incubating birds were watched with glasses at a distance of one hundred and fifty yards and seen to have their legs folded under them in the "usual manner" (Nineteenth Century, 1887, pp. 886-890; see also Ibis, 1888, p. 151).

To the accounts of the authors above mentioned I am privileged to add the results of observations made by myself, in May, 1902, and in May and June, 1904.<sup>1</sup>

It was my especial good fortune, on the first-named occasion, to join forces with Mr. J. Lewis Bonhote of Cambridge, England. As secretary to the Governor of the Bahamas Mr. Bonhote had exceptional opportunities to secure information concerning the localities in which Flamingos were known to nest. With a guide supplied by the Rev. Mr. Matthews, of whom mention is made below, he had previously reconnoitred the ground, and under his leadership no difficulty was experienced in reaching a region in which were several colonies of nests occupied by Flamingos in previous years. We did not, however, succeed in finding the birds breeding. Accounts of this expedition were published both by Mr. Bonhote and myself.<sup>2</sup>

Circumstances preventing a return to the Bahamas in 1903 to continue the search for the Flamingos' nesting ground, through the kind coöperation of the Rev. C. E. Meeres, of Nassau, a negro member of our 1902 expedition was dispatched to the region then visited, with instructions to ascertain whether the birds returned to breed there. He failed to find them.

Later in the year, Mr. Meeres placed me in correspondence with the Rev. F. Barrows Matthews who, residing on the island in which the Flamingos nest, was most favorably situated to aid the Museum in its explorations. Mr. Matthews's coöperation proved invaluable.

Much to my surprise I found that the abandoned nesting ground visited by Mr. Bonhote and myself in 1902, had been discovered by Mr. Matthews, on May 28, 1898. At this time it was occupied, eggs were hatching, and young old enough to run about were seen. Mr. Matthews published an account of his observations under the heading 'Expeditions,' in the Nassau Mission Quarterly, for September, 1898. To the best of my knowledge this is the first published description of a Flamingo rookery containing young birds.

At the approach of the 1904 breeding season, Mr. Matthews, acting as the Museum's representative, sent negroes to search for the Flamingos' nesting grounds. After several weeks' hunting, during which time a large area was covered, a colony of laying birds was found May 8, 1904.

In the meantime, accompanied by Prof. W. M. Wheeler, I had

<sup>1</sup> See also *The Century Magazine* for December, 1904, in which a popular account of the Museum expedition was published, and *Bird-Lore* for December, 1904, where a short account of the habits of the young was given.

<sup>2</sup> See Bonhote, *Avicultural Magazine*, 1903, p. 8, and *Ibis*, 1903, p. 310; Chapman, *Am. Mus. Jour.*, 1902, p. 78, and *Bird-Lore*, 1902, p. 177.

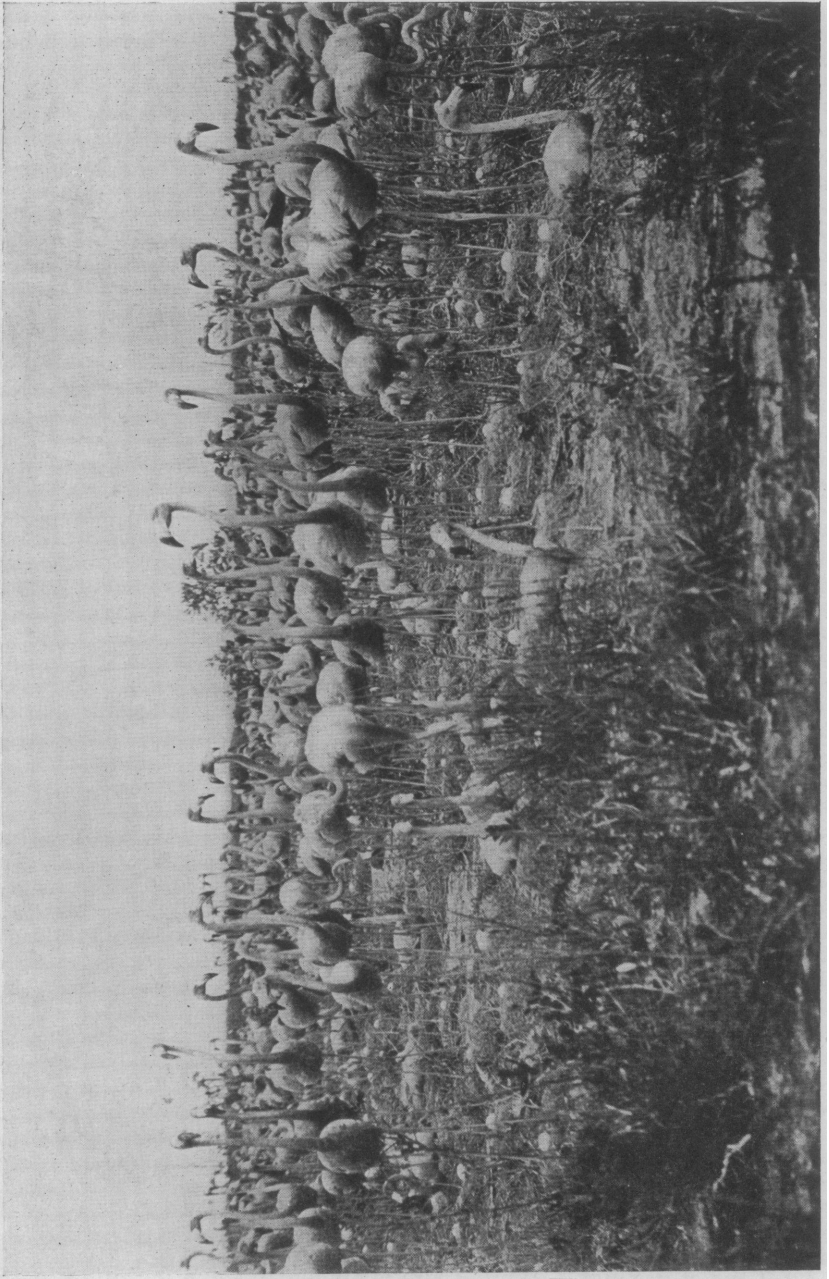


Fig. 1. The Colony Alarmed.

sailed from Miami, Florida, in the schooner yacht 'Gloria' which had been placed at the Museum's disposal by Mr. N. D. Bill of Springfield, Mass. Owing to head winds and mishaps of various kinds Mr. Matthews's home was not reached until May 17. Here we shipped as guide the negro 'Peter' who had found the birds, and continued our voyage, reaching the Flamingo rookery May 20.

The rookery, however, proved to have been flooded by the severe rain storm of May 17, when six inches of rain fell within three hours. Many of the nests were still submerged, fresh eggs were floating in the water or were stranded in the mud. About twenty Flamingos were seen during the day, but the colony, which had evidently contained several hundred birds, had disappeared.

Later we learned that subsequent to the storm the rookery had been visited by negroes who had gathered large numbers of eggs for food.

No other nesting place was discovered, and on May 28 we sailed for Nassau to replenish our supplies and meet additions to our party. In the meantime Peter was sent to the locality visited in 1902. On our return, June 4, he reported that the Flamingos were nesting there in large numbers and that already eggs were hatching. We at once set sail for the place, reaching it June 7. Our tent was pitched about one mile from the rookery which, at that distance, appeared across the 'swash' as a thin pink line. Under favorable conditions of wind the voice of both adult and young birds could be plainly heard from our camp.

We remained here until June 14, during which time the Flamingos were under constant observation. For birds usually so shy they proved unexpectedly tame near their nests. They deserted the rookery, it is true, when one was distant about one hundred and fifty yards, but settled in a bordering lagoon and returned to their nests as soon as one was a few hundred yards away.

A cloth blind erected over an umbrella, and screened by branches, was placed behind a bush thirty feet from the border of the rookery, and, later, in a bush near the center of the rookery, without apparently arousing the birds' suspicions. From the first-named position an opportunity was afforded to observe the colony as a whole; from the second, the individual was studied from as near as six feet. The results of these studies are appended.

#### REMARKS ON HABITS.

*Time of nesting.* — While there is evidently some variation in the time when the Flamingos of the western Bahamas begin to nest it is

probable that ordinarily they begin to lay the first week in May. Mr. Matthews tells me that he has seen newly hatched birds as early as May 28. The nests found the present year on May 8 contained fresh eggs; and in the rookery where my studies were made newly hatched young birds were seen by Peter on June 1. On my first visit to the rookery, June 7, I saw but two young, both less than two days old, but when I left the rookery there were hundreds of young birds running about. There were still large numbers of eggs containing half-grown embryos, and the fact that they were in low nests, which appeared to have been hastily constructed and were grouped together at the border of the rookery farthest from the water, induces the belief that possibly they were occupied by the birds which had been washed out on May 17.

I at one time believed that the date of the Flamingos' breeding season was dependent upon that of the beginning of the rainy season when, obviously, the available breeding area would be greatly increased. Since, however, the rainy season is not inaugurated before May 15, and the birds must evidently begin to build late in April, there can be no close connection between the dates of these events.

*The nesting ground.* — The nesting ground selected by this colony of Flamingos was an extension of that occupied by probably the same colony of birds in 1901 (see Bird-Lore, 1902, p. 179). In that year the nests were placed among large red mangrove bushes where but few could be seen at one time. The area occupied in 1904 is more open in character, the only conspicuous vegetation being coarse grasses, buttonwood shoots, and one good-sized buttonwood bush.

It is evident that in selecting a nesting site the birds are governed not by the nature of the vegetation, but by the height of the water. Since nesting material is not carried but is used where it is found, the birds must build where the ground is sufficiently muddy to be readily worked. The first group of nests seen by us in 1902 was placed on a sand-bar several yards from the nearest vegetation. As has been indicated, we also found nests among a dense growth of large mangroves.

When not disturbed the birds evidently return to the same locality year after year. In the region under consideration nine groups of nests were found within a radius of a mile, all apparently constructed in different years, since they appeared to be in different stages of decay.

Possibly when the governing conditions of any two years are alike, old nests may be repaired, but I saw no nests which seemed to have been rebuilt or added to.

The main portion of the 1904 nesting ground was irregularly triangular in shape and, measuring 60 x 115 x 120 yards, contained approximately 3450 square yards. The nests averaged about 50 to each one hundred square yards, making a total of 1725 in the main



Fig. 2. Leaving the Rookery when alarmed.

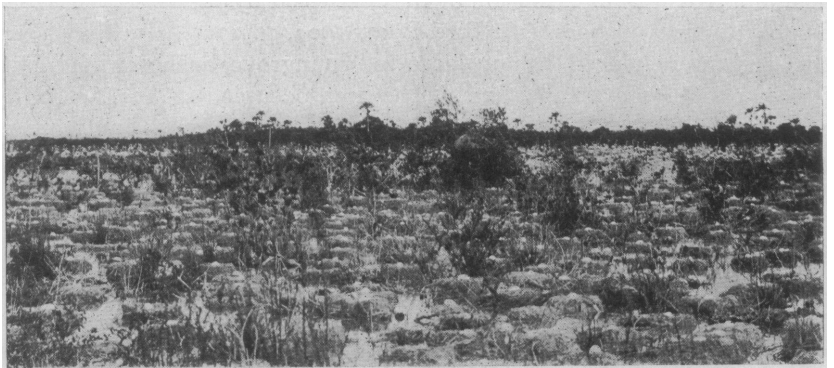


Fig. 3. The Deserted Rookery. The nests are all surrounded by water; the Flamingos have retreated to the background; the blind from which observations were made may be seen in the bush near the center of the picture.

body of the rookery. To this number should be added numerous outlying nests, including a group placed among the mangrove rookery of 1901, bringing the total of occupied nests to about 2000.

*The nest.* — While I did not see Flamingos actually building their nests, I saw them adding to nests in which the egg had already been laid. Standing with a foot on each side of the nest mud was dragged

up the side of the nest with the bill and pressed into position with both bill and feet. Doubtless the method was similar to that employed in building a new nest. My observations did not confirm Mr. Maynard's statement (*Birds Eastern North America*, 1896, p. 109) that the mud is not gathered at random but from two or three pits. When the nature of the ground permitted mud appeared to have been gathered from all about the nest. When, however, outcropping limestone limited the supply a comparatively large pocket might be scooped at some point where the absence of rock permitted a deeper excavation.

The material of which the nest is composed depends, as one might suppose, upon the nature of the spot in which it is built. The nests of 1902, placed on the marl bar, were composed wholly of marl; but under other conditions leaves, roots, and twigs may enter into the composition of the nest to a greater or less extent, and I saw several nests in which sticks played as prominent a part as mud.

The 1902 marl bar nests, which were then, I am told by Mr. Matthews, four years old, had evidently been so washed and weathered that the measurements made of them give a misleading idea of the dimensions of the fresh nest.

In the latter, as the following measurements show, there is more variation in height than in diameter. Thus six nests selected to show the range of variation measured in situ:

Diameter at Base.	Diameter at Top.	Height.
457 mm. (18 in.)	305 mm. (12 in.)	127 mm. ( 5 in.)
508 " (20 in.)	305 " (12 in.)	294 " (11 in.)
508 " (20 in.)	330 " (13 in.)	330 " (13 in.)
508 " (20 in.)	356 " (14 in.)	294 " (11 in.)
508 " (20 in.)	356 " (14 in.)	229 " ( 9 in.)
584 " (23 in.)	330 " (13 in.)	294 " (11 in.)

The average depth of the concavity holding the egg was one inch. There was no nest lining.

Nests were frequently placed so near together that they touched each other, but the average space allotted to each nest is two square yards.

The necessity of building a nest of some height was well illustrated during my stay at the 1904 rookery. Continued heavy rains flooded even the comparatively high ground on which the nests were placed, when every nest became an islet and numbers were submerged. The nests were then water-soaked masses of mud, and I experienced much difficulty in removing entire specimens in this condition.

*The egg.* — Of the nearly 2000 occupied nests examined only two

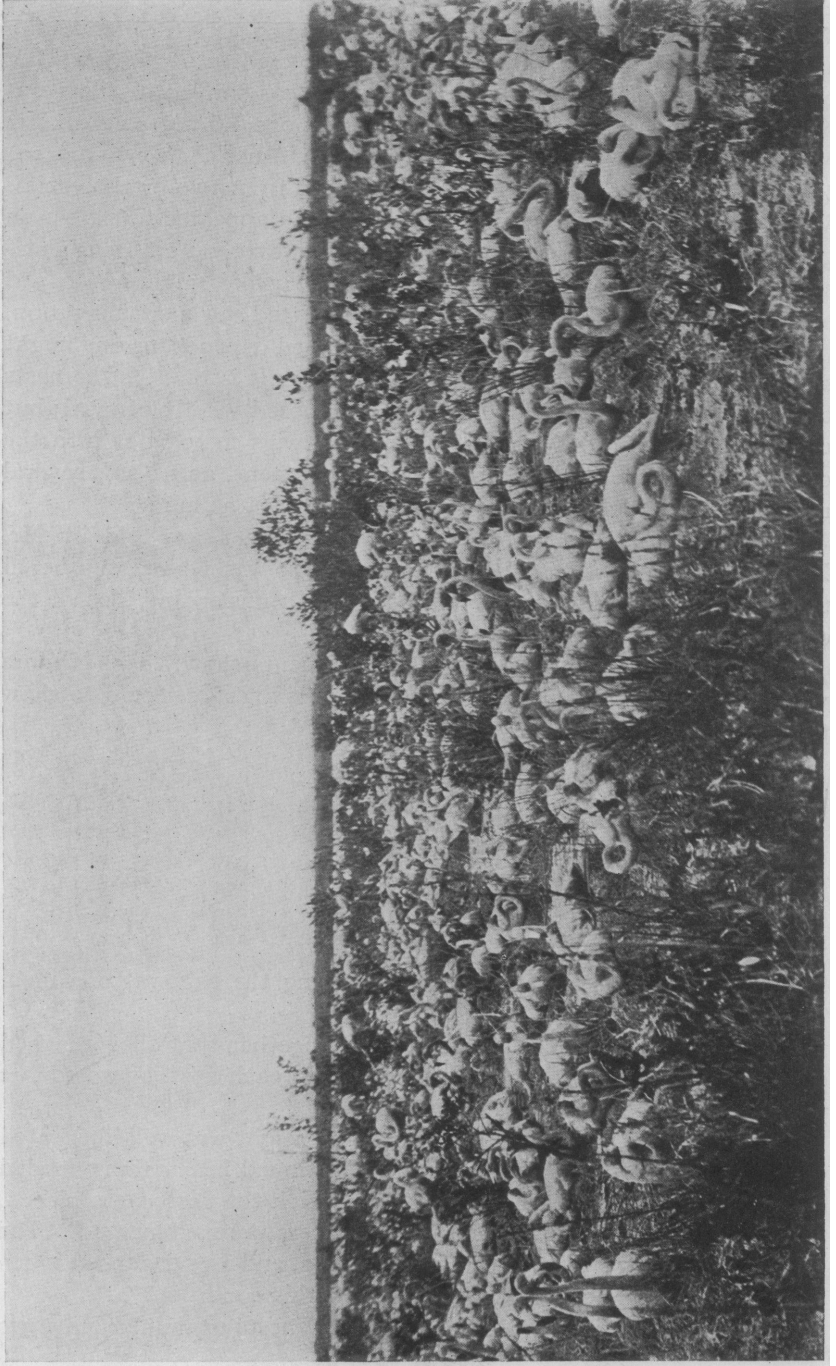


Fig. 4. Incubating and Sleeping.



contained two eggs, the remainder containing either one egg or one young each. The extreme rarity of two eggs in one nest induces the belief that in the instances noted they had possibly been laid by two birds.

Ten eggs measure (in millimeters) as follows: Average,  $90.2 \times 53.9$ ; shortest,  $82.4 \times 52.4$ ; narrowest,  $90.9 \times 49.3$ ; longest,  $97. \times 53.3$ ; widest,  $90 \times 58$ .

*Incubation.*—The period of incubation was not ascertained.



Fig. 5. Showing Pose of Incubating Bird. The birds in the background are 'sparring.'

Doubtless it approximates four weeks. Dissection showed that incubation is performed by both sexes. Only one of the pair, however, is present at the same time, my observations in this regard differing from those of Sir Henry Blake, who states (*l. c.*) that "the hens sat on the nests" while "the male birds had . . . all got together." The birds changed places early in the morning and late in the afternoon. They left or returned to the rookery singly or in flocks containing as many as fifty birds. The individual, therefore, which incubated or cared for the young during the day fed at night, while the one which had been feeding during the day passed the night in the rookery.

There was no relation between sex and the time of day occupied in parental duties, both sexes being represented during the day and hence, doubtless, during the night also.

As the egg pipped the parent bird was seen to stand over it and move it with the bill until the opening was uppermost, thus giving the hatching chick access to the air.

When incubating, as has been stated by Johnston, Chapman,



Fig. 6. Newly-hatched Chick.

Maynard, and Blake (*l. c.*), as well as when brooding, the bird sits upon the nest with the legs folded. In assuming this position, the bird first stands upon the nest with its toes on the rim, then drops forward, the toes remaining at about the same point, while the heel projects slightly beyond the tail, and the tarsus is visible for the entire length. The attitude is typically represented in Figure 5, page 61. In arising the bill is pressed into the side of the nest and for a moment thus forms a tripod with the legs.

*The young bird.*—The young Flamingo when hatched is sufficiently developed to leave the nest before it is dry, under the stimulus

of an apparently instinctive fear. At my approach young birds with the plumage still wet from the egg would crawl over the edge of the nest and fall to the ground or water below, when their strength seemed to fail them.

A few hours later, when the plumage was dry, chicks could swim and run readily, and when they were a day old they invariably left the nest as I drew near.

When not disturbed the young remain in the nest three or four days. During this time they are brooded by the parents.

Their food consists of a blackish liquid, doubtless the juices of partially digested *Cerithium*, which they receive from the parent's bill, a drop at a time, by regurgitation. The parent administers food while standing over the chick with lowered head and neck, or while brooding it, when the head of the young appears from beneath the parents' wing between the body and the humerus. Food was generally given in response to the young bird's open-mouthed appeal, and its administration was preceded by movements of the neck which evidently assisted the act of regurgitation.

While in the nest the young bird eats also the shell of the egg from which it was hatched. This soon becomes broken into small pieces which are readily picked up by the then straight-billed chick, doubtless with greater facility than its bent-billed parent could exhibit. This shell-eating habit appears to be invariable. Numerous chicks were seen exhibiting it, and egg-shells were found in the stomachs of the nearly twenty young examined. Possibly the development of this habit may be due to the limited nature of the parent's food, together with the fact that heavy rains may not only place the chick upon an islet but submerge available feeding areas. Consequently it is important that the food furnished by the parent be supplemented by a supply of bone-forming material which the chick finds in the nest.

The young bird evidently continues under the care of the parent after leaving the nest and, for a time at least, is still fed by regurgitation.

Young birds two days old, which jumped from their nests near my blind as I entered it, found their way home in response to the call of the parent and climbed back into the nest with the aid of bill, wings, and feet, without assistance from the parent.

When not guided by the parent, chicks which had left the nest prematurely and were attempting to return to it, apparently recognized neither their nest nor parent. They endeavored to climb up

the nearest nest on which an adult was sitting, but were not welcomed; threatening, sinuous gestures of the long neck being followed, should the chick persist, by a slight nip on the nape, when the lost young bird continued in its search for home.

When leaving the rookery I took with me a number of young Flamingos, eight or ten days old. Birds at this age were so wild they could not be satisfactorily studied, nor did these chicks ever cease to



Fig. 7. Newly-hatched Chick, which left the nest before the plumage had dried, under the impulse of fear.

show some signs of fear. On reaching Nassau they were placed in a small pen provided with a miniature pool.

The upper mandible had now begun to show some convexity of outline and this change in form was correlated with a change in the manner of feeding, which now resembled that of the parent. When hominy or rice was placed in their artificial pool the birds secured it by slightly pressing the upper mandible into the mud, with which it was then nearly parallel. This portion of the bill was then moved rapidly, and at each contact with the lower mandible (in position now

the upper), or, in other words, as the bill was closed, a little jet of water spurted from each side of it at the base. The action of the upper mandible, therefore, seems designed to force the mud and water through the strainers with which the sides of the bill are beset.

It was of much interest to observe that when the hominy or rice was too deeply imbedded in the mud of the pool to be readily secured in the manner described, the young birds 'danced' as do the adults under similar circumstances. That is, by a shuffling or treading motion of the feet, the food was floated or loosened so that it could be taken into the bill. The operation could be most satisfactorily observed by placing food in a flat-bottomed tin pan containing about two inches of water. It being impossible for the birds to press the bill into the bottom of this receptacle, on entering it they at once 'danced' and quickly caught the floating food. Since old birds did not often feed about the rookery it seems probable that the development of this method of feeding is instinctive.

These young birds often went through the motion of feeding one another, and this act was always accompanied by a rattling call uttered on no other occasion. The nature of the performance is illustrated in Figure 15, page 74. No food appeared to be administered at these times, and the habit may simply have expressed an instinctive desire for feeding by this method which, in the absence of the parent, may have been appeased by the attentions of a young bird. The fact that one bird would often have to beg its companion for some time to satisfy its wants before the apparently reluctant companion yielded, supports this suggestion.

Three of these young birds were brought to New York, arriving July 4, and were given comfortable quarters in the country where, however, they survived only about two weeks. In spite of the fact that they had now been in captivity nearly a month they still always attempted to escape when approached. It was exceedingly interesting to observe that when released on a lawn bordered by high, uncut grass, they not only made no attempt to conceal themselves in the cover the grass afforded, but could not be driven into the grass, where they seemed instinctively to know they would soon trip and be captured.

The notes of the young birds varied with age. When a few hours old their call suggested a puppy-like barking. This was soon followed by a squealing, whistling crow, which, in chorus, produced a shrill volume of sound plainly audible at our camp, a mile from the rookery, day and night, under favorable conditions of wind.

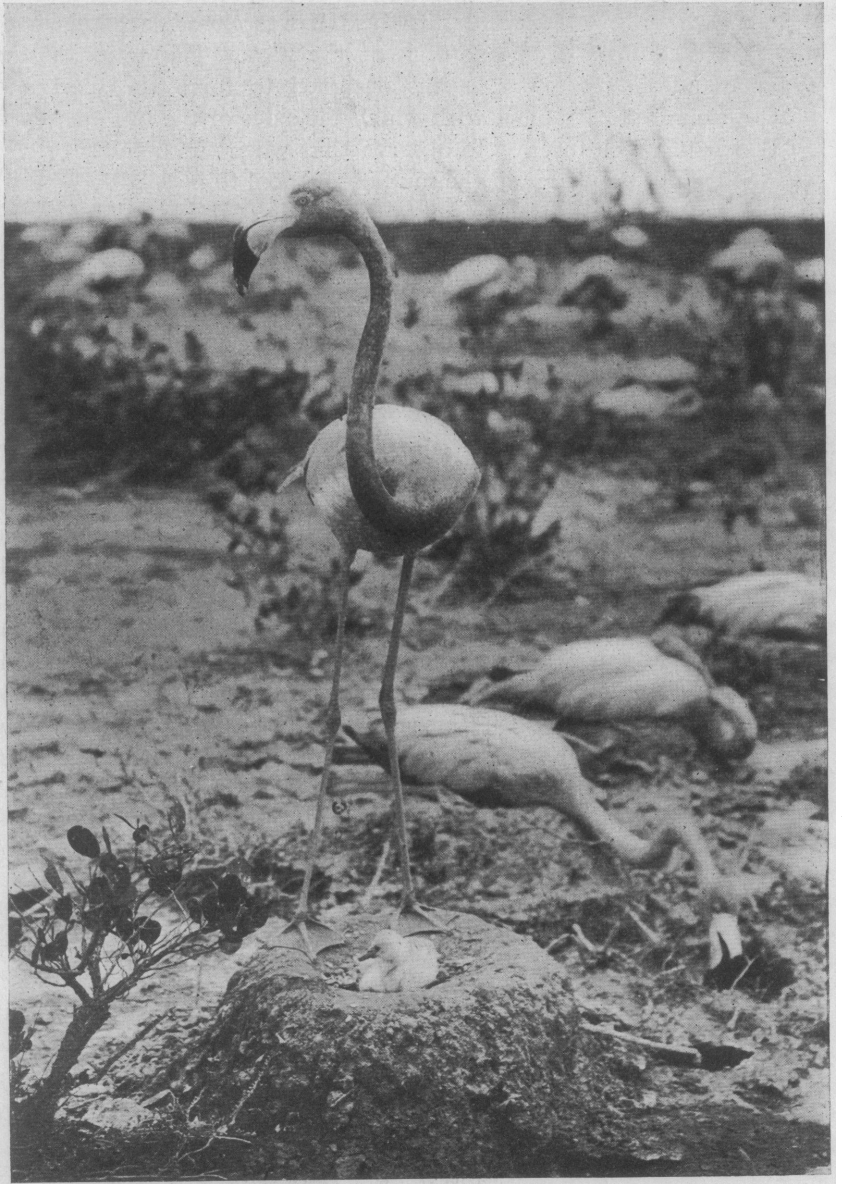


Fig. 8. Chick (about one day old) and Parent.

At the age of from ten days to six weeks or more the characteristic call is a chirruping crow, delivered in response to almost any stimulus. The birds also now uttered a long-drawn *c-a-a-r* and the rattling call mentioned above as an accompaniment to feeding.

*The adult.* — In leaving the rookery at my approach the adults all faced the wind and ran a step or two before springing into the air. When arising from the water they also patter a few steps over the surface before taking wing.

After taking refuge in the lagoon a return to the rookery was always preceded by a flight over it; then, after re-alighting in the lagoon, the rookery was entered on foot. At such times the birds all called their usual goose-like *huh-huh'-huh*, creating a deafening uproar. There was, however, no confusion, each bird going to its own nest with a certainty that implied definite recognition of its location.

Before the egg was hatched the birds seemed to sleep while incubating, and during my first days at the rookery the whole colony of birds was observed sleeping, and at such times not a note would be heard. With the appearance of the chick less time was devoted to sleep and the parents were much more noisy, often apparently calling to their chicks over which they stood, or leaned down to caress.

As might be imagined from the terms of intimacy on which, of necessity, they live while nesting, the birds did not appear to be pugnacious, their exhibitions of anger being confined to threatening movements of the head or a harmless grasping of bill by bill.

Wounded Flamingos, even when but slightly injured, make no attempt at self-defence, being, in this respect, wholly unlike Herons or Cranes, whose method of feeding doubtless prompts a vigorous use of the member which serves so well as a weapon when capturing their natural prey. The Flamingo's fare of shells and grubbing manner of feeding gives him no hint of the power which lies in his bill should he attempt to use it in defence.

The stomachs of all the adults examined contained only the remains of shells of the genus *Cerithium*, which are evidently swallowed entire and ground up in the stomach, the walls of which are exceedingly thick and muscular. The birds sometimes fed in water which reached to their bodies, and the treading or dancing motion, which has been well described by former writers,<sup>1</sup> was employed while the head was submerged.

I did not observe that either while feeding or when in the rookery the birds posted sentinels, as has been stated. The loud note of

<sup>1</sup> See especially Ingraham, *World's Congress on Ornithology*, 1896, pp. 59-69.



Fig. 9. Feeding by Regurgitation.



alarm seemed to come from any part of the rookery, and was immediately taken up and repeated by bird after bird. Should its cause increase the birds soon began to arise, and shortly every bird in the colony would be standing up. If the alarm proved to be unfounded they all dropped back on their nests, but if it was occasioned by a real or supposed source of danger the front or most windward birds took wing first and were followed by those behind them.

On returning to its nest from which the chick had been frightened the parent was observed to call evidently for its missing young. In one instance, although the young did not appear, the parent resumed its place, sitting on the empty nest.

The notes of the adults are varied in character. The commonest is the loud *huh-huh'-huh*, already mentioned, the second syllable of which is strongly accented. This call was given in a low, deep tone and in a higher one of less volume, a difference which I considered sexual, the louder voice being, presumably, that of the male. This was the alarm call, and indeed was heard whenever there was any commotion in the colony. Other calls were a deep nasal, resonant *honk, honk, honk, honk*, even more goose-like in tone than the first call mentioned, a hen-like, drawled *cah-cah-cah-cah*, and a broken *cut-leèk*.

*Mortality among Flamingos.* — Aside from man, Flamingos in the Bahamas appear to have few enemies. The absence of predaceous mammalia, the comparative scarcity of large reptiles and birds of prey, together with the abundance of food, make certain portions of these islands ideal resorts for these non-adaptive, defenceless birds.

The Turkey Buzzard was the only natural enemy of the Flamingo which I observed, and I did not actually see it in the act of eating Flamingo eggs or young. The penetrating chorus of *huh-huh'-huhs* which arose every time a Buzzard sailed over the rookery, the fact that in the Bahamas food for Buzzards is not apparently abundant, and the testimony of Mr. Matthews show that the Buzzards do feed upon Flamingos' eggs and even young birds.

My experience, however, leads me to believe that, aside from attacks by man, the heavy rains of the tropics are doubtless the chief cause of mortality among Flamingos. As has already been mentioned, the first occupied rookery discovered was completely wrecked by a deluge of rain; and even the nests on the ground, high enough to have escaped submergence during the first storm, eventually were flooded. All the nests in the second rookery were surrounded by water when I left, some were under water, and the continuance of the rain doubtless destroyed others. From May 17 to June 15, the rainfall,



Fig. 10. Brooding, and Feeding by Regurgitation.



Fig. 11. Chick Eating the Egg-shell.

as recorded by the resident justice of the island on which the birds nested, was 20.26 inches. The season, however, was exceptional, and it is probable that during many seasons the Flamingos do not suffer from climatic influences.

But at all times they are subject to attack from negroes, who are not only their worst enemy but the only enemy apparently threatening their continued existence in the Bahamas. With their usual improvidence, the negroes not only take the young birds but the eggs as well. Their especial aim is to visit the rookery in July when the young are about half-grown. Placing in brine all the birds which cannot be disposed of while fresh, there is no limit to their demands.

On the island of Abaco the diminution in the numbers of this species appears to have been especially marked. The colony observed by Governor Blake on this island, in 1886,<sup>1</sup> was said by him to contain seven hundred to one thousand birds, but Bonhote, writing in 1903,<sup>2</sup> states that he "could not ascertain for certain" whether the Flamingo still existed on Abaco, and G. M. Allen, who visited the island in 1904, found only one flock of fifty-four birds.<sup>3</sup> The last-named writer states that the species is "subject to constant persecution by the natives." It is apparent, therefore, that unless some measure be taken to protect Flamingos during the nesting season they will continue rapidly to decrease in the Bahamas.<sup>4</sup>

#### REMARKS ON SPECIMENS.

*First downy or natal plumage.* — Lacking material for a comparative study of the pterylosis and feather structure of the Flamingo, I present here only a description of its plumages.

At birth the Flamingo is thickly covered with down which, when released from its waterproof sheaths, is thickly and uniformly distributed over the body. The lores and orbital region are bare, and only the upper half of the tibia is feathered. In general this down is snowy white, with a tinge of bluish gray upon the back and crown. The latter color is variable, sometimes, though rarely, being virtually absent; at others being so strongly developed as to become well-pronounced slaty-gray. (See specimen No. 1, Fig. 16.)

*Second downy or post-natal plumage.* — This plumage is represented

<sup>1</sup> Nineteenth Century, 1887, pp. 886-890; Ibis, 1888, p. 151.

<sup>2</sup> Ibis, 1903, p. 310.

<sup>3</sup> The Auk, 1904, p. 121.

<sup>4</sup> Since the above was written I am glad to be able to add that a law establishing a close season on Flamingos, from April 1 to October 1, has been passed by the Bahaman Assembly. While this law, from the nature of the case, will be difficult of enforcement it should at least prevent the wholesale destruction and open sale of young Flamingos which has heretofore prevailed.

by specimens taken alive which died in captivity. The wear of cage-life and the lack of proper nourishment have both acted, doubtless, to prevent the development of this plumage in a wholly typical manner; nevertheless the conclusions drawn from a study of these specimens are probably reasonably accurate.

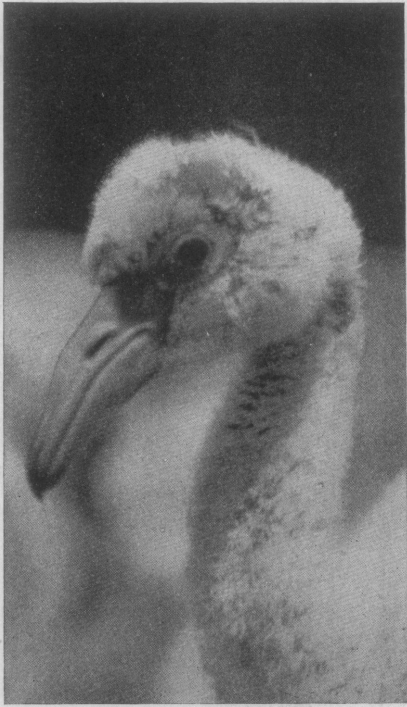


Fig. 12. Head of a Flamingo about two weeks old, showing the beginning of the curve in the mandible.

This second downy plumage is shown by chicks about one month old which had been in captivity nearly three weeks. In general color it is uniform ash gray. Examination shows that this second down succeeds the first by continuous growth; that is, for a time the first or white down appears at the tip of the second or gray down, a constriction at the base of the former and tip of the latter marking the point of attachment.

Material is lacking to show the significance of this second downy plumage or its bearings on the relationships of the Flamingo. An apparently similar plumage is shown by young Swans, but I have not a sufficient number of specimens to warrant the treatment of this question at present. (See specimen No. 2, Fig. 16.)

*Third or juvenal plumage.* — The Flamingo's third plumage, like the second, is evidently acquired by a continuous growth of the shaft which supports both the first and second plumages. As before, therefore, a vanishing plumage appears for a time on the tip of the feather which is pushing it outward. The point of attachment, however, between the base of the second plumage and the tip of the third is marked by a constriction such as exists between the first and second plumages, only when it emerges from its papilla. The constricting sheath quickly disappears and the gray down of the second plumage then appears as a marginal fringe bordering the entire terminal portion of the growing feathers of the third plumage.

This plumage consists of fully formed feathers. It first appears



Fig. 13. Young at the age of about two weeks, feeding after the manner of the adult.

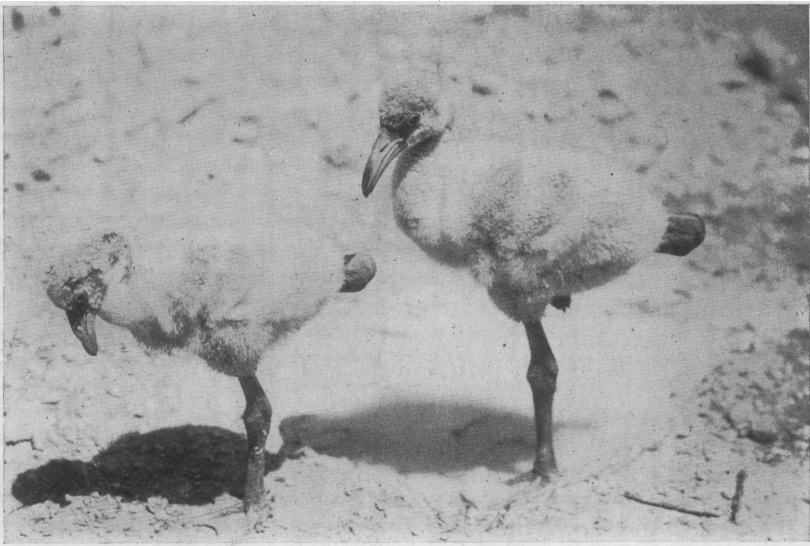


Fig. 14. Young at the age of about two weeks, in the pose of the adult.

upon the *pteryla humeralis*, and a little later is seen upon the anterior lateral branch of the *pteryla ventralis*. Judging from specimens which were brought from the Bahamas to the New York Zoölogical Society, and which on dying there about August 1 were presented to the Museum, and from living specimens brought home by myself, this plumage begins to appear at about the age of five weeks. When fully developed, as it is in a specimen (No. 11392) from Cuba, which died in the Central Park Menagerie, New York City, September 28, 1896, the general color is grayish brown with a tinge of pink upon the

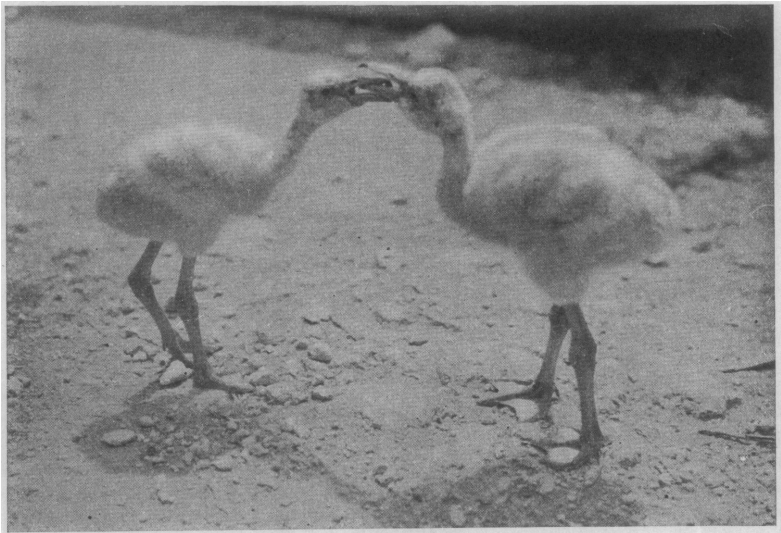


Fig. 15. Young Flamingos feeding each other.

underparts and wings. The feathers of the back have well-marked black shaft-streaks; the tail is pale pinkish white, externally edged with blackish; the primaries are black, the secondaries black internally margined with white except at the tip; the primary coverts are all pinkish, blackish at the tip and on the inner vane; the lesser, median, and greater coverts are generally pinkish basally, blackish at the tip; the axillars are pink; the abdomen is pinkish washed with brown. (See specimen No. 4, Fig. 16.)

*Adult plumage.* — The time of assumption of the adult plumage appears not to be known. On May 20, 1904, I saw a bird apparently in the third plumage just described; but with this exception all the Flamingos seen by me prior to June 1 were in adult plumage. I am led,

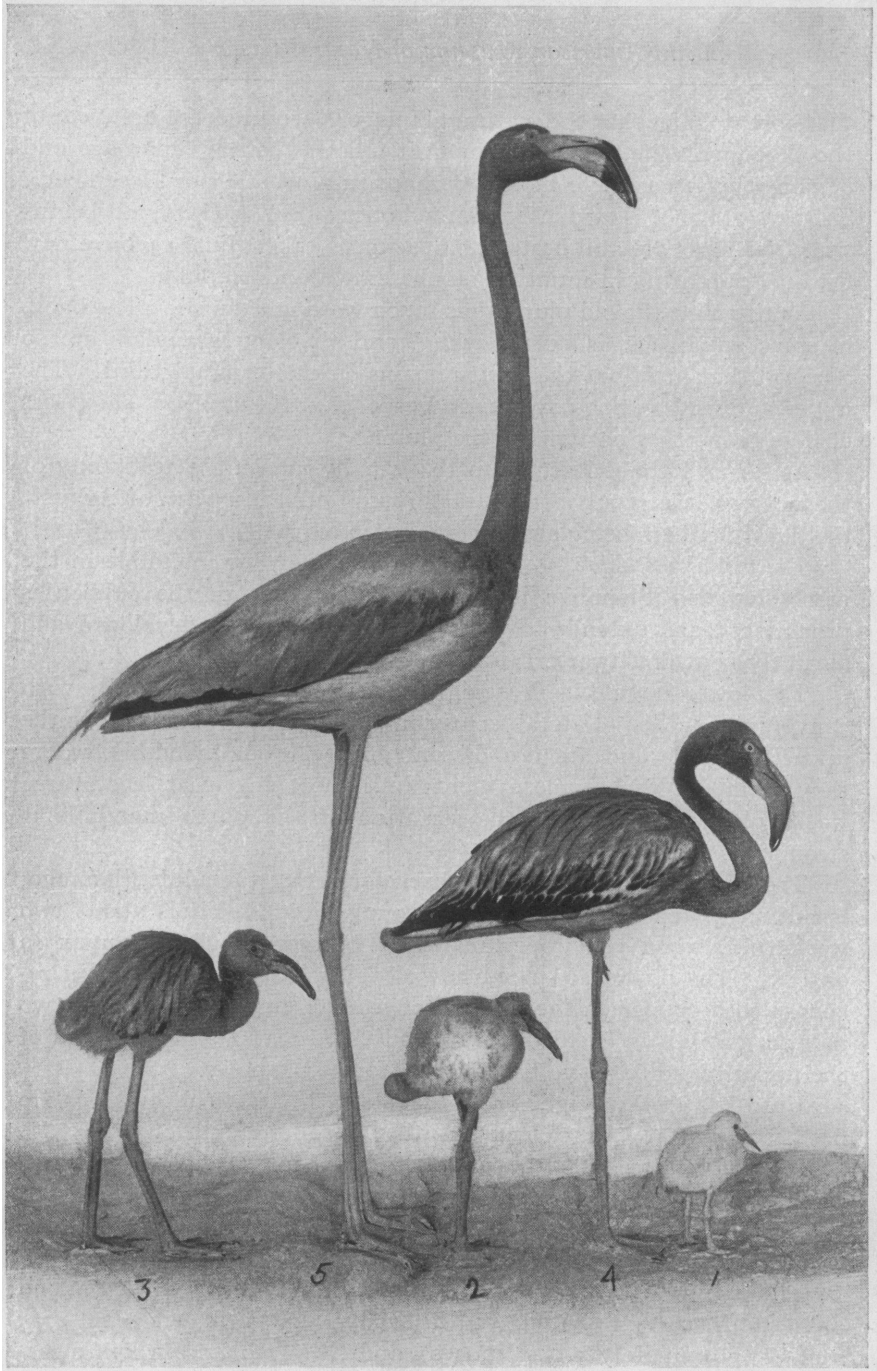


Fig. 16. The Growth of Flamingos. The approximate ages of the birds shown in the accompanying plate are: (1) One day; (2) one month; (3) two months; (4) four months; (5) adult. From mounted specimens in the American Museum of Natural History.

therefore, to infer that the mature plumage is acquired the first year of the Flamingo's life. In my opinion it follows the third plumage and is gained by a complete moult, perhaps in November or December.

Once grown it is evidently moulted once a year. The moult begins while the birds are still nesting. Specimens taken June 13 have new feathers appearing in numbers on the crown and scapulars.

At this time the old plumage is much worn and faded. The back, in some specimens, is nearly white, and the long scapulars are so abraded that little but the shaft remains on the terminal third. The upper and under wing-coverts, and especially the axillars, show less change than other portions of the plumage.

As far as I could learn from the usually inaccurate testimony of the negroes, the moult continues through July and part of August; the flight feathers being shed in the latter month.

*The bill of the chick.* — The outline of the upper mandible in the newly hatched Flamingo is straight. The ridge of the culmen is pronounced and extends to the unguis, which is well developed and abruptly bent downward, making a decided hook.

The lower mandible is straight, the tip, as in the adult, with converging sulcæ. Lateral serrations are barely evident on the upper mandible and are not present on the lower mandible, where they seem not to become evident until the chick is at least three weeks old; at which age the serration of the upper mandible is strongly marked.

The curvature of the bill, so characteristic of the adult Flamingo, is not suggested in the bill of the young bird until it is about two weeks old, when the upper mandible becomes slightly convex in outline. The downward bend now develops rapidly, perhaps in response to a change in the manner of feeding, and at the age of two months the bill is decidedly bent and the serrations of the sides of the upper mandible have become well-formed lamellæ.

Until the chick is eight or ten days old the bill, feet, and legs are flesh color; at the end of this time they become plumbeous.

*Measurements.* — The appended table of measurements of adult, immature, and embryonic specimens reveals several facts of interest. While there is a decided average sexual difference in size, a large female evidently may attain the size of a small male.

The extremes in total length, from the tip of the toes to the end of the bill, are represented by No. 87009, ♂, which measured 1727 mm. (approximately 5 ft. 8 inches), and No. 87104, ♀, which measured 1321 mm. (approximately 4 feet 4 inches).



Comparison of the measurements of embryos and immature birds with those of adults shows a surprising increase in the length of the tarsus, which, in the embryo, is but little longer than the middle toe and claw, and about one-tenth the total length of the bird; while in the adult it is nearly three times the length of the middle toe and claw and approximately one-fifth the total length of the bird. This striking difference in proportions suggests the inference that the Flamingo is descended from a short-legged ancestor, which the embryo and young of existing species also leads us to believe doubtless possessed a straight bill. Possibly the legs as well as the bill have developed in response to the demands of methods of feeding imposed by the limited character of the bird's food. This theory, however, is advanced with hesitation and may be invalidated by discoveries in relation to the food and feeding habits of other species of this family.

Mus. No.	Sex and age.	Total length from tip of bill to end of toes.	Tarsus.	Middle toe and claw.	Chord of Culmen.	Wing.	Tail.	Ratio of tarsus to total length.	Ratio of middle toe to tarsus.
87001	♂ ad.	1626	321	90	128	425	163	19	28
87007	♂ "	1651	328	89.5	129.5	405	164	19	27
87008	♂ "	1676	333	89	121	401	156	20	27
87009	♂ "	1727	343	89	130	408	151	19	26
87010	♂ "	1676	332	89	121	416	150	19	27
87013	♀ "	1549	298	78	129	398	144	19	27
87014	♀ "	1321	251	74	113	370	145	19	29
87015	♀ "	1600	320	87	128	408	149	20	27
87016	♀ "	1499	280	78	116.5	382	140	19	28
87032	Juv.	689	100	64	—	—	—	14	64
87033	"	490	73	58	—	—	—	17	79
87034	"	355	54	45	—	—	—	15	83
87035	"	325	35	30	—	—	—	10	85
87036	"	290	32	24	—	—	—	11	75
87037	"	300	30	22.5	—	—	—	10	75
87038	"	280	29	21	—	—	—	10	73
87070	Embryo.	137	14.5	11.5	—	—	—	10	79
87071	"	110	11	9	—	—	—	10	82
87072	"	91	9	6.7	—	—	—	10	74
87073	"	47	4.5	3.9	—	—	—	9	87

