NESTLING DEVELOPMENT OF BOAT-BILLED HERONS (*COCHLEARIUS COCHLEARIUS*) AT SAN BLAS, NAYARIT, MEXICO

CARLOS JUAREZ L. AND ROBERT W. DICKERMAN

ALTHOUGH the Boat-billed Heron (*Cochlearius cochlearius*) is a widespread species in the New World tropics from Mexico south to Peru and southern Brazil, and is widely maintained and recently bred as a zoo bird (Bell, 1966), little has been written on its sub-definitive plumages and to date few data are available on its nestling development. A study of the nesting biology of the Boat-billed Heron has recently been published (Dickerman and Juarez, 1971). This report on the growth of the nestlings is the second part of that study.

METHODS

The field work was carried out from August to October 1964, the period of nesting activity in the large colony of mixed heron species, 3 kilometers NNE of San Blas, Nayarit (Dickerman and Gavino, 1969; Dickerman and Juarez, 1971). The field work was largely carried out by Juarez, and provided in part the basis of his professional thesis submitted to the Facultad de Ciencias of the Universidad Nacional Autonoma de Mexico (Juarez, 1967). The junior author provided the outline for the project and translated and amplified the manuscript.

Nesting was well underway when the study was initiated on 19 August. At that time 31 nests contained 65 eggs and one newly-hatched chick (Dickerman and Juarez, 1971). All nests and eggs then present were marked. On subsequent daily visits to the colony new nests and eggs were labeled and as chicks hatched they were color coded with a dab of paint. When the young were large enough (usually about 15 to 19 days), they were banded with leg bands provided by the U.S. Fish and Wildlife Service. Each day all new eggs, and as many young as time permitted, were weighed and measured.

Measurements taken were: weight in grams, and the lengths in millimeters of the 3rd and 8th primaries, the tarsus, the upper mandible from the tear duct and from the anterior edge of the nostril, and the width of the upper mandible at the base (Fig. 1). Measurements for the upper mandible from the tear duct and of the third primary were modeled after the study by McClure et al. (1959). The vane and sheath of the 3rd and 8th primaries were measured because of the doubt as to which feather McClure et al. referred to as the 3rd primary. Later W. F. Scherer, one of the co-authors, informed us (pers. comm.) that in the Japanese study they measured the third large primary from the outside (i.e., 8th primary). Measurements were taken with vernier calipers reading to a tenth of a millimeter. Weights of small young were taken with an Ohaus triple-beam balance. Young of a few days and older were weighed in a plastic bag on an Ohaus spring scale read to the nearest gram.

The subspecies of Boat-billed Heron nesting at San Blas, Nayarit, is *Cochlearius cochlearius zeledoni* (type locality Mazatlan, Sinaloa). As in other New World species of the family Ardeidae, there is only a minor degree of sexual dimorphism in wing and tail measurements (1–3 per cent) within populations of the Boat-billed Heron. However

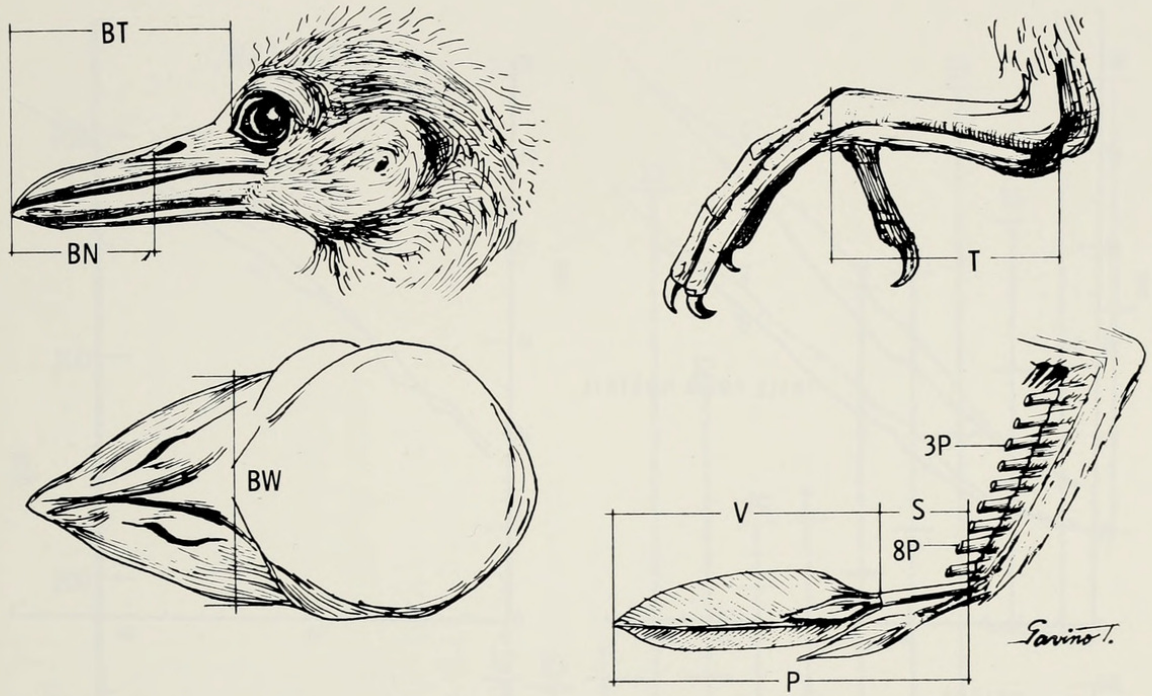

FIG. 1. Method of measuring nestling Boat-billed Herons. BT = culmen from tear duct; BN = culmen from anterior edge of nostril; BW = width of bill; T = tarsus; P = primary (third and eighth); V = vane and S = sheath.

measurements of the tarsus and the exposed culmen vary about 8 per cent between the sexes, with males slightly larger (Table 1). Still, sexual dimorphism in size, even of tarsal and culmen measurements, did not constitute a significant variable in making field measurements of the young. This is supported further by the nearly parallel growth curves for male and female nest mates (Fig. 2).

Carpenter (1971) presented measurements of randomly selected nestlings and older birds raised in the New York Zoological Park and measurements of "mounted specimens" from the collection of the American Museum of Natural History. Because the zoo colony included birds from both Central America and South America, and because the subspecies of the "mounted specimens" measured was not given, comparisons are not made with that study.

TABLE 1

MEASUREMENTS OF ADULT BOAT-BILLED HERONS FROM THE PACIFIC COASTAL LOWLANDS OF MEXICO FROM SINALOA SOUTH TO OAXACA

	Males				Females			
	No.	Range	Mean	SD	No.	Range	Mean	SD
Wing (chord)	16	259–280	269.3	5.4	11	258–273	264.5	4.2
Tail	15	102–110	106.5	2.2	11	100–111	104.6	3.8
Tarsus	16	71–83	79.4	3.0	11	73–78	75.4	1.8
Exposed culmen	16	78–88	83.7	2.8	11	74–82	78.2	2.2

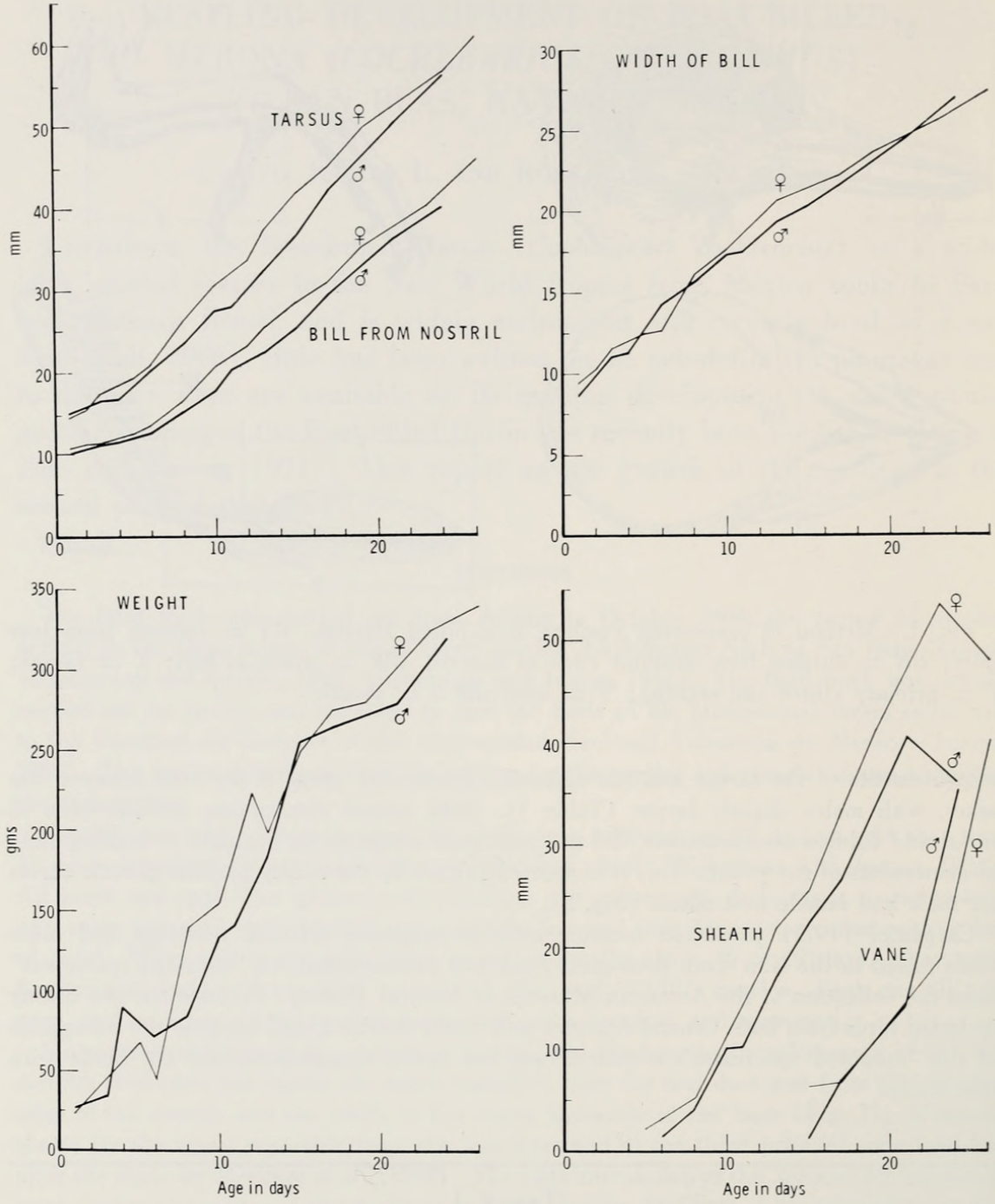

FIG. 2. Growth rates of two Boat-billed Heron nest mates at San Blas, Nayarit. August–September 1964.

NESTLING DEVELOPMENT

Weight.—Gross weights as taken in the field (Fig. 3) were far more variable than were those for young Green Herons (*Butorides virescens*) in the same habitat (Gavino and Dickerman, 1972). Boat-billed young, like those of Black-crowned Night Herons (*Nycticorax nycticorax*), were especially prone

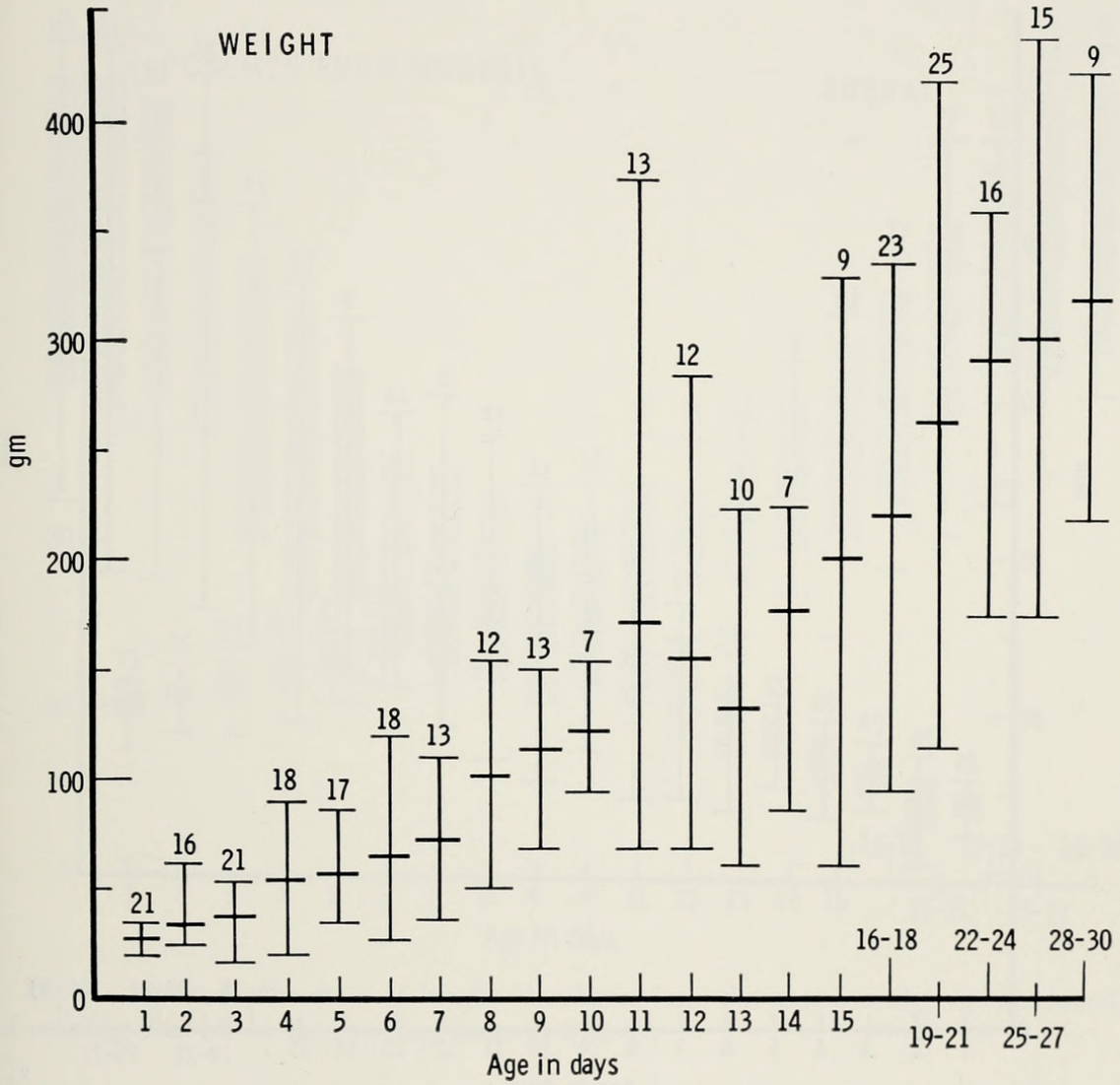

FIG. 3. Daily weights of nestling Boat-billed Herons at San Blas, Nayarit, with range, mean, and number of young in sample.

to regurgitate their food. However it was not always feasible or possible to stimulate regurgitation uniformly. Thus weights for an individual bird might increase (or decrease) by as much as 50 per cent over two consecutive days, due largely to the volume of food in the bird's stomach. Nestlings 20 days of age regurgitated 90–100 g of food, over 30 per cent of the weight of an average nestling at that age.

Secondly, due to the initiation of incubation with the laying of the second egg, hatching was similarly spread out over a several-day period (Dickerman and Juarez, 1971). Thus, for example, young no. 3 in nest 10, weighing 31.8 when two days old, had to compete on the same date with a sibling 7 days old that weighed 110.0 grams! In nest 33 one chick was two days younger than the other. When 10 and 11 days of age respectively, they weighed 110

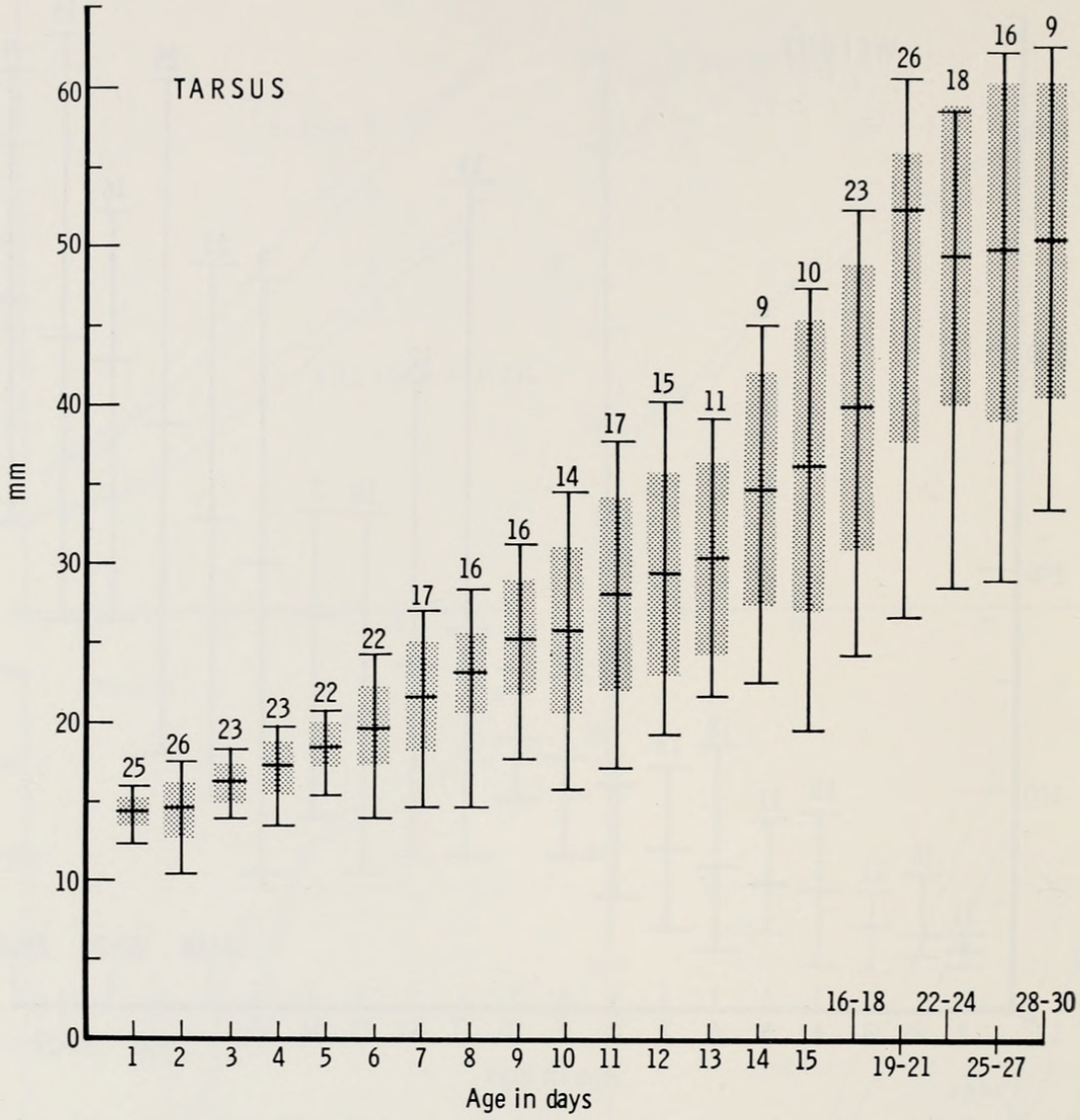

FIG. 4. Daily measurement of length of the tarsus of nestling Boat-billed Herons at San Blas, Nayarit, with range, mean, one standard deviation (gray bar) on either side of the mean, and number of young in sample.

grams and 203 grams; yet at age 25 days they weighed 325 and 260 grams, respectively.

A third cause of low weight gain was poor attendance by the parent bird. In nest 12, three eggs hatched but two young had disappeared by the time the last chick to hatch was 4 days old. Even this single young was apparently poorly fed, for on Figure 3 it represents the minimal weight figure for days 9, 14, 20, and 30! In other nests with two or three young, all developed a pace with at times exceedingly little variation (see Fig. 2 for development of two siblings in nest 6). Because of the great extent of variations in weights, they are of little value as age criteria. Some young 6 days old equaled or

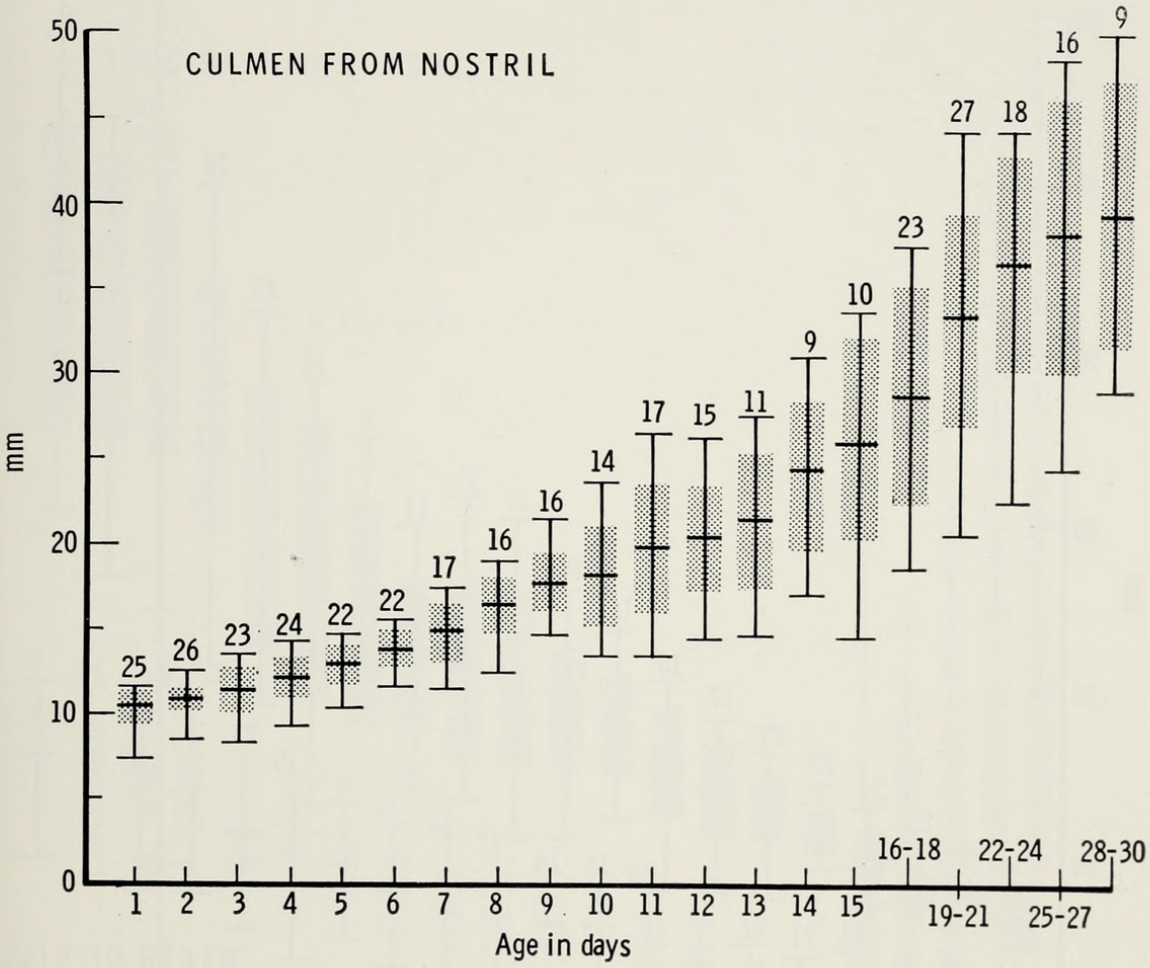

FIG. 5. Daily measurement of length of culmen, from the anterior edge of the nostril, of nestling Boat-billed Herons (key same as Fig. 4).

exceeded in weight other young 19–21 days of age. Conversely, some young 28–30 days of age weighed no more than other young 11 days old.

Gross (1923) in his detailed study of the Black-crowned Night Heron did not mention great disparity in weights among young of the same age. Unfortunately McClure et al. (1959) did not record weights of their large series of aged young Black-crowned Night Herons; and Wolford and Boag (1971) only plotted mean values in their growth curve for weight without giving ranges or sample sizes.

Growth in bony structures.—Growth rates of bony structures that were measured (length of tarsus, length of bill from anterior edge of nostril and width at base and from tear duct) for some individual birds were exceedingly uniform (Fig. 2). However, the measurements of these structures for the population studied showed a moderate to great amount of variation, in part because of the variation in nutrition mentioned above (Figs. 4–6). A running average of the mean values shows that the tarsus grew from 1.0

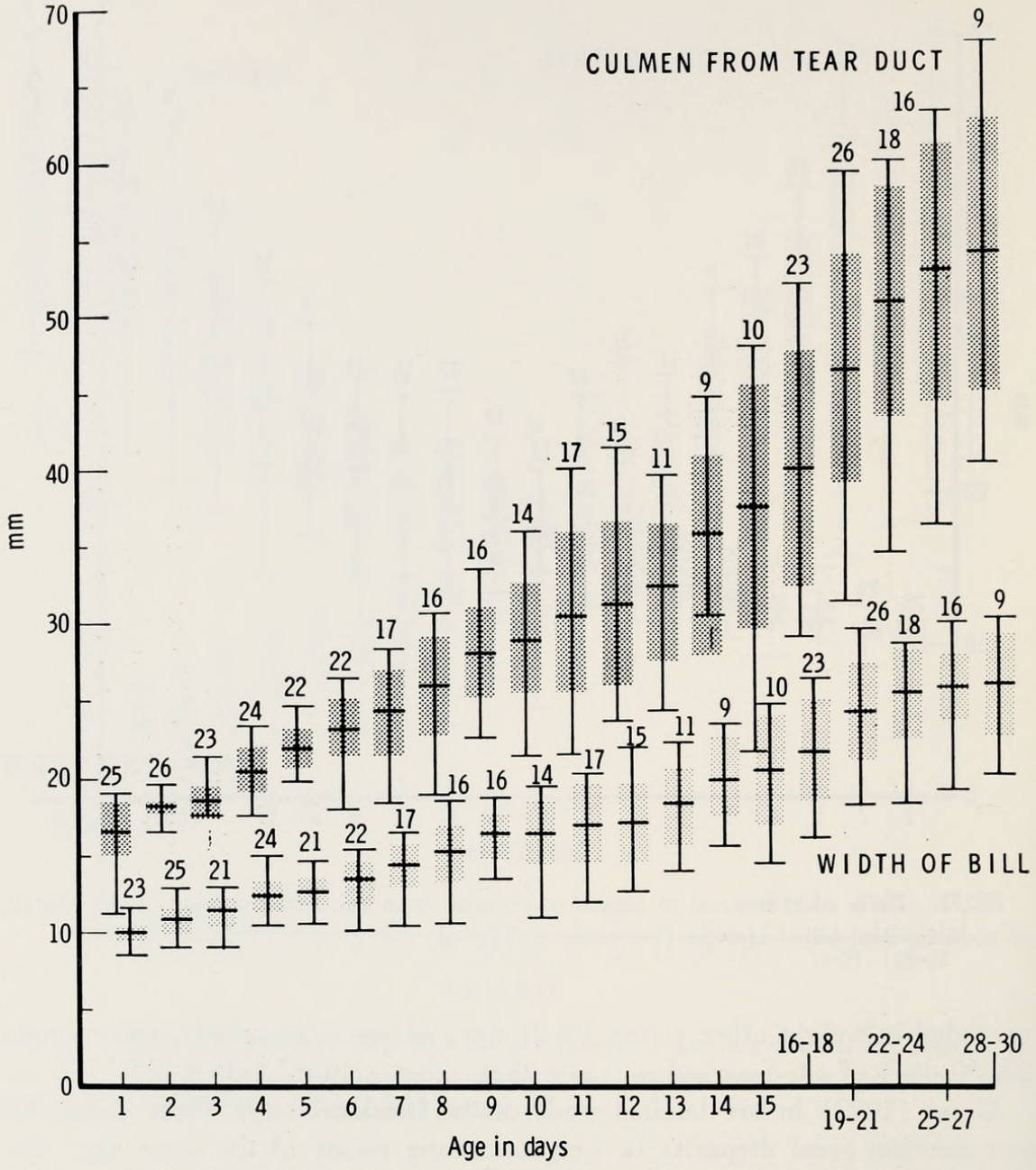

FIG. 6. Daily measurement of length of the culmen from the tear duct and the width of the bill at the base of nestling Boat-billed Herons (key same as Fig. 4).

to 2.9 mm per day to age 18 days. Between day 18 and day 30 the rate stabilized at about 1 mm per day. In contrast, the bill measurements show a slightly increased growth rate after day 14–15, averaging less than 1.5 mm per day before then and over 2.0 per day after that age. The growth rate of the width of the bill was uniform throughout the time studied. Measurements for these structures in the oldest young measured fall considerably below the minimal measurements of comparable measurements for adults (Table 1). This, in the case of the tarsal measurements, is in contrast to the Green Heron,

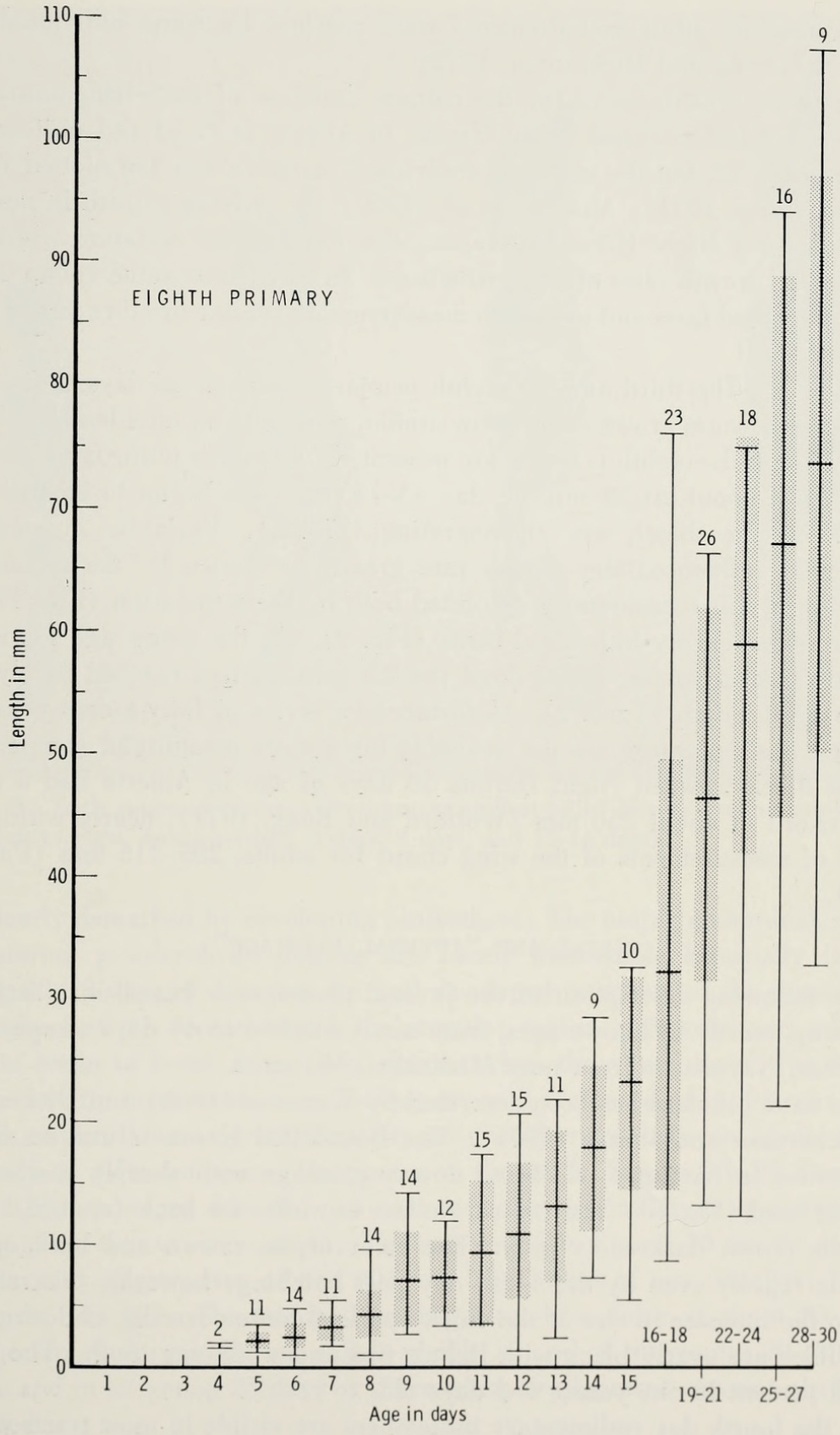

FIG. 7. Daily measurement of length of the eighth primary of nestling Boat-billed Herons (key same as Fig. 4).

where minimal adult measurements were reached by some individuals by day 17 (Gavino and Dickerman, 1972).

The mean growth curve for the culmen (method of measuring unstated) of nestling Black-crowned Night Herons in Alberta is rapid and uniform up to about day 22, but the extent of individual variation was not plotted (Wolford and Boag, 1971). McClure et al. (1959), in studying growth in nestling Black-crowned Night Herons in Japan, also found great variation within an age class in growth rates of bony structures. In their study some young 21–22 days of age had tarsi and mandible measurements similar to other young only 9–10 days old.

Remiges.—The third and the eighth primaries erupted on days 4–6, rarely on day 3. Because growth rates were similar, only data on total length (sheath plus vane) of the eighth primary are presented. When the pinfeathers reached a length of about 20–22 mm on day 13–14, the vane began to emerge. By day 20–21 the sheath was disintegrating (Fig. 2). Variation in nutrition apparently influenced the growth rate greatly as shown by the amount of variation in this measurement exhibited both by the population (Fig. 7) and to a lesser extent by individual birds (Fig. 9). At the oldest age for which we have measurements, 28–30 days, the 8th primary had reached barely half of the adult length (Table 1). Unfortunately, series of fully-grown young in the first basic plumage are not available for a more meaningful comparison. Young Black-crowned Night Herons 30 days of age in Alberta had a mean wing chord of about 250 mm (Wolford and Boag, 1971), nearly within the range of measurements of the wing chord for adults, 285–315 mm (Palmer, 1962).

NATAL AND "JUVENAL PLUMAGE"

The following description of the juvenal plumages is based on a series of 24 young, mostly of known ages, from newly-hatched to 40 days of age, from San Blas, Nayarit or from near Minatitlan, Veracruz.

The natal plumage has been described by Wetmore (1965) and Dickerman, in Dickerman and Juarez (1971). The Boat-billed Heron is unique among the herons in having a tricolored downy plumage with sharply marked bicolored head (Fig. 8). The ventral surface is white, the back (neutral) gray, and the crown dark sooty gray. The color of the crown and back appear to fade rapidly even by the 4–6th day post hatching; however, this may be due to the increase in size of the chick and less dense covering of down. The mandibles are nearly black with lighter tips and white egg tooth. The latter is still present in one young 4–6 days old.

By the fourth day rudimentary pinfeathers are visible in most tracts except in the ventral. The sheaths of the primaries begin to emerge on the 4th day, and by the 8th day all tracts except the caudal anal and powder-down tracts

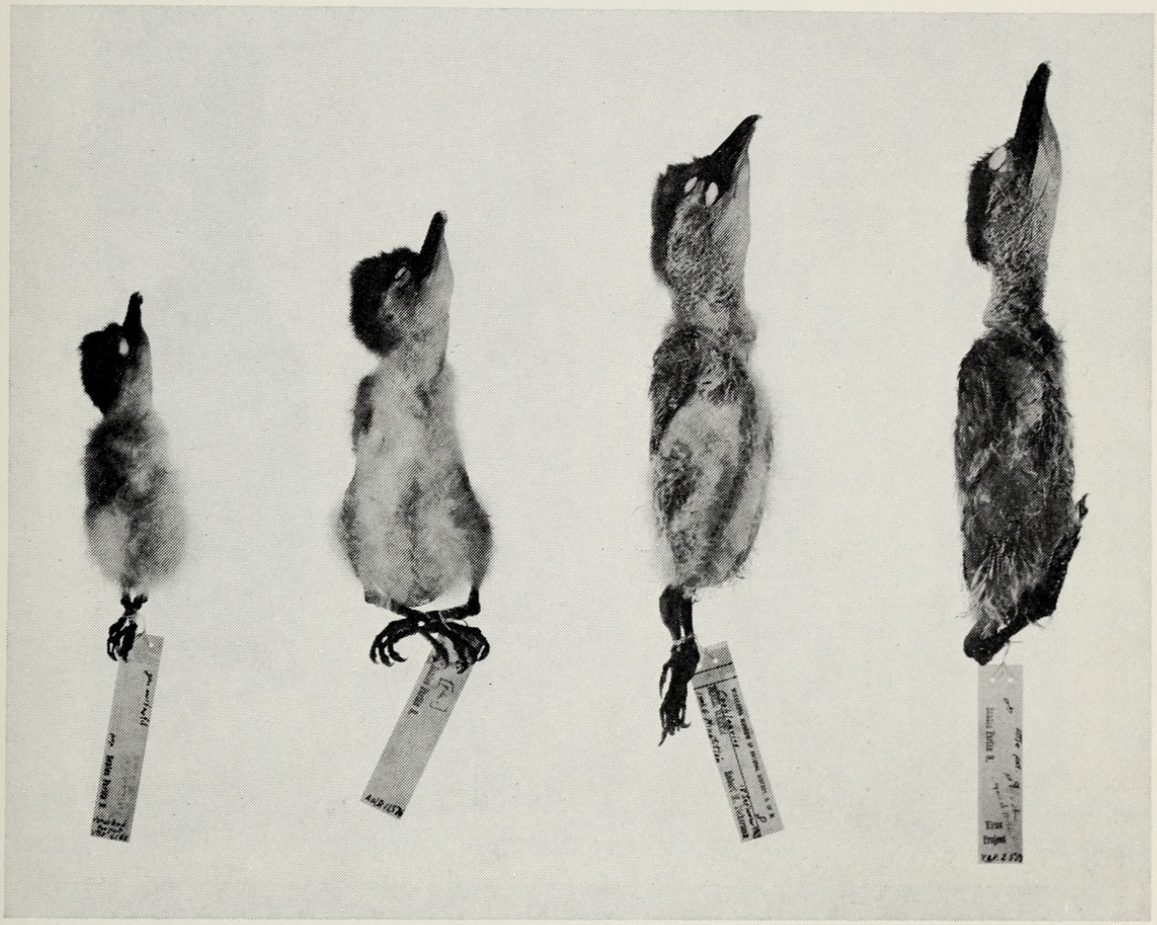

FIG. 8. Early stages of plumage development of Boat-billed Herons (representing ages, from left to right, newly-hatched, 4 days, 8 days, and 13–14 days).

are clearly demarked by developing pinfeathers. The major abdominal, rump, and sternal powder-down patches are barely discernible externally in two young 20–23 days of age, but are well developed in others of the same age.

Feathers of the ventral tracts, the scapular region, primaries and primary coverts begin to break from their sheaths when the young reach two weeks of age and by three weeks some young are well feathered (Fig. 9). As mentioned earlier there is great disparity in growth rates between birds of the same age in different nests. The young on the left in Figure 9 is 23 days old, only 2 days younger than the one next to it, but is similar in appearance to young about two weeks younger. The two young in Figure 10 are 30 days of age (larger; oldest young of nest 30) and 32–35 days of age (smaller; fourth young in nest 12). The tail feathers begin to show color at about 25 days. The pecten of the middle toe nail is visible in one of the young 20–23 days of age and in all young 25 days or older when development was not obviously retarded.

The following description of the juvenal plumage is based on one young 52 days of age (right-hand bird, Fig. 9) and two birds 40 days of age. The

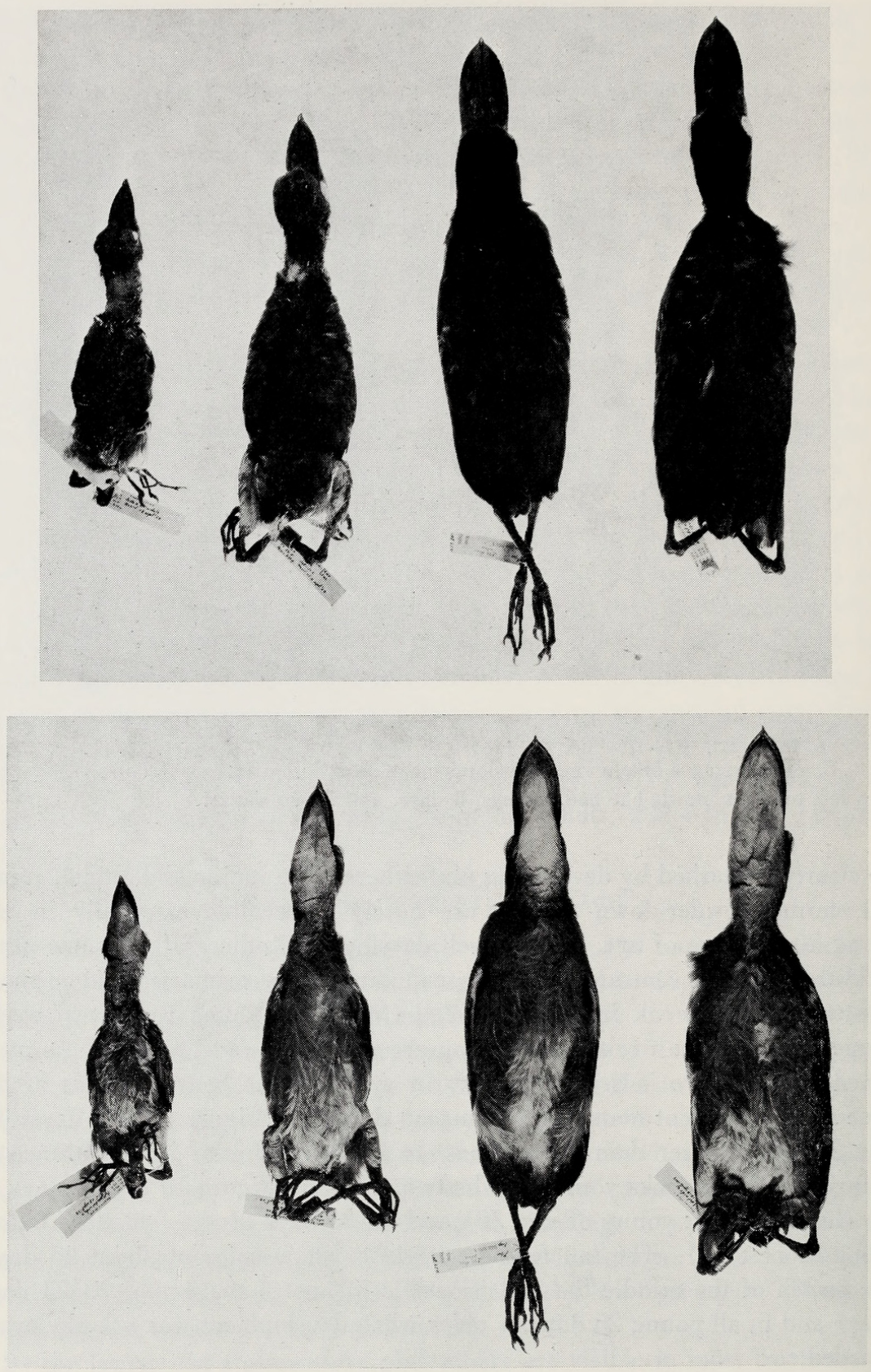

FIG. 9. Dorsal and ventral views of plumage development of Boat-billed Herons (representing ages from left to right, 23 days, 25 days, 30 days, and 32 days).

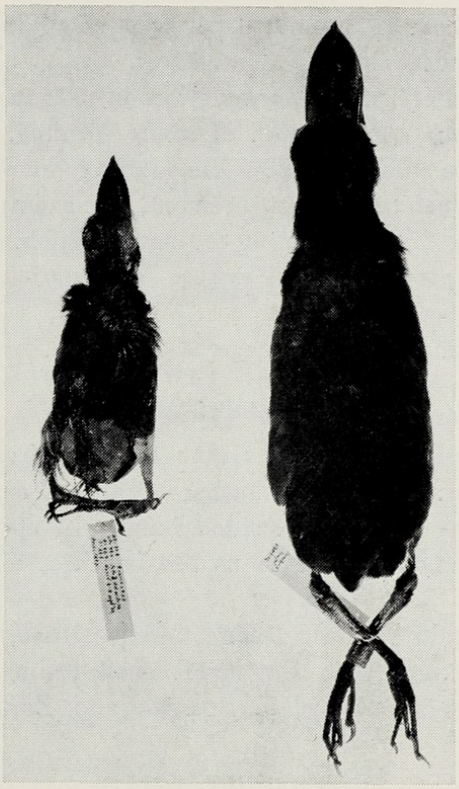

FIG. 10. Young Boat-billed Herons 30 days of age (larger) and 32–35 days of age (smaller) demonstrating disparity in growth rates occasionally observed among nestlings.

forehead, malar area, auriculars and sides are rich medium brown, darker in the subloral area. The crown is black, with the feathers of the nape elongated to 45 mm. The interscapular area and the lesser and middle wing coverts are rich brown, with some individuals showing a vinaceous cast. Remiges, rectrices, and rump area medium gray. The greater wing coverts are medium gray, edged with the brown of the interscapular area. The outermost primary and the feathers of the alula are paler than the other remiges and are tipped and edged with buff. All remiges and rectrices are still sheathed at 52 days.

Ventrally the overall appearance is pale grayish brown to buffy brown, paling to whitish on the belly. The breast is nearly uniform but feathers may be lightly mottled or, especially medially, tipped with dusky gray. The flank feathers are weakly streaked. They have a medial white area, varying in width between individuals from 1.5 to 3.5 mm, that is bordered by medium gray streaks; and the feathers are edged with buffy brown.

SUMMARY

Nestling development of the Boat-billed Heron was studied at San Blas, Nayarit, Mexico August–October 1964. Daily measurements were made on marked young, including weight and length of culmen from nostril and from the tear duct, width of the bill at base, tarsus and primaries 3 and 8. Sexual dimorphism is minimal in all measurements, except length

of the tarsus and culmen where it is about 8 per cent in adults, but did not constitute a significant variable in the measurements of nestlings.

Weights of nestlings were exceedingly variable due in part to prolonged hatching period within clutch and to irregular regurgitation of food. Minimal adult measurements were not obtained by any structure studied by 28–30 days of age at which time the young could no longer be caught. Maximal tarsus measurement, for example, was 63 mm compared to minimal length of 71 for 27 adults from the same region. Variations within an age group were so great that measurements of even a combination of structure would be of little use in determining age of nestlings.

The development of the final basic plumage is described.

ACKNOWLEDGMENTS

The project was supported by Research Grant AI-06248 from the U.S. Public Health Service to the junior author. The senior author wishes to express his gratitude to Dr. Bernardo Villa R., his advisor of the Universidad Nacional Autonoma de Mexico, and both authors appreciate his making available to us the facilities of the Instituto de Biologia of that University.

The Direccion General de la Fauna Silvestre, Mexico, D.F., provided the authors with scientific collecting permits. Gonzalo Gavino T. shared the field work. Dr. Allan R. Phillips read drafts of the manuscript in Spanish and English and provided critical suggestions.

LITERATURE CITED

Bell, J. 1966. Boat-bills in our zoo's "Treetops." Animal Kingdom, 69:251–252.

Carpenter, J. A. 1971. Notes on the biology and behavior of captive Boat-billed Herons, *Cochlearius cochlearius*. Southwestern Naturalist, 16:31–41.

Dickerman, R. W., and G. Gavino T. 1969. Studies of a nesting colony of the Green Heron (*Butorides virescens*) at San Blas, Nayarit, Mexico. Living Bird, 8:95–111.

Dickerman, R. W., and C. Juarez L. 1971. Nesting studies of the Boat-billed Heron (*Cochlearius cochlearius*) at San Blas, Nayarit, Mexico. Ardea, 59:1–16.

Gavino T., G., and R. W. Dickerman. 1972. Nestling development of Green Herons at San Blas, Nayarit, Mexico. Condor, 74:72–79.

Gross, A. O. 1923. The Black-crowned Night Heron (*Nycticorax nycticorax naevius*) of Sandy Neck. Auk, 40:191–214.

Juarez L., C. 1967. Observaciones acerca de la biologia, nidificacion y crianzo de la garza pico de cochuron mexicana, *Cochlearius cochlearius*, en San Blas Nayarit. Thesis Professional, Univ. Nacional Autonoma de Mexico.

McClure, H. E., M. Yoshii, Y. Okada, and W. F. Scherer. 1959. A method for determining age of nestling herons in Japan. Condor, 61:30–37.

Palmer, R. S. 1962. Handbook of North American Birds. Yale Univ. Press, New Haven. Vol. 1, p. 474.

Wetmore, A. 1965. The birds of the Republic of Panama. I. Tinamidae (Tinamous) to the Rhynchopidae (Skimmers). Smithsonian Misc. Coll., 150.

Wolford, J. W., and D. A. Boag. 1971. Distribution and biology of Black-crowned Night Herons in Alberta. Canadian Field-Naturalist, 85:13–19.

CALLE TANQUE 11-B, COLONIA BUENAVISTA, CUERNAVACA, MORELOS, MEXICO AND DEPARTMENT OF MICROBIOLOGY, CORNELL UNIVERSITY MEDICAL COLLEGE, NEW YORK, NEW YORK 10021 (ADDRESS REPRINT REQUESTS TO JUNIOR AUTHOR), 4 MAY 1972.