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4

The Identification of Living Crocodilians

(Figures 1-31)

PETER BRAZAITIS

Department of Herpetology, New York Zoological Society, Bronx, N.Y. 10460

The identification of crocodilians is based largely on morphological characters derived from the examination of skulls, skins, and preserved juvenile specimens. Definitive characters compiled from such material is of limited value when applied to living forms. For this purpose, morphological characters clearly evident in life are defined. An identifying key and supporting species accounts, including common use names, taxonomy, gross morphology, basic life data, distribution, and pertinent references are given. Distributions and distinguishing characteristics are illustrated.

INTRODUCTION

ADULT CROCODILIANS are large, costly to transport, and space-consuming to store in museum collections. Collections consequently tend to consist of small or juvenile specimens that have been preserved entirely or only the hides and skulls of large individuals. Most keys for the identification of crocodilians are based upon the morphology of these materials and consequently have limited applicability to living specimens.

There are two problems. The first is that osteological characters tend to be hidden in living specimens. The second involves color. Juvenile specimens may exhibit an ontogenetic color change as they grow, while museum specimens have their color altered by preservation or tanning.

For these reasons, it seems appropriate to develop a method particularly suitable for the identification of living crocodilians of various ages and sizes. The following key and accounts of the species results from the examination of museum and living material as well as an extensive review of the literature. Its primary aim is the identification of living crocodilians regardless of origin (most specimens reaching zoos come from animal dealers and as a consequence their country of origin is not always known).

ACKNOWLEDGMENTS

I would like to express my thanks to F. Wayne King and the New York Zoological Society for their help during these studies and in the preparation of the manuscript. Carl Gans and many others made helpful comments on the key. Thanks also to the staffs of the American Museum of Natural History (=AMNH), New York, and its Genera of Reptiles Department; the U.S. National Museum, Washington, D.C.; and the Field Museum of

Natural History, Chicago, for allowing the examination of specimens in their collections or making available difficult to obtain literature. I also owe a note of thanks to Mrs. Winifred Brazaitis and Mrs. Katherine Yolla who aided in the preparation of the manuscript. Illustrations are by F. Wayne King, Curator of Reptiles, New York Zoological Park. Distribution maps were prepared by William Elliott.

USE OF THE KEY

The key is composed of paired statements, labelled a and b, which describe contrasting morphological conditions. These paired statements or couplets are numbered 1 through 27.

To identify a live crocodilian start with couplet 1. Decide whether statement a or statement b best describes the specimen in question. Then proceed to the couplet indicated by the number that follows that statement. After reading both parts of the new couplet, again choose statement a or b as being most descriptive of the specimen being identified and move on to the couplet indicated by the number at its end. The number may refer you to the couplet immediately following, or it may have you skip a large segment of the key and proceed to a couplet far ahead. Whichever the case, move only to the couplet indicated. Individual couplets are not specific in themselves and will lead to the proper conclusion only if considered after the elimination of other characteristics by previous couplets.

All characteristics are externally evident. Osteological characters mentioned are visible in life. Whenever necessary the key refers to a figure which will clarify the point in question.

Once a specimen has been identified, it should be further compared with other characteristics listed in the detailed accounts of the species for verification.

1. a) Enlarged fourth mandibular tooth of the lower jaw received into an internal socket in the upper jaw, hidden when the jaws are closed (Figure 1B). Ventral scales lack follicle glands (Figure 2B)..... 2
- b) Enlarged fourth mandibular tooth received into an external notch on the sides of the upper jaw, visible when the jaws are closed (Figure 1C). Ventral scales have follicle glands (Figure 2B), at least in the gular region 11
2. a) Iris of eyes dark brown, red, or orange 3
- b) Iris of eyes other than dark brown, red, or orange 5
3. a) Fewer than 20 teeth on each side of lower jaw *Alligator sinensis*
- b) More than 20 teeth on each side of lower jaw 4
4. a) Ear coverlets black or dark brown, contrasting with color of cranial table (Figures 1 and 2). Minimum of two longitudinal rows of dorsal scales above the hind limbs (Figure 4f)..... *Paleosuchus trigonatus*.
- b) Ear coverlets colored similar to the cranial table. Minimum of four longitudinal rows of dorsal scales above hind limbs (Figure 4d)..... *Paleosuchus palpebrosus*.
5. a) Dorsal color black with distinct yellow or white crossbands 6
- b) Dorsal color black, brown, yellow, or green without yellow or white crossbands 7
6. a) Three or more large dark blotches on the sides of the jaws (Figure 1D). A raised longitudinal median vertebral ridge on trunk (Figure 2A).... *Melanosuchus niger*.
- b) Jaws light or dark, but lacking large dark blotches (Figure 1B). No raised longitudinal median vertebral ridge (Figure 2A) *Alligator mississippiensis*
7. a) Three or more large dark blotches on the sides of the jaws¹..... 8
- b) No large dark blotches on the sides of the jaws² 9
8. a) Nuchal scales arranged in transverse rows of which only the first contains four or more scales, each row separated from the next by a space of soft skin (Figure 5b) *Caiman latirostris*
- b) Nuchal scales arranged in closely associated transverse rows of which the first two rows contain four or more scales (Figure 5a)..... *Caiman crocodilus yacare*
9. a) Legs dark gray or black, body bright yellow-brown. Snout strikingly narrow and elongate, anterior third parallel sided (Figure 4c).... *Caiman crocodilus apaporiensis*
- b) Legs colored as the body. Snout moderate, sides gradually converge to the tip of the snout (Figure 4b) 10
10. a) Dorsal color olive green; back and tail with dark crossbands and flecks *Caiman crocodilus crocodilus*
- b) Dorsal color olive-brown, brown, or yellow-brown. Indistinct or faded dark crossbands on the tail, without dark flecks on back or tail *Caiman crocodilus fuscus*
11. a) Mandibular symphysis extending caudad to the level of the 23rd or 24th mandibular teeth (Figure 3f) *Gavialis gangeticus*
- b) Mandibular symphysis not as above 12
12. a) Mandibular symphysis extending caudad to the level of the 14th or 15th mandibular teeth (Figure 3e)..... *Tomistoma schlegelii*
- b) Mandibular symphysis not as above ... 13
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- b) Nuchal scales arranged in a cluster of four to six scales; separated from the dorsal scales by a transverse row of fewer than four, usually small, scales or an expanse of soft skin (Figures 5d and 5e) 15
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- b) Nuchal scales widely separated from the dorsal scales by an expanse of soft skin (Figure 5f). Ventral scales in 25 to 27 transverse rows *Crocodylus intermedius*
16. a) All ventral surfaces mottled or uniformly dark brown or black. Nuchal scales arranged in longitudinal rows, continuous with the dorsal scales (Figure 5c) 17
- b) Ventral body surfaces uniformly white or cream, with or without lateral dark bars barely entering the ventral scales or dark subcaudal tail spots. Nuchal scales arranged in a cluster of four to six scales (Figures 5d and 5f) 18
17. a) Interior of the mouth (palate) uniformly white or cream, usually two transverse

¹One race of *Caiman latirostris* from Argentina may display faded blotches.

²Most hatchling *Caiman crocodilus* display faint gray blotches on the sides of the jaws which are lost during the first year and are not to be confused with the large dark black, brown, or red blotches shown in figure 1D.

- rows of post-occipital scales (Figure 2A)
.....*Osteolaemus tetraspis osborni*
- b) Interior of the mouth (palate) darkly mottled anteriorly, yellow or cream posteriorly, usually a single transverse row of post-occipital scales (Figure 2A)
.....*Osteolaemus tetraspis tetraspis*
18. a) A distinct pre-orbital ridge, extending well onto the snout at least halfway to the nostril openings (Figure 3b), or cloacal vent surrounded by small scales, extending caudad in irregular line through the first several rings of subcaudal tail whorls (Figure 2C₁)..... 19
- b) No pre-orbital ridge, or a short ridge extending onto the snout less than a third of the distance to the nostril openings, cloacal vent surrounded by small scales not extending caudad through the first several subcaudal tail whorls (Figure 2B)..... 20
19. a) Ventral scales in 29 or more transverse rows (Figure 2B)..... 22
- b) Ventral scales in 28 or fewer transverse rows..... 21
20. a) Transverse dorsal scale rows irregular. Rows composed of from two to six scales each, with scales often missing within a row (Figure 5f)..... 23
- b) Transverse dorsal rows regular. First row composed of four scales, followed by six to 12 rows of six or more scales, again followed by several rows of four scales (Figure 5e)..... 24
21. a) Nuchal scales separated medially by a space of soft skin (Figure 5f)
.....*Crocodylus novaeguineae novaeguineae*
- b) Nuchal scales not separated, scales in medial contact with each other (Figure 5e)
.....*Crocodylus novaeguineae mindorensis*
22. a) Cloacal vent surrounded by small scales, extending caudad in an irregular line through the first several rings of subcaudal tail whorls (Figure 2C₁). Two pairs of post-occipital scales always present (Figure 2A)
.....*Crocodylus siamensis*
- b) Cloacal vent surrounded by small scales, not extending caudad as above. Post-occipital scales usually absent, or represented by only one or two small scales (Figure 5d).....
.....*Crocodylus porosus*
23. a) Width of the mandible at the posterior margin of the mandibular symphysis equal to or greater than the length from the posterior margin of symphysis to the tip of the mandible (Figure 3a)..... 26
- b) Width of the mandible at the posterior margin of the mandibular symphysis less than the length from the posterior margin to the tip of the mandible.....
.....*Crocodylus acutus*
24. a) More than 30 transverse ventral rows from the ventral collar to the cloacal vent. Toes of the front feet extremely short and stumpy
.....*Crocodylus rhombifer*
- b) Thirty (30) or fewer transverse ventral rows, toes elongate and well developed 25
25. a) Fewer than 26 transverse ventral rows. Nuchal scales medially separated by soft skin (Figure 5f).....
.....*Crocodylus novaeguineae novaeguineae*
- b) From 26 to 30 transverse ventral rows. Nuchal cluster not medially separated (Figure 5e)
.....*Crocodylus niloticus*
26. a) Subcaudal tail whorls interrupted by irregular scales or groups of scales between the rings (Figure 2C₂). Young and adults dark greenish-yellow or uniform dark olive drab
.....*Crocodylus moreletii*
- b) Subcaudal tail whorls arranged in uniform rings following one upon the other without interruption. Young and adults brown or yellow-brown with dark brown bars and spots 27
27. a) Ventral collar present (Figure 2B).....
.....*Crocodylus palustris kimbula*
- b) Ventral collar absent
.....*Crocodylus palustris palustris*

USE OF THE SPECIES ACCOUNTS

In the text that follows, each species and subspecies is listed in alphabetical order within the genus and family. Each account is divided into the following subheadings:

SYNONYMS. Common use names applied to the species. Broadly accepted names appear first, native or local names last.

CONTENT. The taxonomic position occupied by the species and the races currently accepted as valid. Systematic arrangement follows Wermuth and Mertens (1961).

SIZE. Maximum size is the size of the largest individual reported in the literature. The average adult size is that size range which currently is representative of the species.

Consideration should be given to the fact that under the pressures of today's hunting methods, few individuals ever live to attain the large sizes previously recorded.

Actual lengths are not available for the hatchlings of some species. In these instances the probable size of the young is given on the basis of known data for comparably sized species.

COLORATION. The color pattern is described. "Brown above with dark flecks and crossbands," would indicate that the ground color of the dorsal surfaces of the head, back, and tail is brown, and that there are numerous darker specks together with dark brown or black transverse crossbands on the dorsal surfaces.

Crocodylians become progressively darker with age and tend, except for those species indicated in the accounts, to become so dark that eventually the juvenile dorsal color pattern is lost. However, even in these cases the sides of the jaws, body and tail which are normally lighter continue to retain the subadult pattern. These dark specimens are usually large old animals.

Obscure patterns and colors often can be temporarily brought to light by moistening the specimen with water or a light application of mineral oil.

CONFORMATION. Details of gross morphology are listed. Scrutinize the individual carefully. Take the time to calculate the snout proportions (Figure 3b). It is helpful here to be aware of the conformations of confusing similar species (Figure 4a, b, and c). Examine the sides of the body in detail. This subheading is designed as a basic guide and lends support to coloration.

SCUTELLATION. The number and shape of various scales is given (Figures 2A and 2B). Be certain to count the scales accurately, according to the limits of the figure. The counts listed are based on living and preserved specimens, coupled with data reported in the literature on that particular species. Although some individuals may display counts which exceed those given for specific areas, the specimen in question should agree overall to the majority of the counts given.

DENTITION. Tooth counts are made on the bases of the right or left sides of the jaws independently. Count broken teeth and empty sockets as though teeth were present. Consult Figure 1B and 1C to determine the fourth tooth position and Figure 3a, d, e, and f for the extent of the fusion of the symphysis. Observe if the posterior teeth are close together or if a space exists between them. The family *Alligatoridae* bears teeth which are rooted in common sockets on the posterior portions of the jaws, giving the base of these teeth the appearance of being close together; nearly touching.

The formula $\frac{5 + 13-14}{15}$ indicates there are five teeth counting from the middle of the tip of the snout to the pre-maxillary/maxillary notch on the side of the upper jaw; or the premaxillary/maxillary socket just inside the edge of the jaw, and there are 13 or 14 maxillary teeth to the angle of the mouth, for a total of 18 or 19 teeth on each side of the upper jaw (Figure 3c). The number below the line indicates there are 15 teeth on each side of the mandible (Figure 3d).

SIMILAR SPECIES. Those species which look like the species under consideration and which may be confused with it, as well as those which an error in the application of the key may lead to. Each is accompanied by a character possessed by the similar species which will serve as a check on the identification made or indicate other possible conclusions.

REMARKS. Basic life data on the species.

DISTRIBUTION. Data in this section is as cur-

rent as possible, although former distributions are also listed.

COMMENTS. Specific information necessary to utilize the pertinent literature. It also includes the author's personal observations.

REFERENCES. Literature on the species, the original description, and life data. These will include additional reference material.

ORDER CROCODYLIA

Family *Alligatoridae*

Alligator mississippiensis (Daudin)

SYNONYMS. American alligator, 'gator, Mississippi alligator.

CONTENT. No subspecies are recognized.

SIZE. Maximum size suggested up to 570cm. Average size 200cm to 300cm. Hatchlings, 22cm to 27cm.

COLORATION. Black above with yellow or white crossbands on the back and tail. Light yellow flecks usually on the sides of the jaws, head, and neck (Figure 1B). Dark bars and vermiculations on the sides of the body and tail, extending down to form bars on the lateral ventral scales.

CONFORMATION. Head and snout rugose. Snout wide, flat and blunt; length 1 to 1.5 times the width at the base. The transverse dorsal rows are broad at midbody and extend slightly onto the sides. Scales on the sides of the body nearly uniform in size, arranged in uniform longitudinal rows alternating with longitudinal rows of smaller scales. The figures are webbed. The ventral scales lack follicle blands.

SCUTELLATION.

Post-occipitals: 2 to 3 transverse rows of irregularly arranged small scales.

Nuchals: 3 to 4 transverse rows of 2 scales; each row separated from the following row and from the dorsal rows by soft skin.

Dorsals: 17 to 18 transverse rows of 8 to 10 scales. Double crest caudal whorls: 17 to 19.

Single crest caudal whorls: 18 to 21.

Ventral collar: a single transverse row of enlarged scales.

Ventral scales: 30 to 35 transverse rows.

Subcaudals: uniform uninterrupted rings.

DENTITION. Fourth mandibular tooth received into an internal socket in the upper jaw (Figure 1B). Mandibular symphysis extends to the level of the fourth or fifth teeth. The teeth are short and thick. Posterior teeth rooted into a common elongated socket. Formula: $\frac{5 + 13-15}{19-20}$.

SIMILAR SPECIES. *Melanosuchus niger*: from three to five large dark spots on the sides of the jaws. *Alligator sinensis*: fingers are not webbed; gray or gray-green above with faint gray and yellow crossbands on the hatchling, uniform dark

gray as adults; fewer than 28 transverse ventral rows.

REMARKS. Inhabits fresh and brackish water marshes, ponds, and waterways. Diet consists primarily of rough fish, small vertebrates, and invertebrates. The female lays an average of 40 to 60 eggs, from June to August, in a mound of mud, sticks, and aquatic vegetation. The female may attend the nest throughout the nine week incubation period. The young remain with the female throughout the first year or more. Alligators dig deep holes, or "dens," which during periods of drought may provide the only source of water for other wildlife. Alligators may hibernate during the cold winter months and may aestivate during hot dry periods. Males and females are vocal, particularly during the breeding season. The species, for its larger size, is inoffensive.

DISTRIBUTION. From Corpus Christi, Texas, east to Florida; north to Tyrrel county, North Carolina; the Mississippi river system, Arkansas and formerly south-east Oklahoma (Figure 6).

COMMENTS. Probably the best known species of crocodilian. Spelling of the species epithet corrected to *mississippiensis* from original *mississippiensis*. The species is protected throughout its range by federal and local legislation as of 1970.

REFERENCES. Boulenger, 1889; Cope, 1900; Craighead, 1968; Daudin, 1802; I.U.C.N. Red Data Book, 1968; Kellögg, 1929; Mook, 1921b; Oliver, 1958; Schmidt, 1922, 1944; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933.

Alligator sinensis Fauvel

SYNONYMS. Chinese alligator, China alligator, Yangtze alligator, *t'o, yow lung, tou lung.*

CONTENT. No subspecies are recognized.

SIZE. One of the dwarf species of crocodilians. Males are on the average smaller than females. A pair of well matured adults at the New York Zoological Park are of nearly equal size. Average adult size is 100 cm to 130 cm; maximum size, approximately 200 cm. Hatchlings, 15 cm to 25 cm.

COLORATION. Young adults are dark gray over all with indistinct lighter cross-bars on the back, sides and tail. Ventrals are mottled with dark and light gray. The head is lightly speckled with yellow or white. Some retain a gray-green ground color. Hatchlings are vividly patterned in yellow-green and gray, with wide yellow or white cross bars. Old adults become uniform dark gray, nearly black. The eyes are large, dark brown, and appear bovine-like.

CONFORMATION. The head is massive and wide, the snout round, wide and blunt, slightly longer than its width at the base. The orbits are not connected anteriorly by a transverse bony ridge (Figure 1A). Two or more poorly developed ridges may extend from the orbits well onto the snout, and usually become overgrown with age,

producing an almost smooth surface. The eyelids are rugose with well-developed upper and lower striated horizontal appendages, eyelash-like in appearance. The fingers of the front feet are not webbed. The scales of the neck, back, and tail are well ossified; extremely coarse, and bark-like. The ventral scales lack follicle glands (Figure 2B).

SCUTTELATION.

Post-occipitals: a single transverse row of 6 to 8 separated keeled oval scales, separated from the nuchals by 2 isolated oval scales.

Nuchals: 3 pairs of enlarged scales arranged in 2 longitudinal rows, in contact with each other and closely followed by the first transverse dorsal row of scales.

Dorsals: 16 to 17 transverse rows of 6 scales.

Double crest caudal whorls: 16 to 17.

Single crest caudal whorls: 16 to 17.

Ventral Collar: a single enlarged transverse row of scales.

Ventral scales: 25 to 27 transverse rows.

Subcaudals: uniform uninterrupted rings.

DENTITION. Fourth mandibular tooth received into an internal socket in the upper jaw. Mandibular symphysis extends to the level of the fourth or fifth teeth. The teeth are thick and short. Those on the rear portions of the mandible and maxillary are rooted in a common elongated socket. Formula: $\frac{5 + 13-14}{18-19}$

SIMILAR SPECIES. *Alligator mississippiensis*: fingers of the front feet are extensively webbed, ventrals in more than 29 rows. *Melanosuchus niger*: median ventral surface immaculate white. *Paleosuchus*: red-brown head and body with extensive brown blotching on the ventral surfaces; only four teeth on each side of the pre-maxillary. *Osteolaemus*: fourth mandibular teeth are exposed in an external notch; ventral scales have follicle glands.

REMARKS. Inhabits the alluvial plains and lowlands along rivers and streams. Feeds largely upon turtles, frogs, crustaceans, and ducks. One of the few species of crocodilians inhabiting temperate climates. Females are said to hibernate in complicated communal burrows while solitary males excavate simply burrows. Hibernation takes place from late September to March. Emergence coincides with the beginning of the rainy season and mating soon follows. Both sexes emit a distinctive booming cough with the female occasionally instigating courtship. The nest is probably constructed of organic debris. Eggs are laid from June to mid-August and may hatch in 20 to 25 days.

DISTRIBUTION. Original specimen reported taken in Shense Province. Also recorded from Changhsing in Chekiang, Wuhu, in Anwei Province, Chin-I-Kiang, Cheun-Ho river system, the Yangtze river valley (Figure 7).

COMMENTS. Little taxonomic confusion exists concerning this species. However, much of the life

history data is confounded in folklore and superstition to recent times.

REFERENCES. Barbour, 1922; Boulenger, 1889; Chu Cheng-kuan, 1957; Fauvel, 1879; Hsiao, 1934; I.U.C.N. Red Data Book, 1968; Mook, 1923; Wermuth, 1953; Wermuth and Mertens, 1961.

Caiman crocodilus crocodilus (Linnaeus)

SYNONYMS. Alligator, South American caiman, spectacled caiman, *baba*, *babilla*, *caimán*, *caimán blanco*, *caiman sclerops*, *cochirré*, *coscarudo*, *jacaré*, *jacarétinga*, *jacaré de lunetos*, *lagarto blanco*, *lagarto negro*, *ocoroche*, *tinga*, *yacaré blanco*.

CONTENTS. Four races of *Caiman crocodilus* are recognized: *Caiman crocodilus crocodilus*, *Caiman c. apaporiensis*, *Caiman c. fuscus*, *Caiman c. yacare*.

SIZE. Maximum size, 250 cm; average adult, 150 cm to 200 cm; hatchlings, 20 cm to 25 cm.

COLORATION. Dorsally olive green with numerous dark brown or black flecks on the head, body, and tail. Dark brown or black crossbands on the back and tail. Ventral surfaces are unpatterned, uniform cream, or yellow. No large dark blotches on the sides of the jaws (Figure 1A). Hatchlings display a series of faded bars on the sides of the jaws, no longer visible at about 35 cm total length.

CONFORMATION. Snout slightly elongate, longer than its width at the base. A well-developed transverse bony ridge connects the orbits anteriorly (Figures 1A and 4B). The upper eyelids are raised into a high point or tubercle. Transverse ventral rows of scales overlap each following row. Ventral follicle glands are absent (Figure 2B). The fingers are not webbed.

SCUTELLATION.

Post-occipitals: 2 to 3 relatively regular transverse rows of 6 to 8 enlarged scales.

Nuchals: 4 to 5 transverse rows of scales. Each row closely followed by the next. Two (2) or more rows containing 4 scales each. Nuchals continuous with the dorsal rows.

Dorsals: 18 to 19 transverse rows of 8 to 10 scales.

Double crest caudal whorls: 12 to 13.

Single crest caudal whorls: 20 to 22.

Ventral collar: a single enlarged transverse series of scales.

Ventral scales: 20 to 24 transverse rows.

Subcaudals. uniform uninterrupted rings.

DENTITION. Fourth mandibular teeth received into an internal socket in the upper jaw (Figure 1A). First and fourth mandibular teeth may pierce the upper jaw in older adults. Mandibular symphysis extends to the level of the fourth or fifth teeth. Posterior teeth rooted into a common elongated socket. Formula: $\frac{5 + 14-15}{18-20}$.

SIMILAR SPECIES. *Caiman c. yacare*; *Caiman latirostris*: both bear large dark blotches on the sides of the jaws. *Caiman c. fuscus*: dorsally yel-

low-brown or brown overall, without dark brown or black dorsal speckling; no dark crossbands on the back in specimens 90 cm or more in length; double crest caudal whorls 13 to 14, snout moderate. *Caiman c. apaporiensis*: snout elongate and narrow, anteriorly parallel-sided; bright yellow-brown dorsally.

REMARKS. An inhabitant of ponds, streams, marshes, and rivers. Occasionally found in brackish water estuaries, often in close ecological association to other species of crocodylians. Diet consists largely of aquatic insects, crustaceans, and fish. Breeding takes place year round, primarily from late December to March. The eggs, 15 to 40 in number, are deposited into a mound of organic debris occasionally constructed by the female some distance from the nearest water. The young hatch in about 25 to 35 days. The female remains in the vicinity of the nest throughout incubation. Males are known to be territorially defensive. Individuals over 60 cm in length usually carry gastroliths.

DISTRIBUTION. Guiana, Venezuela, Trinidad, the Amazon drainage, eastern Colombia to Peru (Figure 8).

COMMENTS. With the exception of *Caiman c. yacare*, juveniles of the three remaining races are extremely difficult to identify subspecifically, without locality data.

Caiman c. chiapasius is sometimes used to identify a questionable race from the Choco of Colombia, Gorgona Island, Central America, and Mexico.

REFERENCES. Bocourt, 1876; Boulenger, 1889; DeCarvalho, 1955; Hagmann, 1906; I.U.C.N. Red Data Book, 1968; Linnaeus, 1758; Mook, 1921b; Schmidt, 1928b; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933.

Caiman crocodilus apaporiensis Medem

SYNONYMS. Caiman, *cochirré*, *cocodrillo*, *jacarétinga*, *lagarto negro*, *ocoroche*, slender-snouted caiman, *tinga*.

CONTENT. Four races of *Caiman crocodilus* are recognized: *Caiman c. crocodilus*, *Caiman c. apaporiensis*, *Caiman c. fuscus*, *Caiman c. yacare*.

SIZE. Nineteen individuals collected by F. Medem ranged in length from 62 cm to 209 cm. Hatchlings unreported.

COLORATION. Bright yellow-brown above with black spots and vermiculations, denser on the head. From four to six dark bars on the tail. Extremities dark gray or black. Ventrals yellow. Some individuals bear yellow scales on the sides of the neck. Young individuals reported to be brighter yellow than any other species of caiman.

CONFORMATION. Skull and snout elongate. Snout strikingly elongated, narrow, and anteriorly parallel-sided, longer than its width at the base (figure 4c). A transverse bony ridge connects the anterior points of the orbits. The upper eyelids are

raised into a high point or tubercle. Transverse ventral rows of scales overlap each following row. Ventral scales lack follicle glands (Figure 2B). The fingers are not webbed.

SCUTELLATION.

Post-occipitals: 2 transverse rows of 6 to 7 scales each.

Nuchals: 4 transverse rows of 2 to 4 scales each.

The first 2 rows on the type specimen bear 4 scales each. Nuchals continuous with the dorsal scale rows.

Dorsals: 19 transverse rows, the widest containing 9 scales.

Double crest caudal whorls: 13.

Single crest caudal whorls: not reported.

Ventral collar: a single transverse series of enlarged scales.

Ventral scales: 20 to 24 transverse rows.

Subcaudals: not reported, but believed to be uninterrupted uniform rings.

DENTITION. As in *Caiman crocodilus crocodilus*. Formula: $\frac{5 + 17-18.}{20}$.

SIMILAR SPECIES. *Caiman c. crocodilus*: dark olive-green above, with dark brown or black flecks; snout slightly elongate, not anteriorly parallel-sided. *Caiman c. fuscus*: yellow-brown, brown, dusky brown above; no dark flecks or spots on the dorsal surfaces of the body; extremities yellow, yellow-brown as is the body. *Caiman c. yacare*; *Caiman latirostris*: from three to five large dark blotches on the sides of the jaws.

REMARKS. Little is known of this crocodylian's life history or ecological relationships. Isolated by waterfalls and rapids.

DISTRIBUTION. Found only in the upper Rio Apaporis, between the falls of Jirijirimo and Puerto Yiviya, a distance of about 200 kilometers in Colombia (Figure 9).

COMMENTS. Type and paratype specimens deposited in the Field Museum of Natural History. Additional specimens in the Instituto de Ciencias Naturales Bogota, Colombia.

REFERENCES. Medem, 1955, 1968; Wermuth and Mertens, 1961.

Caiman crocodilus fuscus (Cope)

SYNONYMS. Alligator, caiman, Central American caiman, dusky caiman, Magdalena caiman, spectacled caiman, *babilla*, *cocodrillo*, *tinga*.

CONTENT. Four races of *Caiman crocodilus* are recognized: *Caiman c. crocodilus*, *Caiman c. apaporiensis*, *Caiman c. fuscus*, *Caiman c. yacare*.

SIZE. Maximum size approximately 225cm. Average adults 125cm to 175cm. Hatchlings, 21cm to 26cm.

COLORATION. Adults light brown, olive brown or light yellow above. Dark crossbands visible on the sides of the tail only. Ventrals, uniform cream or yellow. Old adults lose almost all signs of cross-

bands and appear uniformly dark dusky brown or olive brown. Hatchlings, light brown or yellow with dark brown crossbands on the back and tail. Five to seven faint dark bars usually evident on the sides of the jaws, no longer visible on animals 35cm or larger (similar to Figure 1A).

CONFORMATION. Snout triangular, gradually converging sides. Snout equal to or shorter than its width at the base. A transverse bony ridge connects the anterior points of the orbits (Figure 4b). Upper eyelids elevated into a high point or tubercle. Transverse ventral rows of scales overlap each following row. Ventral scales lack follicle glands (Figure 2B). The fingers are not webbed.

SCUTELLATION.

Post-occipitals: 3 to 4 transverse rows of 6 to 10 slightly enlarged irregularly arranged scales.

Nuchals: 4 to 5 transverse rows of 2 to 4 scales, continuous with the dorsal scales.

Dorsals: 17 to 18 transverse rows of 8 to 10 scales.

Double crest caudal whorls: 13 to 14.

Single crest caudal whorls: 23 to 24.

Ventral collar: a single transverse row of enlarged scales.

Ventral scales: 22 to 24 transverse rows of 12 to 15 scales each.

Subcaudals: uniform uninterrupted rings.

DENTITION. See *Caiman c. crocodilus*. Formula: $\frac{5 + 14-15.}{18-20}$.

SIMILAR SPECIES. *Caiman c. crocodilus*: dark olive-green above, flecked with dark brown or black on the head, body and tail; dark crossbands visible on the back and tail; double caudal whorls: 12 to 13; snout slightly elongate, slightly longer than its width at the base. *Caiman crocodilus yacare*; *Caiman latirostris*: from four to five large dark blotches on the sides of the jaws. *Caiman c. apaporiensis*: snout strikingly narrow and elongate, anteriorly parallel-sided; dark crossbands evident on the back and tail; double caudal whorls 13; some individuals bear orange scales on the sides of the neck; dorsal color as *Caiman c. fuscus*; numerous dark spots on the back, sides, and head.

REMARKS. See *Caiman c. crocodilus*. Breeding takes place throughout the year. From 18 to 30 eggs are laid in a mound of organic debris, collected by the female. Little is known of the life habits. Incubation takes approximately 75 days. Protection of the nest and young by both parents is reported. Adults known to carry gastroliths in small quantities.

DISTRIBUTION. Southern Mexico, Panama through Central America, Colombia and the river systems Magdalena, Sinu, and Rio Atrato (Figure 10).

COMMENTS. With the exception of *Caiman c. yacare*, juveniles of the three remaining races are extremely difficult to identify subspecifically, without locality data. *Caiman c. chiapasius* is

sometimes used to identify members of this race from the Choco of Colombia, Gorgona Island, Central America, and Mexico.

REFERENCES. Bocourt, 1876; Cope, 1868; I.U.C.N. Red Data Book, 1968; Medem, 1962, 1968, 1969; Miguel Alvarez Del Toro, 1967, *in litt.*; Schmidt, 1928b; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933.

Caiman crocodilus yacare (Daudin)

SYNONYMS. Paraguayan caiman, *angosto*, *caimán del Paraguay*, *caimán yacaré*, *coscarudo*, *jacaré*, *jacarétinga*, *jacaré de lunetos*, *lagarto*, *tinga*, *yacare*, *yacaré de hocico*.

CONTENT. Four races of *Caiman crocodilus* are recognized: *Caiman c. crocodilus*, *Caiman c. apaporienis*, *Caiman c. fuscus*, *Caiman c. yacare*.

SIZE. Adults 250cm not uncommon. Hatchlings average 20cm to 30cm.

COLORATION. Adults densely speckled with black on the dorsal surfaces of the head, back, and tail; usually appear totally black above. The speckled young become progressively darker with age and assume the adult coloration at about 100cm in length. Young and adults are characterized by three to five large dark blotches on the sides of the jaws (Figure 1D). Ventrals, uniform cream or yellow, patterned along the lateral margins by slightly dark vermiculations extending onto the ventral scales from the sides. Some individuals bear reddish or orange vermiculations on the sides of the body or neck. Such individuals probably led K. P. Schmidt to inquire into the identity of the "red jacare" of Paraguayan report.

CONFORMATION. Snout and skull triangular, without parallel sides. Snout slightly longer than the width at the base. The first two teeth of the mandible as well as the fourth mandibular teeth invariably pierce the snout of adult animals. A transverse bony ridge connects the anterior points of the orbits. The upper eyelid is raised into a point or tubercle. Transverse ventral rows of scales overlap each following row. Ventral scales lack follicle glands (Figure 2B). The fingers are not webbed.

SCUTELLATION.

Post-occipitals: 3 to 4 irregular transverse rows of enlarged scales.

Nuchals: 4 to 5 transverse rows of scales. The first 2 to 3 rows composed of 4 scales each, latter rows of 2 to 3 scales each, continuous with the dorsal scales.

Dorsals: 17 to 18 transverse rows of 8 to 10 scales each.

Double crest caudal whorls: 13 to 15.

Single crest caudal whorls: 17 to 19.

Ventral collar: a single transverse series of enlarged scales.

Ventral scales: 22 to 25 transverse rows of 14 to 16 scales each.

Subcaudals: uniform uninterrupted rings.

DENTITION. See *Caiman c. crocodilus*. Formula:
$$\frac{5 + 14-15}{17-21}, \text{ average } \frac{19}{18}$$

SIMILAR SPECIES. *Caiman latirostris*: ventral collar composed of two transverse rows of slightly enlarged scales; snout length equal to or one-and-one-fourth times the width at the base; only the first transverse row of nuchal scales composed of four scales. *Melanosuchus niger*: upper eyelid flat above, without a raised projection or tubercle; median two longitudinal rows of scales elevated along the vertebral line (see species account).

REMARKS. A common species of streams, swamps, and mangroves of southern tropical South America. Fish and crustaceans are the principle diet. The 30 to 45 eggs, 42mm to 45mm x 72mm to 78mm in size, are deposited in a mound of organic debris. Hatching in November is reported. Populations are rapidly becoming decimated due to the depredations of hide hunters. Gastroliths are not reported carried by this subspecies.

DISTRIBUTION. Southern Brazil, Paraguay, Bolivia. The river systems of Parana, Paranaíba, north to the Sao Francisco; the whole of the Mato Grosso; the rivers of Itenez and Mamore (Figure 11).

COMMENTS. The overlapping distributions of *Caiman latirostris* and *Caiman crocodilus yacare* pose an interesting basis for ecological studies, noting the divergence in the conformation of the skull structure of the former species.

REFERENCES. Daudin, 1802; DeCarvalho, 1955; Mook, 1921b; Schmidt, 1928b; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933.

Caiman latirostris (Daudin)

SYNONYMS. Brazilian caiman, broad-snouted caiman, *ancho*, *jacaré de papo amarelo*, *tinga*, *ururau*, *yacaré de hocico*.

CONTENT. Two races of *Caiman latirostris* are described; *Caiman latirostris latirostris* and *Caiman latirostris chacoensis*.

SIZE. Maximum size probably to 300cm. Adults up to 250cm have been recorded. Hatchlings average 22cm to 30cm.

COLORATION. Adults dark brown or dark olive green above, densely flecked with dark brown or black. Wide dark crossbands on the tail, sometimes slightly evident on the back. Old adults appear uniform dark brown or black above with faint bars visible on the sides of the tail. Hatchlings and juveniles, dark brown above with dark brown or black flecks and crossbands on the back and tail, flecks on the head. All stages are uniform cream or yellow on the ventral surfaces with faint dark vermiculations on the lateral ventral scales. From three to five large dark blotches on the sides of the jaws (similar to Figure 1D).

CONFORMATION. Skull and snout low, wide,

and extremely blunt. Snout length equal to or wider than length to tip of snout. The raised transverse bony ridge which connects the anterior points of the orbits is developed into a high inverted "U" shape, extending from the ninth maxillary tooth at the lateral border of the snout, back to and across the anterior points of the orbits, then down again to the opposite side of the snout to the lateral border at the ninth maxillary tooth (Figure 4a). Although plainly evident in juveniles and adults, this character is not sufficiently developed in hatchlings to be diagnostic. The upper eyelids are raised into a point or tubercle, although not as well developed as in *Caiman crocodilus*. The ventral scales lack follicle glands (Figure 2B); lateral rows are keeled. The fingers are not webbed.

SCUTELLATION.

Post-occipitals: 2 transverse rows of 6 to 8 distinctly enlarged keeled scales.

Nuchals: 3 to 4 transverse rows of scales. Only the first of which is composed of 4 scales. Each transverse row of scales separated from the next by a short space of soft skin. Nuchals continuous with the dorsals.

Dorsals: 17 to 18 transverse rows of 6 to 8 scales each, rarely 10.

Double crest caudal whorls: 13 to 16.

Single crest caudal whorls: 22 to 23.

Ventral collar: 2 transverse rows of slightly enlarged scales.

Ventral scales: 26 to 30 transverse rows of 12 scales each, average 27 to 28 rows.

Subcaudals: uniform uninterrupted rings.

DENTITION. Fourth mandibular teeth received into an internal socket in the upper jaw. Mandibular symphysis extends to the level of the fourth or fifth teeth. The posterior maxillary and mandibular teeth are slightly separated, rooted in nearly unconnected individual bony sockets. None of the mandibular teeth pierce the upper jaw. Formula: $\frac{5 + 12-14, \text{ usually } 18}{17-20} \frac{18}{18}$.

SIMILAR SPECIES. *Melanosuchus niger*: post-occipitals in three to five transverse rows of small scales; two median longitudinal rows of scales elevated along the vertebral line; upper eyelids flat, without points or tubercles. *Caiman c. yacare*: first two transverse rows of nuchal scales contain four scales each; each row closely followed by the next. *Caiman c. crocodilus*; *Caiman c. apaporiensis*; *Caiman c. fuscus*: lack large dark blotches on the sides of the jaws. *Caiman latirostris chacoensis* bears indistinct faded dark blotches on the sides of the jaws. This slightly smaller race inhabits the Chaco provinces of Argentina south to latitude 32°. The ventral scales average 22 to 25 transverse rows.

REMARKS. Inhabits open rivers, pools, and lagoons. Food consists of birds and mammals, although the massive shape of the jaws suggests a diet of crustacea or perhaps aquatic turtles. Gastroliths have been reported in this species. Little is

known of the life habits or ecology. Nesting consists of a mound of organic debris into which about 50 eggs are laid. Hatching takes place in five or six weeks.

DISTRIBUTION. The eastern lowlands of Brazil, south to Sao Paulo then west into Paraguay and northeastern Argentina. The river systems Sao Francisco, Doce, Parana, Paranaibo, and Paraguay (Figure 12).

COMMENTS. Lateral jaw markings and scutellation are the diagnostic characters in determining the very young. On the Rio Parana, this species overlaps distributions with *Caiman c. yacare* and possibly *Melanosuchus niger*. *Paleosuchus* is also known to occur in the region. The ecological relationship between these species is not well known. Chromosomal analysis may be helpful in confirming the identification of the hatchling young.

REFERENCES. Boulenger, 1889; Cohen and Gans, 1970; Daudin, 1802; DeCarvalho, 1955; Freiberg and Carvalho, 1965; Mook, 1921b; Schmidt, 1928b; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933.

Melanosuchus niger (Spix)

SYNONYMS. Black caiman, *assú*, *caimán*, *caiman negro*, *cocodrilo*, *jacaré*, *jacaré assu*, *jacare açu*, *yacaré uassu*, *lagarto*.

CONTENTS. No subspecies are recognized.

SIZE. One of the largest members of the Alligatoridae. Males may reach 500cm in length. Average adult 300cm to 400cm, hatchlings about 30cm.

COLORATION. One of the few species which retains most of the juvenile coloration throughout life. Jet black above with narrow yellow crossbands on the body and tail, neck and base of skull light tan or yellow. From three to five large dark blotches on the sides of the jaws (similar to Figure 1D). Ear coverlets black, as is the median dorsal surface of the snout. Median ventral surfaces immaculate white bordered by jet black. White coloration restricted to the medial portions of the abdominal region in specimens from Brazil; all white with black vermiculations barely extending onto the lateral ventral scales in those from the south and Bolivia.

CONFORMATION. The head is massive, wide, and high. Snout slightly pointed, slightly longer than the width at the base. Orbits are large, connected anteriorly by a feeble transverse bony ridge (Figure 4b), with a deep depression in front of each orbit. Four oblique elevations extend to the lateral margins of the snout from the pre-orbital region. Upper eyelids are flat, striated, and slightly ossified. The two longitudinal vertebral rows of scales are elevated to form a visible elevated backbone. The fingers are not webbed. Follicle glands are absent on the ventral scalation (Figure 2B).

SCUTELLATION.

Post-occipitals: 3 to 5 transverse rows of 6 to 10

slightly enlarged scales.

Nuchals: 4 to 5 transverse rows of 2 to 4 scales, continuous with the dorsal scales.

Dorsals: 18 to 19 transverse rows of scales.

Double crest caudal whorls: 16 to 18.

Single crest caudal whorls: 21 to 24.

Ventral collar: 2 transverse rows of slightly enlarged scales.

Ventral scales: 25 to 29 transverse rows of from 12 to 14 scales.

Subcaudals: uniform uninterrupted rings.

DENTITION. Fourth mandibular tooth received into an internal socket in the upper jaw. Mandibular symphysis extends to the level of the fourth or fifth. Teeth thick and short, posteriorly rooted in a common elongated socket. Formula: $\frac{5 + 13-14}{18-19}$.

SIMILAR SPECIES. *Alligator mississippiensis*: has fingers extensively webbed, no longitudinal vertebral elevation. *Caiman crocodilus yacare*: ventrals in less than 26 transverse ventral rows. *Caiman latirostris*: upper eyelid raised in a point, a single transverse bony ridge connecting the anterior points of the orbits and extending laterally to the edge of the snout at the ninth maxillary teeth.

REMARKS. This species prefers the quiet waters of ponds, lagoons, and marshes rather than open moving rivers. Food consists of mammals, birds, and fishes. Gastroliths are rarely recorded from this species. Sexual maturity is achieved at lengths of more than two meters. Breeding occurs from October to January. The female deposits 30 to 50 eggs in a mound constructed of organic debris, and remains in the vicinity of the nest throughout the incubation period. The eggs, 86mm x 52mm to 97mm x 56mm in size, are deposited at a depth of about 40cm within the nest. Little is known of the life habits or ecology of this large and once common species of crocodylian.

DISTRIBUTION. Although once common throughout the Amazon basin, this species is no longer found in great numbers anywhere. Eastern Colombia, Peru, south to Bolivia, the Brazilian Amazon basin north to Guiana (Figure 13).

COMMENTS. Because of its large size and hide value, this species may well become extinct within the near future. Probably already too few in numbers to be the subject of extensive ecological studies.

REFERENCES. Boulenger, 1889; DeCarvalho, 1955; Hagmann, 1906; I.U.C.N. Red Data Book, 1968; Medem, 1963, 1968, *in litt*; Mook, 1921b; Schmidt, 1928b, 1944; Spix, 1825; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933.

Paleosuchus palpebrosus (Cuvier)

SYNONYMS. Cuvier's smooth-fronted caiman, dwarf caiman, musky caiman, *cochirre*, *yacare coroa*.

CONTENT. No subspecies are recognized.

SIZE. The smallest crocodylians. Record is 172cm.

Average adult 90cm-120cm; hatchlings 15cm-20cm.

COLORATION. Reddish brown above, blotched with brown on the ventral surfaces. Very dark, nearly black individuals are not uncommon. Light areas of the head and body may be light brown or yellow. The ear coverlets match the color of the cranial table which is noticeably reddish brown. The dorsal surface of the snout is uniform reddish brown. Some large red blotches on the sides of the jaws. The iris of the eyes are reddish brown or orange, white surrounding tissue is noticeably evident.

CONFORMATION. The head and snout is square and high. Snout length one-and-one-half times the width at the base; unornamented and smooth. The orbits are not anteriorly connected by a transverse bony ridge. The upper eyelids are flat, smooth, and entirely ossified. The post-occipitals and nuchal scales are particularly raised into a sharp keel or ridge. All dorsal scales are well-keeled. Transverse rows of ventral scales overlap each following row and forms an effective bony shield. Lateral longitudinal rows of ventral scales are keeled. Follicle glands are not present (Figure 2B). The fingers of the front feet are not webbed.

SCUTELLATION.

Post-occipitals: 2 transverse rows of small sharply keeled scales. Individuals with only one row are not common.

Nuchals: 4 to 5 transverse rows of sharply keeled scales. The first row contains 2 scales, the second and third rows 3 to 4 scales, followed by 1 or 2 rows of 2 scales each, continuous with the dorsal scales.

Dorsals: 18 to 19 transverse rows of 8 scales, reduced to 4 scales over the hind limbs.

Double crest caudal whorls: 10 to 11.

Single crest caudal whorls: 17 to 21.

Ventral collar: a single enlarged transverse row of scales.

Ventral scales: 19 to 24 transverse rows of 16 scales.

Subcaudals: uniform uninterrupted rings.

DENTITION. Fourth mandibular teeth received into an internal socket in the upper jaw. Mandibular symphysis extends to the fourth or fifth tooth. The teeth are often tipped with orange, posteriorly rooted in a common elongated socket. Formula: $\frac{4 + 14-15}{21-22}$.

SIMILAR SPECIES. Genus *Osteolaemus*: has 14 to 15 teeth on each side of the lower jaw. Genus *Melanosuchus*: has five teeth on each side of the pre-maxillary and 17 to 18 teeth on each side of the lower jaw. Genus *Alligator*: has five teeth on each side of the pre-maxillary, more than 25 transverse ventral rows. *Paleosuchus trigonatus*: snout elongate and slender, usually only one transverse row of post-occipitals; dorsals reduced to two scales over the hind limbs; ear coverlets in contrast (dark) to the cranial table, dorsal surface of the snout with a median dark stripe.

REMARKS. Inhabits fast moving rocky streams in the tropical rain forests. Found singly or in pairs, never in aggregations, closely associated with waterfalls and rapids. All available types of vertebrates and invertebrates are consumed. Aestivates in burrows secreted under the roots of trees along stream banks. Little is known of the breeding habits of this species. A nest is constructed by gathering organic material into a mound not far from a small stream or brook. About 18 to 25 eggs are laid and hatch approximately four weeks later. Breeding takes place throughout the year, except for the rainy season, however, there are reports to the contrary. Most individuals are extremely shy, quick to assume the defensive and surprisingly agile. Dr. Federico Medem is the authority on the genus.

DISTRIBUTION. The whole of tropical South America, from the Guianas in the north and Mexiana Island; south to Sao Paulo, Brazil; the Rio Pastaza in Ecuador to the east coast (Figure 14).

COMMENTS. Any confusion concerning this species lies in its ecological relationship to *Paleosuchus trigonatus*, which together make up the genus *Paleosuchus*. Both species appear to occupy the same habitat within the same distribution. Specific niches are not fully understood. Many individuals display overlapping physical characteristics, although *P. palpebrosus* shows a greater degree of dermal ossification. Interbreeding of the two species under captive conditions, if possible, would be most interesting.

REFERENCES. Boulenger, 1889; Cuvier, 1807; DeCarvalho, 1955; Medem, 1958b, 1967; Mook, 1921b; Schmidt, 1928b; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933.

***Paleosuchus trigonatus* (Schneider)**

SYNONYMS. Schneider's smooth-fronted caiman, *cochirre*, *jacaré coroa*, *jacaré curua*, *yacaré coroa*.

CONTENT. No subspecies are recognized.

SIZE. Record is 225cm, male; average adult, 100cm to 130cm; hatchlings, 15cm to 20cm.

COLORATION. Dark brown above. Dark brown or black crossbands on the back and tail. Some individuals laterally tinged with yellow. Cranial table is dark brown, ear coverlets contrasting black or darker brown. A dark brown or black median dorsal stripe on the snout. Ventral surfaces densely blotched with brown. Iris of the eyes reddish brown or orange, white surrounding tissue noticeably evident.

CONFORMATION. Cranial table square and high. Snout elongate, pointed, length 1.5 times the width at the base. Orbits not anteriorly connected by a transverse bony ridge. Upper eyelids flat, entirely bony. Post-occipital and nuchal scales sharply keeled, raised. Lateral longitudinal rows of dorsal scales keeled, median rows flattened, feebly

keeled. Lateral longitudinal rows of ventral scales keeled. Transverse rows of ventral scales overlap the following row, forms an effective bony shield. Follicle glands are absent (Figure 2B). Fingers are not webbed.

SCUTELLATION.

Post-occipitals: usually a single transverse row of sharply keeled enlarged scales. A second row of smaller enlarged keeled scales not uncommon. Nuchals: 4 to 5 transverse rows of 2 scales, continuous with the dorsal scales.

Dorsals: 17 to 18 transverse rows of 6 scales, reducing to 2 to 3 scales over the hind limbs.

Double crest caudal whorls: 9 to 10.

Single crest caudal whorls: 17 to 19.

Ventral collar: a single enlarged transverse row of scales.

Ventral scales: 18 to 24 transverse rows of 10 to 12 scales.

Subcaudals: uniform uninterrupted rings.

DENTITION. Fourth mandibular teeth received in an internal socket in the upper jaw. Mandibular symphysis to the fourth or fifth tooth. Teeth often tipped with orange, posteriorly rooted in a common elongated socket. Formula: $4 + 14-15$.

21-22

SIMILAR SPECIES. Genus *Osteolaemus*: has 14 to 15 teeth on each side of the mandible. Genus *Melanosuchus*: has 17 to 18 teeth on each side of the lower jaw, five teeth on each side of the pre-maxillary. Genus *Alligator*: has more than 25 transverse ventral rows; five teeth on each side of the pre-maxillary. *Paleosuchus palpebrosus*: two transverse rows of post-occipitals, dorsals reduced to four scales over the hind limbs; ear coverlets not contrasting to the cranial table; no dark median stripe on the dorsal surface of the snout.

REMARKS. See *Paleosuchus palpebrosus*.

DISTRIBUTION. South America. From Bahia, Brazil, in the south; west to northern Bolivia and the tributaries of the Amazon river in eastern Peru; north through Colombia to Ciudad Bolivar on the Rio Orinoco, Venezuela; eastward through Guiana, Surinam, and Mexiana Island (see species map for *Paleosuchus palpebrosus*, Figure 14).

COMMENTS. See *Paleosuchus palpebrosus*.

REFERENCES. Boulenger, 1889; DeCarvalho, 1955; Medem, 1952, 1958b, 1967; Mook, 1921b; Schmidt, 1928b; Schneider, 1801; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933.

Family Crocodylidae

***Crocodylus acutus* Cuvier**

SYNONYMS. American crocodile, American saltwater crocodile, "caiman," *caiman de aguya*.

CONTENT. No subspecies are recognized.

SIZE. Maximum size of 700cm suggested. Average adult, 300cm to 400cm. Hatchlings, 25cm to 30cm.

COLORATION. Adults gray-green, dark olive-green, or gray-brown above with dark crossbands

on the back and tail, obscure in the old adult. Ventrals white or yellow-white. Lateral ventral scales spotted with gray or black. Subcaudals densely spotted with gray or black. Young colored as the adult, although with a base color of gray rather than green. Individuals from Cuba are dark olive-green with yellowish flecks above. These individuals appear nearly black above. The common coloration closely resembles, but is darker than, the coloration of *Crocodylus rhombifer*.

CONFORMATION. Skull and snout low, moderately slender, and elongate. Snout length 1.8 to 2.5 times the width at the base. Width of the mandible at the posterior point of the mandibular symphysis less than the distance from the same point to the tip of the snout (Figure 3a). Adults and young adults develop a median hump-like swelling on the snout anterior to the orbits when viewed in profile (Figure 2E). The snout is otherwise smooth and unornamented. The scutellation is highly irregular and variable among individuals. Many of the scales on the dorsal surfaces of the neck and body are separated from each other by soft skin. The skin between the enlarged scales is for the most part smooth and without many small raised scales. The dorsal scales are restricted to the median region of the back and are flanked by individual separated enlarged scales, also found on the sides of the body. The ventral scales have follicle glands. The fingers are webbed.

SCUTELLATION.

Post-occipitals: a single transverse row of 4 to 6 enlarged scales medially divided equally, otherwise usually in contact with each other.

Nuchals: 4 enlarged scales in a quadrate, flanked by a scale on each side, together forming a cluster greatly separated from the dorsal scales by an expanse of smooth skin. Variability in nuchal pattern is great among individuals and may be represented by a single scale or more than 6 scales. The nuchals are also greatly separated from the post-occipitals.

Dorsals: 16 to 17 transverse rows of enlarged scales, 1 to 6 scales per row.

Double crest caudal whorls: 16 to 17.

Single crest caudal whorls: 15 to 16.

Ventral collar: a single enlarged transverse series of scales.

Ventral scales: 26 to 32 transverse rows.

Subcaudals: uniform uninterrupted rings.

DENTITION. Fourth mandibular teeth received into an external notch on the sides of the upper jaw. Mandibular symphysis extends to the level of the fourth or fifth teeth. First two mandibular teeth often piercing the upper jaw in adults. All teeth individually socketed. Formula: $5 + 13-14$.

15

SIMILAR SPECIES. *Crocodylus intermedius*: dorsal color light yellow, yellow-green, or whitish-yellow with dark crossbands on the back and tail; Mandibular symphysis extends the level of the

sixth tooth occasionally reaching the level of the seventh tooth. *Crocodylus moreletii*: width of the mandible at the posterior point of the mandibular symphysis equal to or greater than the distance from the same point to the tip of the snout; adult size less than 250cm; individuals a meter or more in length lose the dark bars on the back and tail and become nearly uniform dark green; subcaudal rings interrupted by irregular groups of small scales. *Crocodylus niloticus*: nuchal scales closely associated to the dorsal scales, separated only by one or two small scales; dorsal scales arranged in uniform rows, extending well onto the sides of the body.

REMARKS: Inhabits coastal mangroves, lagoons, marshes, and larger ponds. Rivers within tidal limits are frequented. Has been found swimming 300 to 400 meters off-shore. Often caught by fishermen in their nets. Food consists of small mammals, fish, turtles, birds, and crustaceans. Egg laying in some portions of the range takes place the year round, but breeding usually occurs in February and March with eggs being laid from March to May. Hatching takes place from late April to June. From 30 to 60 eggs are deposited in a simple hole excavated by the female in soft sand or gravel.

DISTRIBUTION. In the United States, extreme southern coastal Florida and the Florida keys. Once as far north as Indian River. From Mexico, once found as far north as Mazatlan on the Pacific coast. Its occurrence on the Atlantic coast of Mexico is questionable. Through Central America to coastal Colombia and once to coastal northwestern Venezuela. In the West Indies, particularly from Cuba, Hispaniola and Jamaica. Not found in Puerto Rico (Figure 15).

COMMENTS. First reported in Florida in 1822, first collected in 1869. Reported to hybridize with *Crocodylus rhombifer* in semi-captivity in Cuba. Extreme difficulty encountered in separating young and juveniles of this species from those of *Crocodylus moreletii* on the west coast of Mexico. Such individuals probably led to the proposed use of *Crocodylus mexicanus* Dumeril and Bocourt (1870). Ecological relationships to *Crocodylus intermedius*, if still found in Venezuela, not known.

REFERENCES. Allen and Neill, 1953; Barbour, 1923; Boulenger, 1889; Cope, 1900; Cuvier, 1807; DeSola, 1930; I.U.C.N. Red Data Book, 1968; Medem, 1962, 1968; Mook, 1921a; Moore, 1953; Schmidt, 1924, 1944; Varona, 1966; Wermuth, 1953; Wermuth and Mertens, 1961; and West, 1900.

Crocodylus cataphractus Cuvier

SYNONYMS. Slender-snouted crocodile, West African slender-snouted crocodile, cabinda, sub-water crocodile.

CONTENT. No subspecies are recognized.

SIZE. Maximum size given is 400cm. Large adults today rarely more than 300cm, and 200cm to 250cm are average. Hatchlings probably average about 25cm.

COLORATION. Adults dark olive green or brown above, with 10 to 13 dark brown or black crossbands on the back and tail. The head is unpatterned and uniform dark brown or green. Hatchlings are more vividly colored, some with dark and yellow flecks. Ventral surfaces usually uniform cream or white. Specimens from Liberia are often ventrally patterned with numerous large black spots, several on the sides of the jaws.

CONFORMATION. The cranial table is square and high; the eyes set high on the skull. The snout is unornamented, slender, smooth, and elongate, noticeably concave. Length 2.7 to 3.3 times the width at the base. The fourth mandibular teeth usually protrude well above the snout in the adult. The dorsal scales are well keeled. The transverse dorsal scale rows are restricted to the middle of the back and do not extend down onto the sides of the body. Several large irregularly arranged separated scales sometimes form a loose row on the sides of the body. The fingers of the front feet are slightly webbed at the base. The ventral scales have follicle glands.

SCUTELLATION.

Post-occipitals: 1 to 2 pairs of small scales formed as follows: 2 scales isolated from each other, usually with 2 additional scales posterior and diagonal to the first pair of isolated scales. These are divided equally along the midline by smooth skin bearing 2 longitudinal rows of nearly indistinct small scales.

Nuchals: the nuchals are preceded by a transverse row of 4 to 6 small scales. The nuchals are composed of 4 transverse rows of 2 scales each continuous with the dorsal scales (Figure 5c).

Dorsals: 18 to 19 transverse rows of 6 scales each.

Double crest caudal whorls: 16 to 18.

Single crest caudal whorls: 15 to 16.

Ventral collar: a single transverse row of enlarged scales.

Ventral scales: 25 to 29 transverse rows.

Subcaudals: uniform uninterrupted rings.

DENTITION. Fourth mandibular teeth exposed in an external notch on the sides of the upper jaw. First mandibular teeth often pierce the tip of the snout in adults. Mandibular symphysis extending to the level of the seventh or eighth teeth. The teeth are long and needle-like along the entire jaw. All are rooted in widely separated individual sockets. Formula: $\underline{5(4) + 13-14}$.

15-16

SIMILAR SPECIES. *Crocodylus johnsoni*: nuchal scales arranged in a quadrate, flanked by two scales nearly continuous with the dorsal scales.

Crocodylus intermedius: nuchal scales arranged in a quadrate, flanked by two scales separated from the post-occipitals and the dorsal scales.

Tomistoma schlegelii: mandibular symphysis extending to the level of the fourteenth to fifteenth tooth. *Gavialis gangeticus*: mandibular symphysis extending to the level of the twenty-third to twenty-fourth tooth.

REMARKS. Inhabits streams and rivers where it feeds upon fishes and crustaceans. Although usually considered a fresh water species, it does occur in brackish water mangroves. The eggs are deposited in a mound of forest debris scraped together by the female.

DISTRIBUTION. West Africa, with a single east African locality at Ujiji, a tributary of Lake Tanganyika. Rivers south of Senegal and as far as the Congo River system. Reported from Fernando Po (Figure 16).

COMMENTS. *Tomistoma schlegelii* (S. Muller) skull figure reproduced in error as *Crocodylus cataphractus*, Wermuth and Mertens, 1961.

REFERENCES. Boulenger, 1889; Cuvier, 1824; Mook, 1921b; Schmidt, 1919, 1944; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933.

Crocodylus intermedius Graves

SYNONYMS. Orinoco crocodile, Venezuelan delta crocodile, "caiman."

CONTENT. No subspecies recognized.

SIZE. Adults reported to 678cm. Males the larger, females usually less than 400cm to 450cm. Hatchlings, 22cm to 25cm.

COLORATION. Adults light yellow, yellowish green above, yellow laterally. Gray or black crossbands on the back and tail. Ventral white or yellowish white, unpatterned to the cloacal vent. Subcaudals with dark gray or black spots. Adults may appear completely white while basking. Juveniles are patterned as the adults, although lack green and dorsally are blotched with irregular dark spots. Melanistic individuals from Angostura reported but unconfirmed by Medem.

CONFORMATION. Head and snout elongate and slender. Snout length 2 to 2.5 times the width at the base. Only a slight swelling rather than a median pre-orbital hump in front of the eyes on the adult. Snout otherwise unornamented. The dorsal scales are arranged in nearly uniform longitudinal rows and overall demonstrate more of a regularity in arrangement than *C. acutus*. The broad dorsal scales extend laterally onto the sides of the body. A longitudinal row of six to eight enlarged scales (some larger than the dorsal scales) on the sides of the body. The ventral scales have follicle glands. The fingers are webbed.

SCUTELLATION.

Post-occipitals: a single transverse row of 4 to 6 enlarged scales equally divided medially by smooth skin, otherwise in contact with each other.

Nuchals: 4 enlarged scales in a square flanked by a scale on each side, forming a cluster, widely separated from the dorsal scales by smooth skin.

Dorsals: 16 to 17 transverse rows of 4 to 6 scales.

Double crest caudal whorls: 17 to 19.

Single crest caudal whorls: 17 to 18.

Ventral collar: a single transverse row of enlarged scales.

Ventral scales: 25 to 27 transverse rows of 14 to 18 scales.

Subcaudals: uniform uninterrupted rings.

DENTITION. Fourth mandibular teeth received into an external notch on the sides of the upper jaw. Mandibular symphysis extends to the level of the sixth teeth, possibly as far as the seventh teeth. The teeth are elongated and needle-like, each individually socketed. Formula: $\frac{5 + 14}{15}$.

SIMILAR SPECIES. *Crocodylus acutus*: dorsal color green, gray-green; mandibular symphysis extends to the level of the fourth or fifth tooth. *Crocodylus cataphractus*: nuchals arranged in four transverse rows of two scales, continuous with the dorsal scales. *Crocodylus johnsoni*: nuchals formed in a cluster of scales, continuous with the dorsal scales.

REMARKS. A large fresh water dwelling species frequenting rivers, lagoons, and ponds. The food consists principally of fish and some mammals. From 15 to 70 eggs are deposited into a hole excavated in sandy soil or gravel, incubated at approximately 31°C, from January to February. Hatching takes place from late February to late March. Reported to aestivate during dry seasons and may dig caves or dens. Numerous gastroliths are reported carried. The species is for all practical purposes extinct throughout its entire range, except for a few remote areas, due entirely to the depredations of the hide and leather industry.

DISTRIBUTION. Restricted to the Orinoco river system of Venezuela and eastern Colombia, and occasionally waived to Trinidad. May have ranged into the Guianas at one time (Figure 17).

COMMENTS. Dr. F. Medem is the authority on this species. The species has been confused with other crocodylians in the literature: the *Crocodylus intermedius* skull figured in Mook (1921), Wermuth (1953), Wermuth and Mertens (1961) is an example of *Crocodylus cataphractus* Cuvier. *Temsacus intermedius* Gray (= *C. intermedius* Graves) in Rochebrune (1883) is erroneously included in the fauna of Africa. The Orinoco crocodile life figure in DeSola (1933), Ditmars (1913), and Wermuth (1953) is an example of *Crocodylus cataphractus* Cuvier. Much of this has been clarified by Brazaitis (1971).

REFERENCES. Boulenger, 1889; Brazaitis, 1971; DeSola, 1933; Ditmars, 1913; Graves, 1819; Gray, 1869; I.U.C.N. Red Data Book, 1968; Lutkin, 1884; Medem, 1958, 1968; Mook, 1921; Rochebrune, 1883; Schmidt, 1919, 1944; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933.

Crocodylus johnsoni Krefft

SYNONYMS. Johnson's crocodile, Johnston's crocodile, Johnston's river crocodile, fish crocodile.

CONTENT. No subspecies are recognized.

SIZE. Average adult 180cm to 240cm. Maximum

size 300cm. Hatchlings approximately 20cm to 25cm.

COLORATION. Dark brown or olive green above, flecked with black. Some faint dark crossbands on the back and tail. Ventrals uniform white.

CONFORMATION. Snout slender and elongate, length 2.3 to 3.2 times the width at the base. Snout smooth and unornamented. The teeth form a perfectly interlocking zigzag pattern along the sides of the jaws. The dorsal scales are formed in nearly perfect length rows, as are the longitudinal rows of scales which line the sides of the body. None are enlarged. The fingers are not webbed. The ventral scales have follicle glands.

SCUTELLATION.

Post-occipitals: a single transverse row of 4 enlarged scales, separated medially but otherwise in contact with each other.

Nuchals: 4 scales in a square, flanked by a scale on each side, forming a cluster. Nuchal scales continuous with the dorsal scales (Figure 4e).

Dorsals: 18 transverse rows of 6 to 8 scales.

Double crest caudal whorls: 17.

Single crest caudal whorls: 16 to 17.

Ventral collar: a single transverse row of enlarged scales.

Ventral scales: 22 to 24 transverse rows.

Subcaudals: some individuals bear rings interrupted by several irregular groups of small scales.

DENTITION. Fourth mandibular teeth exposed in an external notch on the sides of the upper jaw (Figure 1B). Mandibular symphysis extends to the level of the sixth or eighth teeth. The first mandibular teeth may pierce the snout. Formula:

$$\frac{5 + 14-16}{15}$$

SIMILAR SPECIES. *Crocodylus intermedius*; *Crocodylus acutus*: nuchal scales widely separated from the dorsal scales by an expanse of skin. *Crocodylus cataphractus*: nuchals are arranged in four transverse rows of two scales each, continuous with the dorsal scales.

REMARKS. Inhabits freshwater streams, rivers, and lagoons. Feeds chiefly on fish, small vertebrates, and invertebrates; as well as other crocodiles and lizards. From 12 to 24 eggs are deposited in a hole in sand or gravel, excavated by the female in August and September. The eggs are buried approximately 40cm deep, in a nest close to the water. Hatching takes place in November and December, prior to the wet season. The female attends the nest during incubation and remains with the young for a short period after hatching.

DISTRIBUTION. Northern Australia, from the Fitzroy River in the west to about latitude 21° south in the east (Figure 18).

COMMENTS. The spelling of the common name has been the subject of some confusion. The original type was collected by Sub-Inspector Johnstone in the Herbert River in Queensland.

However, the collector's name was misspelled by Gray (1873) in describing the type as *Crocodylus johnsoni*.

REFERENCES. Boulenger, 1889; Gray, 1874; Krefft, 1873; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933; Worrell, 1963.

***Crocodylus moreletii* Dumeril, Bibron, and Dumeril**

SYNONYMS. Morelet's crocodile, "alligator," Central American crocodile, Belize crocodile.

CONTENT. No subspecies are recognized.

SIZE. Adults rarely 250cm. Average size 100cm to 150cm. Hatchlings, 22cm to 27cm.

COLORATION. Young are dark olive green with dark crossbands on the back and tail. Some yellow flecks on the dorsal surfaces and yellow vermiculations on the sides. Overall becomes darker with age, nearly uniform dark green or black at about 100cm. Some dark vermiculations extend onto the lateral ventral surfaces in the form of short bars.

CONFORMATION. The head is flat and wide, the eyes small and set low into the skull. The snout is massive and wide, length 1.5 times the width at the base. A median ridge, slightly humped anterior to the orbits (Figure 2E) extends down well onto the snout. The squamosals are nearly lost in the flattened, laterally rounded, cranial table. The scales of the back, sides, and tail are feebly keeled. The flanks are smooth. The transverse rows of dorsal scales are flanked by irregularly arranged separated scales on the back and sides of the body. Ventral scales have follicle glands. The fingers are webbed.

SCUTELLATION.

Post-occipitals: a single transverse row of 4 to 6 enlarged scales equally divided medially by smooth skin, each scale separate from each other.

Nuchals: 4 enlarged scales in a square flanked by a scale on each side, forming a cluster, separated from the dorsals by a space of soft skin.

Dorsals: 15 to 17 transverse rows of 4 to 6 scales in contact with each other and flanked by irregularly arranged separated scales.

Double crest caudal whorls: 19 to 20 (17 to 18 reported).

Single crest caudal whorls: 19.

Ventral collar: a single transverse row of enlarged scales.

Ventral scales: 29 to 33 transverse rows.

Subcaudals: rings interrupted by irregular groups of small scales (Figure 2C₂).

DENTITION. Fourth mandibular teeth exposed in an external notch on the sides of the upper jaw. First mandibular teeth often pierce the upper jaw. Mandibular symphysis extends to the level of the fourth or fifth teeth. Mandible wider at the posterior point of the symphysis than from the same point to the tip of the jaw. Teeth are rather short and thick, rooted in individual sockets. Formula:

5 + 13-14.

15

SIMILAR SPECIES. *Crocodylus acutus*: dorsal color green, gray-green with dark crossbands on the back and tail, subcaudals in uniform uninterrupted rings. *Crocodylus rhombifer*: toes short and not webbed; subcaudals in uniform uninterrupted rings. *Crocodylus palustris*: color brown or yellow-brown with dark crossbands; subcaudals in uniform uninterrupted rings. *Crocodylus n. novae-guineae*: less than 26 transverse ventral rows. *Crocodylus niloticus*: from 26 to 30 transverse ventral rows; nuchals in close association to the dorsal rows.

REMARKS. Inhabits fresh water, swamps, and marshes, occasionally entering brackish water. Diet consists of fish, small mammals, and crustacea. Young reported to hatch in January in Honduras and September in Yucatan. Eggs are deposited in sand. Little is known or confirmed about life data. Considered close to extinction throughout most of its distribution.

DISTRIBUTION. Pacific coast of Mexico from the state of Nayarit and Sinaloa south. Atlantic coast from Tamaulipas south through Yucatan, British Honduras, and Guatemala (Figure 19).

COMMENTS. Young animals easily confused with the young of *Crocodylus acutus* on the west coast of Mexico. The species was not recognized by Mook (1921) as distinct from *C. rhombifer*, a most closely related species, ecologically.

REFERENCES. Boulenger, 1889; C. and A. Dumeril, 1851; I.U.C.N. Red Data Book, 1968; Mook, 1921b; Powell, 1965; Schmidt, 1924; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933.

***Crocodylus niloticus* Laurenti**

SYNONYMS. African crocodile, Ethiopian crocodile, Madagascan crocodile, or "alligator," Nile crocodile.

CONTENT. No subspecies are recognized.

SIZE. Adults 700cm would be extremely large individuals. Average size would be 400cm to 600cm. Hatchlings, 26cm to 34cm.

COLORATION. Adults and young dark olive green, yellow-green, brown with dark crossbands on the back and tail. Old adults uniform dark brown or green with faint dark crossbands. Dark spots and vermiculations on the sides of the body extends down onto the lateral ventral scales. Ventrals are white, light gray, or cream. Specimens from Madagascar are densely flecked with dark brown or black on the head, back, and tail.

CONFORMATION. The snout is moderate, extremely rugose, length 1.6 to 2 times the width at the base. The transverse dorsal scales are broad at the mid-body and extend onto the sides. The lateral body scales are large, barely discernible from the dorsal scales in size but feebly keeled. Few, if any, individual enlarged scales on the sides

of the body. Ventral scales have follicle glands. The fingers are slightly webbed at the base.

SCUTELLATION.

Post-occipitals: a single transverse row of 4 to 6 enlarged scales divided equally at the midline, otherwise in contact with each other.

Nuchals: 4 large scales in a square, flanked by a scale on each side, forming a cluster. Nuchals are separated from the dorsal scales by 1 to 2 small scales.

Dorsals: 17 to 18 transverse rows of 6 to 8 small scales.

Double crest caudal whorls: 17 to 18.

Single crest caudal whorls: 15 to 16.

Ventral collar: 1 to 2 transverse rows of slightly enlarged scales.

Ventral scales: 26 to 30 transverse rows.

Subcaudals: usually uniform uninterrupted rings.

DENTITION. Fourth mandibular tooth exposed in an external notch on the sides of the upper jaw. Mandibular symphysis extending to the level of the fourth or fifth teeth. All teeth are individually socketed. Formula: $\frac{5 + 13-14}{14-15}$

SIMILAR SPECIES. *Crocodylus p. palustris*: *Crocodylus p. kimbula*: some transverse dorsal rows reduced to four scales per row; ventral collar consists of a single transverse row of enlarged scales; some populations without a noticeable ventral collar. *Crocodylus n. novaeguineae*; *Crocodylus n. mindorensis*: ventral scales in 24 to 26 transverse rows. *Crocodylus siamensis*: from 30 to 34 transverse ventral rows; a longitudinal bony ridge raised between the orbits on the frontal region of the skull.

REMARKS. Inhabits all regions where suitable nesting sites may be found. From 25 to 95 eggs are deposited in a hole excavated by the female in sand or gravel during the dry season. In regions where more than one dry season occurs, two reproductive cycles may occur. The female guards the nest during the incubation period, approximately 60 days at 32-35°C. The female aids the young to emerge at hatching time. Moisture detrimental to the developing eggs. Hatching usually coincides with the beginning of the rainy season. Males breed at 290cm to 300cm. Females breed at 200cm.

DISTRIBUTION. All of Africa, except the Sahara. Found in Madagascar, the Comores, and once reported from the Seychelles Islands. No longer found in Israel (Figure 20).

COMMENTS. An important predator seriously endangered by hide-hunting. Many populations have well developed dermal ossifications in the ventral regions.

REFERENCES. Boulenger, 1889; Cott, 1961; Grandidier, 1872; I.U.C.N. Red Data Book, 1968; Modha, 1967; Mook, 1921b; Pooley, 1966; Schmidt, 1919, 1944; Wermuth, 1953; Wermuth and Mertens, 1961.

***Crocodylus novaeguineae novaeguineae* Schmidt**
SYNONYMS. New Guinea crocodile, freshwater crocodile.

CONTENT. *Crocodylus novaeguineae* is composed of two races: *Crocodylus novaeguineae novaeguineae* and *Crocodylus novaeguineae mindorensis*.

SIZE. Maximum size 284cm. Average adult is 180cm to 200cm. Hatchlings approximately 25cm.

COLORATIONS. Drab olive green, gray-green above with interrupted dark crossbands on the back and tail; extending onto the sides but not onto the ventral scales. Dorsal surfaces flecked with dark brown or black. Ventrals uniform white.

CONFORMATION. Snout elongate, length 1.8 to 2.3 times the width at the base. A slight suggestion of a pre-orbital ridge present at the anterior points of the orbits in adult individuals. The dorsals are broad at the midbody, extending onto the sides. Lateral body scales nearly as large as the dorsals, oval, arranged in uniform longitudinal rows alternating with rows of smaller oval scales. The fingers are webbed. The ventral scales bear follicle glands.

SCUTELLATION.

Post-occipitals: a transverse row of 4 enlarged scales, divided equally at the midline, separated from each other.

Nuchals: variable in size and arrangement. Four scales in a square, with a scale on each side, forming a cluster. Nuchal scales tend to be separated from each other, particularly along the midline; which divides the cluster with a space of smooth skin. Nuchals separated from the dorsals by 2 small scales only.

Dorsals: 17 transverse rows of scales. The widest at midbody bears 10 scales.

Double crest caudal whorls: 18 to 20.

Single crest caudal whorls: 17 to 19.

Ventral collar: a single transverse row of enlarged scales.

Ventral scales: 24 to 25 transverse rows of scales. Subcaudals: uniform uninterrupted rings.

DENTITION. Fourth mandibular teeth exposed in an external notch on the sides of the upper jaw. Mandibular symphysis extends to the level of the fourth or fifth teeth. All teeth are independently socketed. Formula: $\frac{5 + 13-14}{15}$

SIMILAR SPECIES. *Crocodylus n. mindorensis*: sides of the body bear one or two slightly irregular rows of enlarged scales; nuchal scales in contact with each other, not separated along the midline. *Crocodylus porosus*: ventrals in more than 29 transverse rows; post-occipitals usually absent. *Crocodylus siamensis*: a longitudinal raised ridge between the orbits on the frontal; ventrals in more than 30 transverse rows; a median row of small scales extending caudad from the vent through the first several rows of subcaudal whorls.

REMARKS. Although frequenting fresh water, it is also known to enter brackish waters. The species prefers shallow lakes, swamps, and marshes. Reported to construct a nest of sticks, mud, and aquatic vegetation and grass. From 23 to 35 eggs are laid in November and incubate at 39°C; 77mm x 49mm in size. The diet consists largely of waterfowl and small mammals.

DISTRIBUTION. Inland, New Guinea (Figure 21).

COMMENTS. The ecological relationship between this species and *Crocodylus porosus* is not clearly understood, nor is the parallel relationship to the Philippine race. Wermuth (1953) placed the New Guinea and Philippine crocodiles in species synonymy.

REFERENCES. Neill, 1946; Schmidt, 1928a, 1932, 1944; Smith, 1931; Wermuth, 1953; Wermuth and Mertens, 1961; Werner 1933.

***Crocodylus novaeguineae mindorensis* Schmidt**

SYNONYMS. Freshwater crocodile, Mindoro crocodile, Philippine crocodile.

CONTENT. *Crocodylus novaeguineae* is composed of two races: *Crocodylus novaeguineae novaeguineae* and *Crocodylus novaeguineae mindorensis*.

SIZE. Maximum size up to 250cm; average 150cm to 200cm.

COLORATION. Patterned as *Crocodylus n. novaeguineae*. Dorsal color brown, transverse dorsal bars on the back and tail. Short dark bars extend onto the ventral scales on the sides. Ventrals are white.

CONFORMATION. Snout moderate, length 1.8 to 2.3 times the width at the base. Two ridges extend well onto the snout from the anterior points of the orbits. Transverse dorsal rows broad at mid-body extending laterally onto the sides. One or two irregularly arranged longitudinal rows of three to six enlarged scales on each side of the body. Fingers are slightly webbed at the base. Ventrals have follicle glands.

SCUTELLATION.

Post-occipitals: a single transverse row of 4 to 6 enlarged scales, separated medially, but otherwise in contact with each other.

Nuchals: 4 enlarged scales in square, flanked by a scale on each side, forming a cluster. Nuchals closely associated to but separated from the dorsals by two small scales. Scales making up the cluster are in contact with each other and are not separated along the midline by soft skin.

Dorsals: 17 transverse rows of 6 to 8 scales.

Double crest caudal whorls: 18 to 19.

Single crest caudal whorls: 16 to 18.

Ventral collar: a single transverse row of enlarged scales.

Ventral scales: 25 to 26 transverse rows.

Subcaudals: uniform uninterrupted rings.

DENTITION. As *Crocodylus n. novaeguineae*.

Formula: $5 + 13-14$.

15

SIMILAR SPECIES. *Crocodylus n. novaeguineae*: nuchal cluster separated along the midline by soft skin; scales on the sides of the body uniform in size, arranged in uniform longitudinal rows. *Crocodylus porosus*; *Crocodylus siamensis*: more than 29 transverse ventral rows.

REMARKS. Life habits little known, probably comparable to *Crocodylus n. novaeguineae*.

DISTRIBUTION. The Phillipine Islands of Luzon, Mindoro, and Mindanao (Figure 22).

COMMENTS. Rapidly becoming extinct due to uncontrolled hunting.

REFERENCES. Schmidt, 1935, 1938, 1944, 1956; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933.

***Crocodylus palustris palustris* Lesson**

SYNONYMS. Mugger, marsh crocodile, Indian swamp crocodile.

CONTENT. *Crocodylus palustris* is composed of two races: *Crocodylus palustris palustris* and *Crocodylus palustris kimbula*.

SIZE. Adults recorded up to 400cm. Average adult 200cm to 300cm. Hatchlings approximately 27cm.

COLORATION. Brown, yellow-brown, or olive-brown, with dark crossbands on the back and the tail. Dark vermiculations on the sides of the body and tail barely enter the ventral scales. Ventrals uniform white.

CONFORMATION. Head and snout massive and rugose. Eyes set low into the skull. Snout length 1.3 to 1.5 times the width at the base. The dorsal scales are restricted to the median dorsal region and do not extend down onto the sides of the body. Two longitudinal rows of five to six enlarged scales on each side of the body. The fingers are slightly webbed at the base. Ventral scales have follicle glands.

SCUTELLATION.

Post-occipitals: usually a single transverse row of 4 to 6 enlarged scales, separated equally at the midline, but otherwise in contact with each other.

Nuchals: 4 scales in a square, flanked by a scale on each side, forming a cluster; closely associated to but separated from the dorsals by two small scales.

Dorsals: 16 to 18 transverse rows of 4 to 6 scales.

The majority of scale rows contain 4 scales.

Double crest caudal whorls: 18 to 19.

Single crest caudal whorls: 16.

Ventral collar: no distinct transverse series of enlarged scales.

Ventral scales: 26 to 32 transverse rows.

Subcaudals: uniform uninterrupted rings.

DENTITION. Fourth mandibular teeth exposed in an external notch on the sides of the upper jaw. Mandibular symphysis extends to the level of the

fourth or fifth teeth. All teeth are independently socketed. Formula: $(4) \frac{5 + 14}{15}$.

SIMILAR SPECIES. *Crocodylus p. kimbula*: ventral collar present; a single transverse series of enlarged scales. *Crocodylus moreletii*: subcaudals interrupted by irregular groups of small scales; dorsal color dark olive green or black. *Crocodylus porosus*: post-occipitals usually absent, or one to four slightly enlarged separated scales; two pre-orbital ridges extend well onto the snout from the anterior points of the orbits.

REMARKS. Inhabits swamps and rivers usually above tidal limits. Twenty or more eggs are deposited approximately 40cm deep in holes dug in soft sand or gravel by the female at the beginning of the rainy season. The site chosen is usually beneath a fringe of brushwood above flood limits. The female attends the nest throughout the 40 day incubation period, and is said to liberate the young from the nest at hatching. The diet consists of fish, birds, and mammals.

DISTRIBUTION. India and West Pakistan to the Brahmaputra of west Assam. A single report from Burma is doubtful (Figure 23). Two specimens of questionable locality, "The Philippines," were examined (AMNH 4805 and AMNH 4806).

COMMENTS. Subspecific morphological differences are subject to overlapping variation with the related subspecies. There are significant ecological differences in the life habits which should be further investigated.

REFERENCES. Boulenger, 1889; Deraniyagala, 1939; DeRoos, 1915; Loveridge, 1945; Mook, 1921b; Schmidt, 1944; Smith, 1928, 1931; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933; Yadov, 1968.

Crocodylus palustris kimbula Deraniyagala

SYNONYMS. Muggar, Ceylon marsh crocodile, stream crocodile, lake crocodile, albino crocodile (a color phase), *ala kimbula*, *hole kimbula*, *kulathe muthele*.

CONTENT. *Crocodylus palustris* is composed of two races: *Crocodylus palustris palustris* and *Crocodylus palustris kimbula*.

SIZE. Adults 350cm to 400cm; record is 557cm. Average size about 200cm, in recent times. Hatchlings 25cm to 27cm.

COLORATION. As *Crocodylus p. palustris*.

CONFORMATION. As in *Crocodylus p. palustris*.

SCUTELLATION.

Post-occipitals: as in *Crocodylus p. palustris*.

Nuchals: as in *Crocodylus p. palustris*.

Dorsals: 16 to 18 transverse rows of 4 to 6 scales.

The majority of transverse rows contain 6 scales. Double crest caudal whorls: 18 to 19.

Single crest caudal whorls: 16.

Ventral collar: a single transverse row of enlarged

scales.

Ventral scales: 26 to 32 transverse rows.

Subcaudals: uniform uninterrupted rings.

DENTITION. As *Crocodylus p. palustris*. Formula: $(4) \frac{5 + 14}{15}$.

SIMILAR SPECIES. *Crocodylus p. palustris*: ventral collar absent. Additional as *C. p. palustris*.

REMARKS. Seldom inhabits rivers flowing at any speed. Prefers sedentary ponds, marshes, and swamps. Frequently enters saltwater lagoons. Gregarious in habit; known in Ceylon for its ferocity. Burrows, with entrances and exits underwater, are dug in sand banks in which the animal aestivates during the dry season. The nest is dug in nearby sand or gravel in August to May. Eggs have been reported in February, April, and May. Incubation takes about 50 or 60 days. The diet consists primarily of frogs, terrapins, and mammals. Natives believe that copulation takes place in brushwood in March.

DISTRIBUTION. Lowland areas and plains of Ceylon (Figure 24).

COMMENTS. As *Crocodylus p. palustris*.

REFERENCES. Deraniyagala, 1936, 1939; Wermuth, 1953; Wermuth and Mertens, 1961.

Crocodylus porosus Schneider

SYNONYMS. Estuarine crocodile, man-eating crocodile, saltwater crocodile, sea-going crocodile, *baya*, *buaja*, *buaya*, *gatte kimbula*, 'gator, *goekeya*, *semmuklon*.

CONTENT. *Crocodylus porosus minikanna* was recognized as a subspecies indigenous to Ceylon. It is not considered in this work.

SIZE. The largest reptile and crocodylian in the world today. Maximum recorded size is 1005 cm (collected in Bengal in 1840). Average adult, 350 cm to 450 cm; hatchlings, 22 cm to 30 cm.

COLORATION. The hatchlings and young adults are yellow above with numerous large dark spots on the head, body, and tail. Adults become dark olive drab above with slight yellow remaining on the sides. Some of the dark spotting is also retained. The ventrals are immaculate white.

CONFORMATION. Snout moderate, becoming massive with age, rugose, length 1.7 to 2.1 times the width at the base. Two longitudinal bony ridges extend onto the snout from the anterior points of the orbits. Squamosals are raised into a bony ridge. Dorsal scales are restricted to the median portions of the back and do not extend laterally onto the sides of the body. Scales of the sides of the body are small, uniform in size, and arranged in uniform longitudinal rows. The fingers are webbed. The ventral scales have follicle glands.

SCUTELLATION.

Post-occipitals: absent entirely or represented by 1 to 4 small slightly enlarged, well separated, scales. The skin in the post-occipital region is

composed of numerous, irregularly arranged, small bead-like scales.

Nuchals: 4 large scales arranged in a square, with a scale on each side forming a cluster widely separated from the dorsal scales.

Dorsals: 16 to 17 transverse rows of 6 to 8 scales. Double crest caudal whorls: 19 to 20.

Single crest caudal whorls: 19 to 21.

Ventral collar: a single enlarged row of transverse scales.

Ventral scales: 31 to 35 transverse rows.

Subcaudals: some individuals have rings interrupted by irregularly arranged small scales.

DENTITION. Fourth mandibular teeth exposed in an external notch on the sides of the upper jaw. Mandibular symphysis extends to the level of the fourth or fifth teeth. All teeth are independently socketed. Formula: $4(5) + 13-14$.

15

SIMILAR SPECIES. *Crocodylus siamensis*: a raised longitudinal ridge between the orbits in the frontal region; fingers are slightly webbed at the base; enlarged scales on the sides of the body; from two to four enlarged post-occipitals; dorsal color of young and adults, dark green above with light flecks, white on the lower sides and ventral surfaces; numerous small scales surround the cloacal vent and proceed caudad through several subcaudal tail whorls. *Crocodylus n. novaeguineae* and *Crocodylus n. mindorensis*: ventral scales in less than 28 transverse ventral rows.

REMARKS. Prefers saltwater marshes, mangroves, pools, and rivers within tidal limits; although not uncommon in rivers and large streams well up-river. Long sea journeys are not uncommon for this species, a habit contributing to the development of an extensive distribution. Known throughout its range for its great size and ferocity. The 25 to 50 eggs are deposited into a mound of organic debris scraped together by the female. Nesting may take place during the wet season as well as the dry period, which is usual in parts of its range. Females breed at about 250 cm. Incubation takes nearly three months at 32°C, although five months at lower temperatures is reported. Food consists of fishes, but all forms of vertebrates and invertebrates are consumed when available.

DISTRIBUTION. Ceylon and the gulf coast of India, on the west coast as far north as Cochin, eastward to the coasts and tidal waters of Thailand, Cambodia east to Hong Kong; the Philippines, Solomon Islands, and Fiji; the coast and offshore islands of northern Australia and New Guinea; Borneo, Celebes, Sumatra, and Indonesia (Figure 25).

COMMENTS. Individuals from Ceylon bear small post-occipitals. Additional investigations into other island populations seems to be called for before recognizing the variation as a subspecies. *Crocodylus porosus* life figure in Barret (1950) is an example of *Alligator mississippiensis*.

REFERENCES. Barrett, 1950; Boulenger, 1889; DeRooij, 1915; Kimura, 1968; Loveridge, 1945; Mook, 1921b; Schmidt, 1932, 1944, 1956; Schneider, 1801; Smith, 1931; Wermuth, 1953; Wermuth and Mertens 1961; Werner, 1933; Worrel, 1963.

***Crocodylus rhombifer* Cuvier**

SYNONYMS. Cuban crocodile, "caiman," *cocodrilo*, *zaquendo*, *perla*, *cocodrilo perla*, *criollo*, *legitimo*.

CONTENT. No subspecies are recognized.

SIZE. Adults rarely more than 350 cm. A maximum size of 500 cm is suggested. Average adult 200 cm to 250 cm. Females larger than males in average size, reported. Hatchlings little known, approximately 20 cm to 30 cm.

COLORATION. Adults yellow-green or green above with dense dark green or black speckling on the head, body, and tail. The post-occipitals, nuchal, and dorsal scales are often extremely dark or black. The small raised pointed scales which cover the skin between the large body scales are tipped with yellow and black. The limbs, sides of the body, and tail are blotched with yellow and black vermiculations. A series of dark bars extends onto the ventral scales from the side vermiculations. Ventral surfaces are white, laterally tinged with yellow on some individuals. The edges of the eyelids are usually white, giving a "spectacled" appearance. Old adults become darker with age but retain the yellow and black blotches and vermiculations on the sides of the body and tail. Juveniles are patterned as the adults in vividly rich tones.

CONFORMATION. The head and jaws are massive. The snout rugose, length 1.4 to 1.6 times the width at the base. Adults bear a longitudinal ridge on the snout, originating at a point medially anterior to the orbits (suggestive of a pre-orbital hump at this point), and extending down the middle of the snout to level of the external lateral pre-maxillary/maxillary notches. The squamosals are elevated into a bony ridge (Figure 2A). The uniformly arranged dorsal scales are confined to the median region of the back and do not extend down onto the sides of the body. There are two to three longitudinal rows of enlarged isolated scales on each side of the body. The ventral scales have follicle glands. The fingers are extremely short and lack webs.

SCUTELLATION.

Post-occipitals: a single transverse row of 4 sharply keeled, enlarged scales, well separated from each other. The greatest separation occurring at the midline dividing the scales equally.

Nuchals: 4 enlarged scales in a quadrate flanked by a scale on each side, forming a cluster in close association to the dorsal scales but separated from them by 1 to 2 small scales.

Dorsals: 16 to 17 transverse rows of 6 scales each.

Median longitudinal rows only feebly keeled.

Double crest caudal whorls: 17 to 19 rings.

Single crest caudal whorls: 17 to 18

Ventral collar: a single transverse row of enlarged

scales.

Ventral scales: 32 to 33 transverse rows.

Subcaudal scales: uniform uninterrupted rings.

DENTITION. Fourth mandibular teeth exposed in an external notch in the sides of the upper jaw. Mandibular symphysis extends to the level of the fourth or fifth teeth. All teeth independently socketed. Formula: $5 + 13-14$.

15

SIMILAR SPECIES. *Crocodylus moreletii*: fingers are long and webbed; subcaudals arranged in rings interrupted by groups of irregular small scales; few interscales, keeled but not tubercular in elevation. *Crocodylus niloticus*; *Crocodylus novaeguineae*: ventrals in less than 30 transverse rows. *Crocodylus palustris*: dorsal scales irregularly arranged; subcaudals, arranged in uniform uninterrupted rings; broadest transverse rows extending onto the sides; dorsal color is brown. *Crocodylus acutus*: fingers long and webbed; dorsal scales irregularly arranged; snout elongate and slender. *Crocodylus siamensis*: fingers long and webbed.

REMARKS. A freshwater swamp-dwelling species, feeding largely on fish, turtles, and small mammals. The eggs, 78mm x 52mm in size, are reported to be laid in a nest excavated in the ground.

DISTRIBUTION. Formerly the Isle of Pines, the Zapata swamp, central Cuba (Figure 26).

COMMENTS. Few individuals remain in the wild due to the depredations of the hide-hunters and agricultural drainage of the habitat. Numbers estimated at about 3,000, with a few more in zoological institutions. Most existing individuals contained in semi-captive enclosed areas along with *Crocodylus acutus*. Hybridization between the two species reported.

REFERENCES. Barbour and Ramsden, 1919; Boulenger, 1889; Buide, 1967; Cuvier, 1807; DeSola, 1930; I.U.C.N. Red Data Book, 1968; Mook, 1921b; Varona, 1966; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933.

Crocodylus siamensis Schneider

SYNONYMS. Siamese crocodile, freshwater crocodile, *buaya*.

CONTENT. No subspecies are recognized.

SIZE. Adults 350 cm to 400 cm. Average adult 250 cm to 300 cm. Hatchlings, approximately 25 cm.

COLORATION. Dark olive, yellow, or brownish-green, spotted with black above. Dark crossbands on the back and tail. Ventrals white or yellowish-white.

CONFORMATION. Snout is moderate and slightly concave, length 1.5 to 1.6 times the width of the base. A short pair of sharply converging ridges at the anterior point of the orbits. A longitudinal bony ridge is evident between the orbits on the frontal (Figure 4e). The squamosals are raised in a high ridge. The dorsal scale rows are broadest at midbody and extend onto the sides. Two irregular

longitudinal rows of enlarged scales on each side of the body. The fingers are slightly webbed at the base. Ventral scales have follicle glands.

SCUTELLATION.

Post-occipitals: a single transverse row of 4 enlarged scales separated equally along the midline as well as from each other.

Nuchals: 4 scales in a square, flanked by a scale on each side, forming a cluster; widely separated from the post-occipitals as well as the dorsal scales.

Dorsals: 16 to 18 transverse rows of 6 scales.

Double crest caudal whorls: 19 to 20.

Single crest caudal whorls: 17 to 19.

Ventral collar: a single transverse row of enlarged scales.

Ventral scales: 30 to 34 transverse rows.

Subcaudals: anterior several rings interrupted by irregular groups of small scales. A series of small scales surround the cloacal vent and extend caudad through the first several rings of subcaudal tail whorls (Figure 2C₁).

DENTITION. Fourth mandibular teeth exposed in an external notch on the sides of the upper jaw. Mandibular symphysis extends to the level of the fourth or fifth teeth. All teeth are independently socketed. Formula: $4 + 13-14$.

15

SIMILAR SPECIES. *Crocodylus porosus*: lacks a longitudinal ridge between the orbits; yellow or yellow-green above with black spots and crossbands; small scales surround the cloacal vent only. *Crocodylus p. palustris*; *Crocodylus p. kimbula*: nuchal scales closely associated to the dorsal scales, separated only by two small scales. *Crocodylus moreletii*: squamosals flattened, laterally rounded; a slight hump or swelling medially anterior to the orbits, continuing as a slight ridge down the middle of the snout; the fingers are webbed. *Crocodylus n. novaeguineae* and *C. n. mindorensis*: less than 28 ventral rows.

REMARKS. Inhabits rivers and freshwater swamps above tidal limits. Diet consists of fishes. The eggs are deposited in a hole excavated in a mudbank at the beginning of the rainy season. Mound nesting also reported. The female attends the nest. She is said to dig the youngsters out of the nest when hatched and remains with them for some time. Young and extremely vocal and "yong" repeatedly when disturbed.

DISTRIBUTION. Central and peninsular Thailand; Cambodia, the river Quae (north to latitude 16°); and the northern part of the Malay peninsula. Questionable reports from Java (Figure 27).

COMMENTS. Has been bred in large numbers under captive conditions in Thailand. Wild populations are largely depleted.

REFERENCES. Boulenger, 1889; DeRooij, 1915; Loveridge, 1945; Schmidt, 1944; Schneider, 1801; Y. Siah *in litt.*; Smith, 1931; Taylor, 1970; Wer-

muth, 1953; Wermuth and Mertens, 1961; Werner, 1933.

Osteolaemus tetraspis tetraspis Cope

SYNONYMS. Broad-nosed crocodile, West African crocodile.

CONTENT. *Osteolaemus tetraspis* is divided into two races: *Osteolaemus tetraspis tetraspis* and *Osteolaemus tetraspis osborni*.

SIZE. Adults rarely 200 cm in length. Average size 100 cm to 150 cm. Hatchling size unrecorded.

COLORATION. Adults uniform black above, blotched or uniform black on the ventral surfaces. Young blotched with brown above with broad black crossbands on back and tail. Some yellow vermiculations on the sides of the jaws, body, and tail. Ventral surfaces blotched with brown or black. The iris of the eyes of the young and adults is dark brown. The palate white or cream, anteriorly mottled with black.

CONFORMATION. Snout short, wide and blunt, concave. The nasal region is well elevated on the snout in the adult. Snout only slightly longer than its width at the base, rugose but without other ornamentation. The eyes are large, eyelids rugose, with well-developed "eyelash-like" appendages. The dorsal scales are arranged in uniform longitudinal rows. The two vertebral rows lack any significant keel. Several enlarged, irregularly arranged scales may be found on each side of the body. The ventral scales have follicle glands, at least in the gular region. The fingers are slightly webbed at the base.

SCUTELLATION.

Post-occipitals: usually a single transverse row of sharply raised scales.

Nuchals: 4 large scales arranged in a square, closely associated to, but separated from the dorsals by 2 small scales.

Dorsals: 17 to 20 transverse rows of 6 to 8 scales. Double crest caudal whorls: average 11 (10 to 12). Single crest caudal whorls: 15 to 17.

Ventral collar: a single transverse row of enlarged scales.

Ventral scales: 26 to 27 transverse rows.

Subcaudals: uniform uninterrupted rings.

DENTITION: Fourth mandibular teeth exposed in a notch on the sides of the upper jaw. Mandibular symphysis extends to the level of the fourth or fifth teeth. The teeth are short and thick, individually socketed. Formula: $4 + \frac{12-13}{14-15}$.

SIMILAR SPECIES. *Alligator sinensis*: fourth mandibular teeth socketed; there are five teeth on each side of the pre-maxillary. *Paleosuchus trigonatus*; *Paleosuchus palpebrosus*: more than 20 teeth on each side of the lower jaw. *Osteolaemus tetraspis osborni*: snout flat, not concave; nostrils not elevated above the snout; interior of the mouth (palate) yellowish-white.

REMARKS. Inhabits streams, possibly saltwater

estuaries, bordering rain forests. Diet consists largely of crustaceans and fish. The eggs are laid in a mound of organic debris scraped together by the female on high ground near water. Nesting takes place from December to the end of February. The eggs are reported to be tolerant of moisture and not dependent on a dry season for incubation.

DISTRIBUTION. West Africa, south of the Sahara and northwest of the Congo River system (Figure 28). Distributional separation between the two races of *Osteolaemus* is not clearly defined.

COMMENTS. See *Osteolaemus tetraspis osborni*.

REFERENCES. Boulenger, 1889; Cope, 1861; Inger, 1948; Schmidt, 1919, 1944; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933.

Osteolaemus tetraspis osborni (K.P. Schmidt)

SYNONYMS. Black crocodile, bony crocodile, Congo dwarf crocodile, dwarf crocodile, rough back crocodile.

CONTENT. *Osteolaemus tetraspis* is divided into two races: *Osteolaemus tetraspis tetraspis* and *Osteolaemus tetraspis osborni*.

SIZE. Largest specimen collected by Schmidt was 114 cm. Maximum size probably 150 cm.

COLORATION. As *Osteolaemus t. tetraspis*. Some adults display faint, wide brown crossbands on the back and tail. The interior of the mouth (palate) yellowish-white or white.

CONFORMATION. As *Osteolaemus t. tetraspis*. Snout is flat, not concave. Nasal region is not elevated. A lateral longitudinal row of approximately five enlarged scales on each side of the body.

SCUTELLATION.

Post-occipitals: 2 transverse rows of 4 scales, separated from each other.

Nuchals: 3 pairs of scales arranged in 2 longitudinal rows, ending in close proximity to but not in contact with the dorsal scales.

Dorsals: 18 transverse rows, the broadest containing 16 scales (rows of 4 scales followed by rows of 6 scales, followed by rows of 4 scales).

Double crest caudal whorls: 12 to 14.

Single crest caudal whorls: 17 to 19.

Ventral collar: a single transverse row of enlarged scales.

Ventral scales: 21 to 23 transverse rows.

Subcaudals: uniform uninterrupted rings.

DENTITION. As in *Osteolaemus t. tetraspis*. Formula: $4 + \frac{12-13}{24-15}$.

SIMILAR SPECIES. *Osteolaemus tetraspis tetraspis*: snout concave, nostrils elevated; interior of mouth (palate) darkly mottled anteriorly, posteriorly cream or white.

REMARKS: Inhabits streams and rivers within rain forest. Nesting is similar, in the use of a mound of organic debris.

DISTRIBUTION. Northern Congo River system (Figure 29).

COMMENTS: Schmidt originally designated this race as a new genus, *Osteoblepharon*, which has not been upheld.

REFERENCES: Inger, 1948; Schmidt, 1919, 1944; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933.

Tomistoma schlegelii (S. Muller)

SYNONYMS. Malayan garial, Malayan gharial, false gavial, *baya kanulong*, *buai sapit*, *buai senjulong*, *bedai sampit*.

CONTENT. No subspecies are recognized.

SIZE. Maximum size to 500 cm. Average adult 350 cm to 400 cm. Hatchlings approximately 30 cm.

COLORATION. Dark reddish-brown above with dark brown or black spots and crossbands on the back and tail. Ventrals grayish-white. Juveniles are mottled with black on the sides of the jaws, body, and tail.

CONFORMATION. Snout extremely long and slender, parallel sided, length 3 to 3.5 times the width at the base. Snout smooth and unornamented. The dorsal scales are broad at midbody and extend onto the sides of the body. One or two longitudinal rows of six to eight enlarged scales on each side of the body. The fingers are webbed at the base. The ventral scales have follicle glands.

SCUTELLATION.

Post-occipitals: frequently a single pair of slightly enlarged scales. Some individual bear several small keeled scales divided medially by soft granular skin.

Nuchals: 3 transverse rows of 2 enlarged scales, continuous with the dorsal scales.

Dorsals: 22 transverse rows of 6 to 8 scales. (Note: dorsal + nuchal rows equals a total of 22 to 23 rows).

Double crest caudal whorls: 18.

Single crest caudal whorls: 17.

Ventral collar: a single transverse row of enlarged scales.

Ventral scales: 22 to 24 transverse rows.

Subcaudals: uniform uninterrupted rings.

DENTITION. The first and fourth mandibular teeth are exposed in external notches on the sides of the upper jaw. All teeth long and needle-like, interlocking on the sides of the jaws and are individually socketed. Mandibular symphysis extends to the level of tooth 14 to 15. Formula: $4-6 + 15-16$, usually $20-21$.

19-20

19-20

SIMILAR SPECIES. *Gavialis gangeticus*: mandibular symphysis extends to the level of tooth 23 to 24. *Crocodylus cataphractus*; *C. intermedius*; *C. johnsoni*: mandibular symphysis extends to the level of the sixth to eighth tooth.

REMARKS. Feeds chiefly on fish and small mammals. Inhabits freshwater rivers, lagoons, and marshes. Little is known of its life habits. The eggs

measure 97 mm to 109 mm x 64 mm.

DISTRIBUTION. Borneo, Sumatra, Malaya, and the Perak River of southern Thailand (Figure 30).

COMMENTS. Rapidly becoming exterminated throughout its range.

REFERENCES. Boulenger, 1889; De Rooij, 1915; De Sola, 1933; Loveridge, 1945; Mook, 1921b; Muller, 1838; Schmidt, 1944; Taylor, 1970; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933.

Famii Gavialidae

Gavialis gangeticus (Gmelin)

SYNONYMS. Gangetic gharial, garial, gavial, gharial, Indian gavial.

CONTENT. No subspecies are recognized.

SIZE. Maximum recorded size 625 cm. Average adult 350 cm to 450 cm. Hatchlings approximately 37 cm.

COLORATION. Dark or light olive above with dark crossbands and speckling on the head, body, and tail. Dorsal surfaces becoming dark almost gray-black at about 20 years of age. Ventrals are yellowish-white.

CONFORMATION. Snout extremely long and slender, parallel sided. Squamosals rounded and flat. Snout length 3.3 to 5.5 (in young) times the width of the base, smooth and completely unornamented. Males develop a hollow nasal protrusion at sexual maturity. The neck is elongated and thick. The scales on the sides of the body are oval, uniform in size, and arranged in uniform longitudinal rows. The dorsals are more or less restricted to the median regions of the back. The fingers are short and thickly emarginated with a web. The ventral scales have follicle glands, at least in the gular region.

SCUTELLATION.

Post-occipitals: a single enlarged pair of separated scales or two small scales with two additional scales at diagonals to the first pair.

Nuchals: 4 transverse rows of 2 scales continuous with the dorsal scales.

Dorsals: 21 to 22 transverse rows of 6 scales. (Nuchals + dorsals = 21 to 24 rows).

Double crest caudal whorls: 18 to 20.

Single crest caudal whorls: 15.

Ventral collar: no enlarged transverse row of scales.

Ventral scales: 30 to 31 transverse rows.

Subcaudals: in uniform uninterrupted rings.

DENTITION. The teeth are long and needle-like, often extending above and below the jaws along most of the anterior jaw line. The first and fourth mandibular teeth exposed in external notches on the sides of the upper jaw. Mandibular symphysis extends to the level of tooth 23 to 24. The teeth are individually socketed. Formula: $5 + 23-24$.

25-26

SIMILAR SPECIES. *Tomistoma schlegelii*:

mandibular symphysis extends to the level of the fourteenth to fifteenth tooth.

REMARKS. Feeds primarily on fish, although corpses are said to be eaten as well as birds and small mammals. Frequents open rivers and streams. Captive specimens have difficulty swallowing meats and prefer fish. Forty or more eggs are deposited in a hole excavated in sand or gravel. Hatchlings reported in March or April.

DISTRIBUTION. Northern India, West Pakistan to Assam. The rivers Indus, Ganges, Mahanadi, Kaladan, and the Brahmaputra (Figure 31). A single record exists from the Irrawaddy River in Burma.

COMMENTS. One of the most primitive, timid, and inoffensive of crocodylians. Indian gavial life figure in De Sola, 1933 is an example of *Tomistoma schlegelii*.

REFERENCES. Boulenger, 1889; De Sola, 1933; Gmelin, 1789; Mook, 1921b; Schmidt, 1944; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933.

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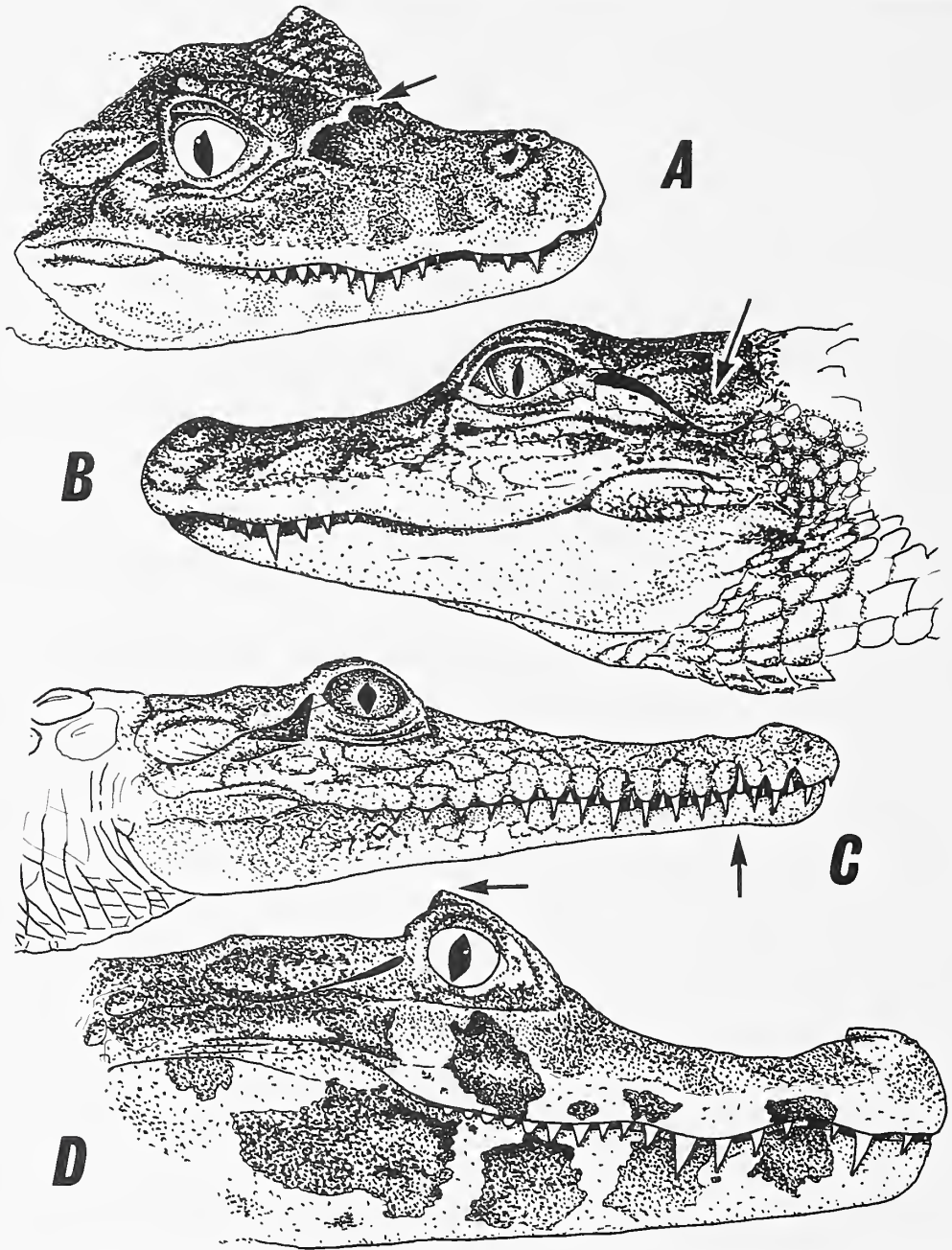


FIGURE 1. *Caiman crocodilus crocodilus* (A) lacks dark blotches on the sides of the jaws. The arrow indicates the transverse bony ridge which, in resembling the nose-bridge of human eye glasses, has given rise to one of the English common names for this animal, spectacled caiman.

Like all members of the family Alligatoridae, the fourth mandibular tooth of *Alligator mississippiensis* (B) is hidden in an internal socket when the mouth is closed. The arrow indicates the ear coverlet which extends over the tympanum from the squamosal bone.

In *Crocodylus johnsoni* (C), as in all crocodiles, family Crocodylidae, the fourth mandibular tooth is exposed (as indicated by the arrow) when the mouth is closed.

Caiman crocodilus yacare (D) has dark blotches on the sides of the jaws. This character is also found in a few other caimans, *Caiman latirostris* and *Melanosuchus*, and crocodiles, some *Crocodylus cataphractus* and *Tomistoma*.

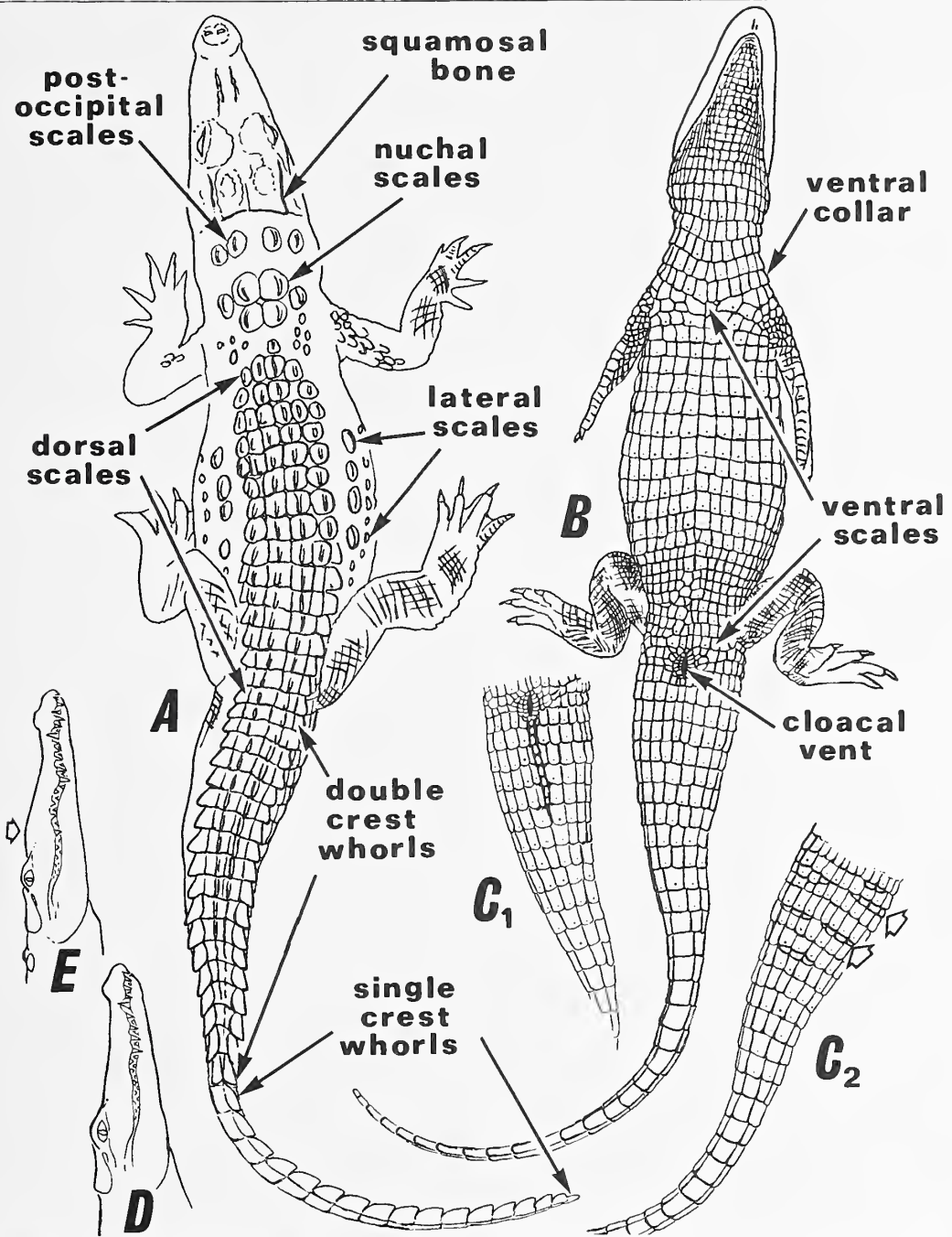


FIGURE 2. Diagrammatic dorsal (A) and ventral (B) views of crocodilian. Some of the morphological characters used in distinguishing between species are indicated. Transverse scale rows are counted by beginning and ending with the rows indicated by the arrows. The cranial table consists of the flat portion of the skull between the squamosal bones. Members of the families Crocodylidae and Gavialidae have follicle glands on the ventral scales (indicated by the single dots on the scales). The Alligatoridae lack these follicle glands.

Except for rare sports ("freaks"), the scales under the tails of crocodilians are arranged in complete transverse rows (B), but in typical *Crocodylus moreletii* (C₂) there are incomplete rows and extra scales intruded between the rows. *Crocodylus siamensis* has a series of small scales which extend caudad through the first several rings of subcaudal tail whorls from the cloacal vent (C₁). A few crocodiles have distinct a hump on the snout (E), which most do not (D).

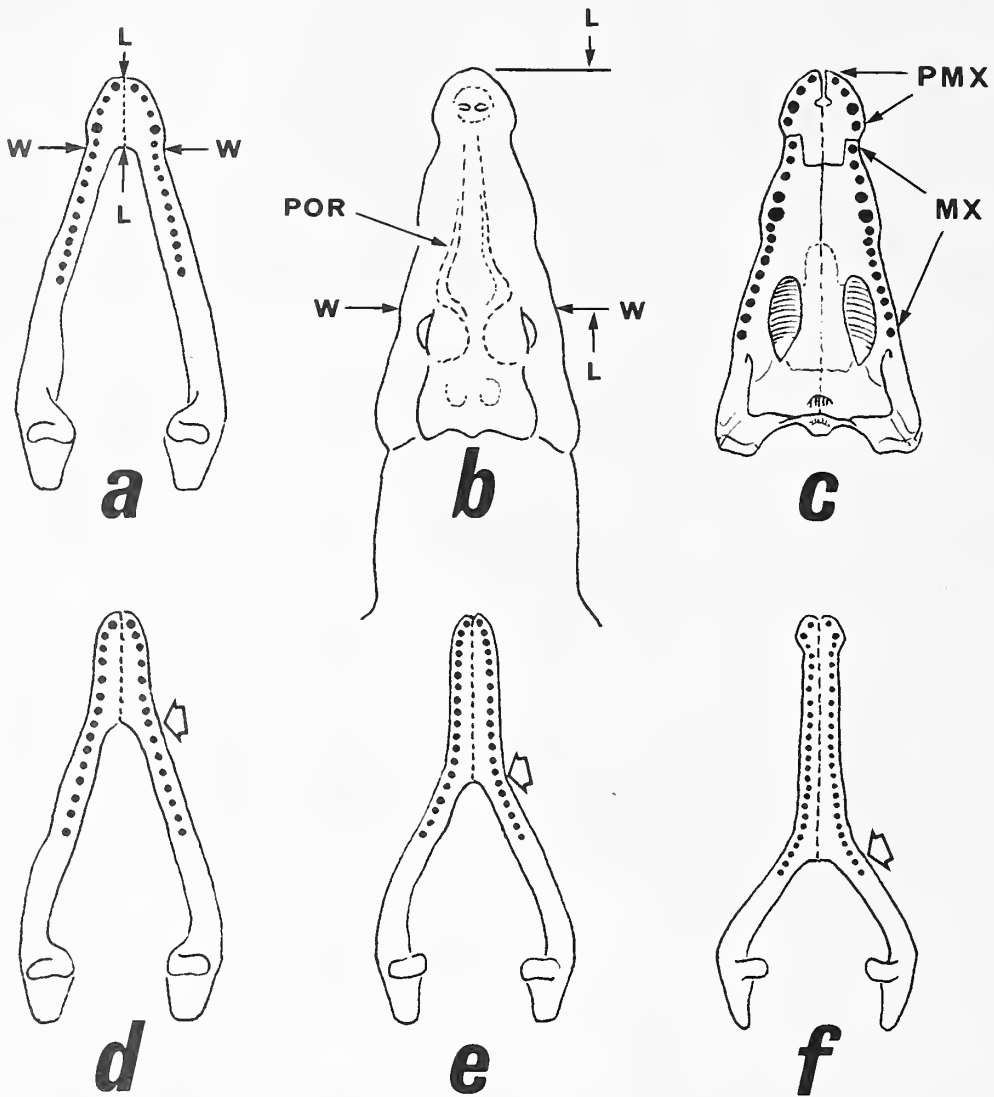


FIGURE 3. Measurements and morphological characters of crocodilian mandibles and skulls. The number of teeth are counted independently on the right and left sides.

All the mandibular teeth (a) found on one side are given as a single number, while the teeth of the upper jaw (c) are given as two numbers, the teeth found on the premaxillary bone (PMX) and those found on the maxillary bone (MX). The width of the mandible (a) at the posterior margin of the symphysis is indicated by arrows (W). The length of the mandibular symphysis is indicated by arrows (L). The length of the snout (b) is measured

in a straight line from the tip of the premaxillary bone to the anterior corner of the orbit, indicated by arrows (L). The width of the snout (b) is measured at a point opposite the anterior corner of the orbits, indicated by arrows (W). Some species of crocodiles have raised preorbital ridges (POR) of bone on their snouts. Most crocodilians have the symphysis of the mandible fused only to the level of the fourth or fifth tooth (a). However, some species have a symphysis whose posterior margin (indicated by the open arrows) is fused to the level of the eighth (d), fourteenth or fifteenth (e), or twenty-third (f) teeth.

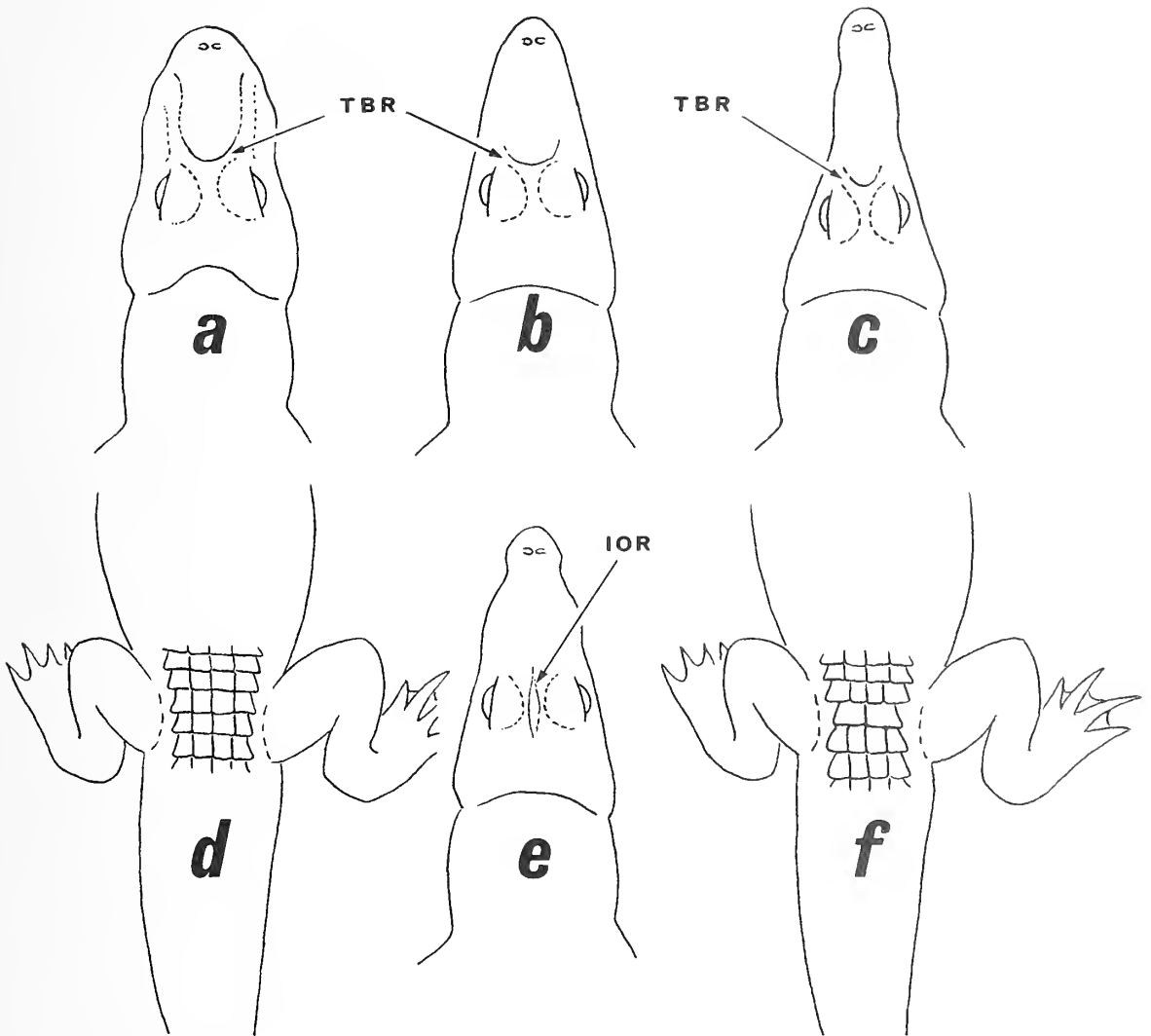


FIGURE 4. The snout of adult *Caiman latirostris* (a) is broad and short, while *Caiman crocodilus crocodilus* (b) is moderately short and wide, and *Caiman crocodilus apaporensis* (c) is long and narrow, even being parallel-sided anteriorly. Many caimans possess a transverse bony ridge (TBR)

extending across the snout just anterior to the orbits. Adult *Crocodylus siamensis* (e) has a longitudinal interorbital ridge (IOR) present. *Paleosuchus palpebrosus* has a minimum of four large dorsal scales over the hindlimbs (d), while *Paleosuchus trigonatus* has a minimum of two scales (f).

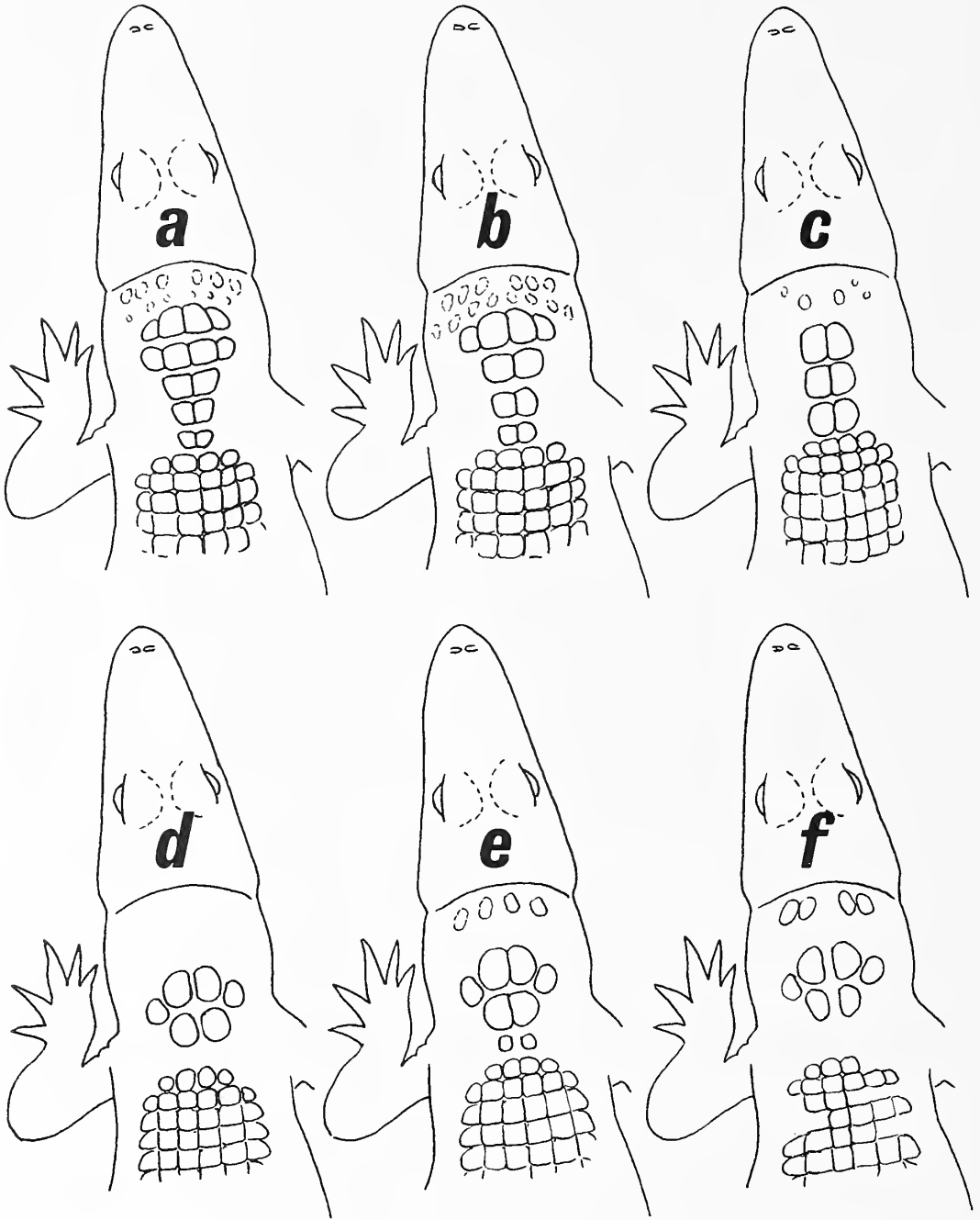


FIGURE 5. Diagrammatic representation of the arrangement of post-occipital scales, nuchal scales, and dorsal scales in crocodylians (see Figure 2).

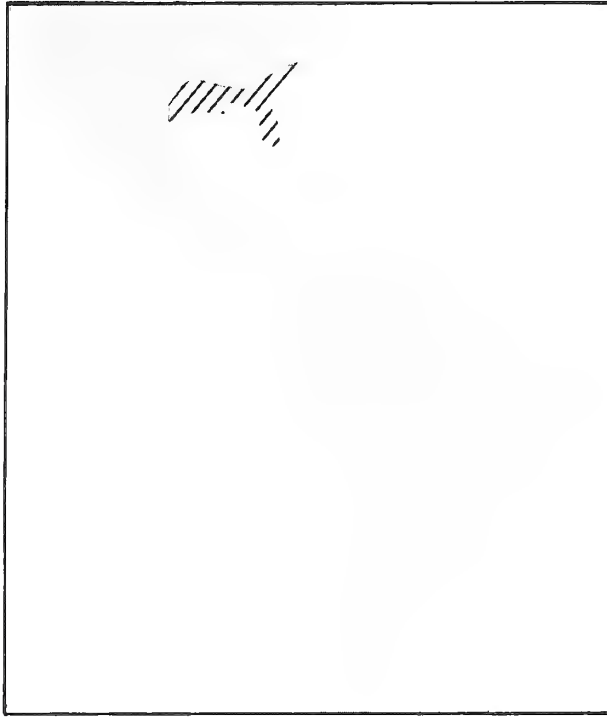


FIGURE 6. Range of distribution of *Alligator mississippiensis*.

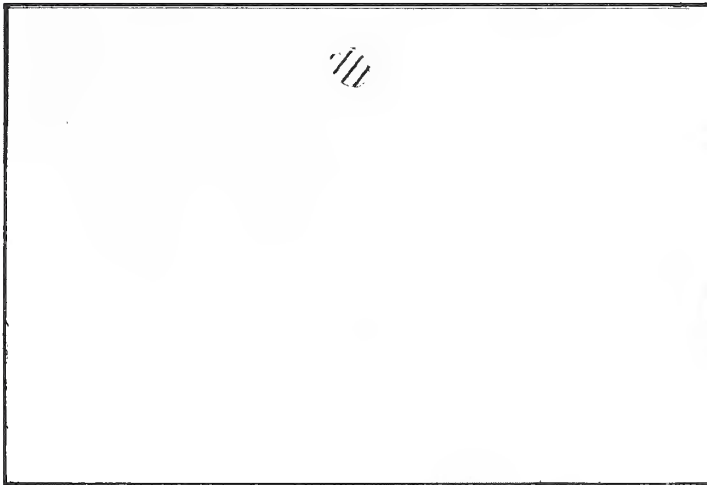


FIGURE 7. Range of distribution of *Alligator sinensis*.

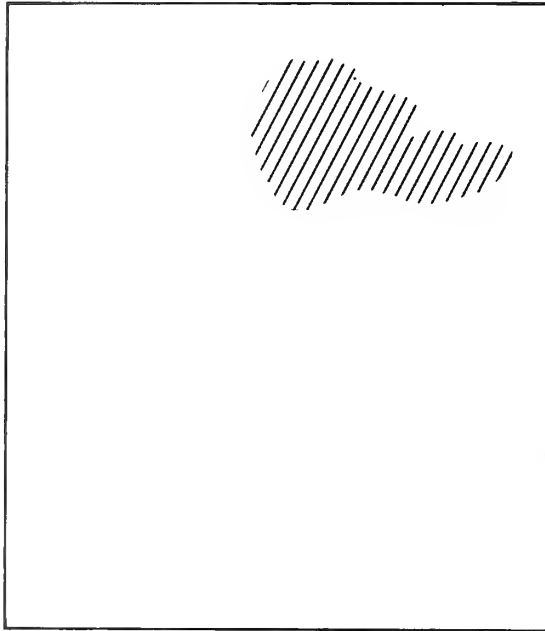


FIGURE 8. Range of distribution of *Caiman crocodilus crocodilus*.

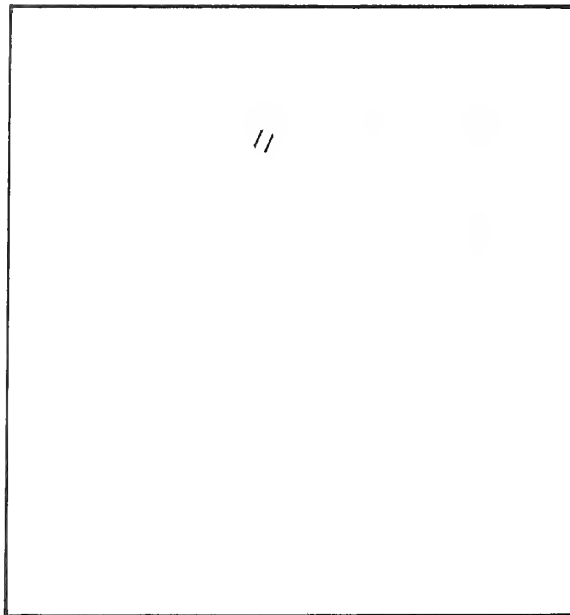


FIGURE 9. Range of distribution of *Caiman crocodilus apaporiensis*.

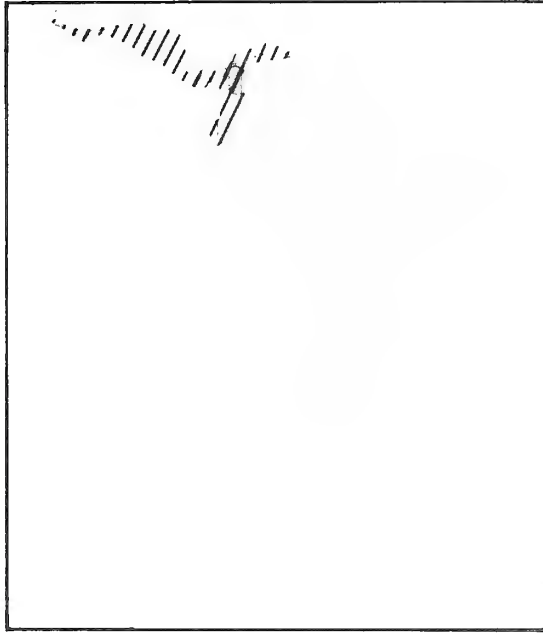


FIGURE 10. Range of distribution of *Caiman crocodilus fuscus*.

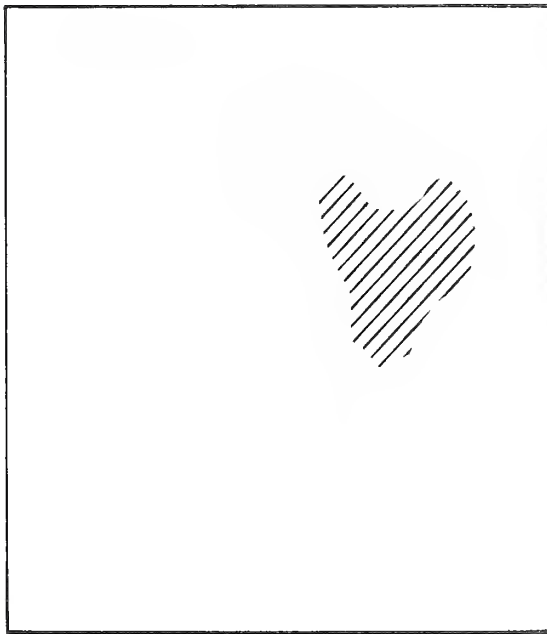


FIGURE 11. Range of distribution of *Caiman crocodilus yacare*.



FIGURE 12. Range of distribution of *Caiman latirostris*.



FIGURE 13. Range of distribution of *Melanosuchus niger*.

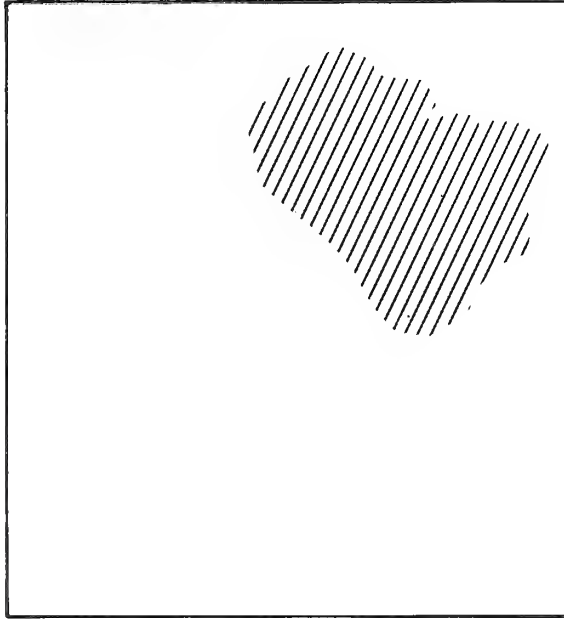


FIGURE 14. Range of distribution of *Paleosuchus palpebrosus*.

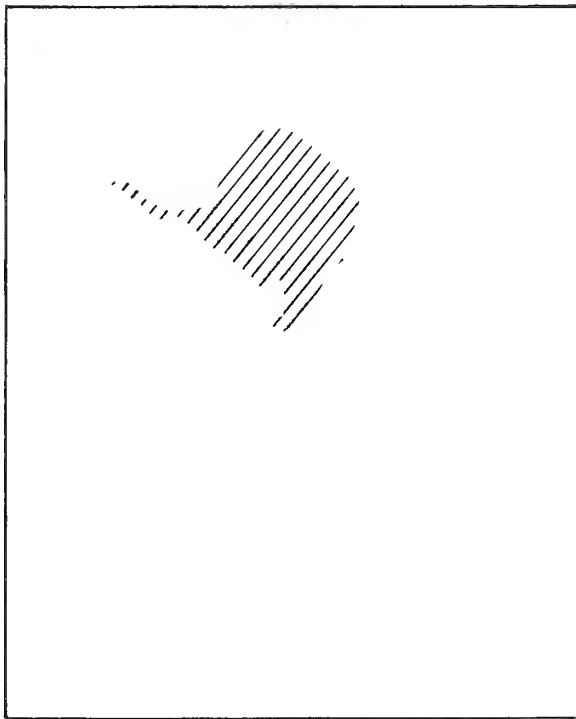


FIGURE 15. Range of distribution of *Crocodylus acutus*.

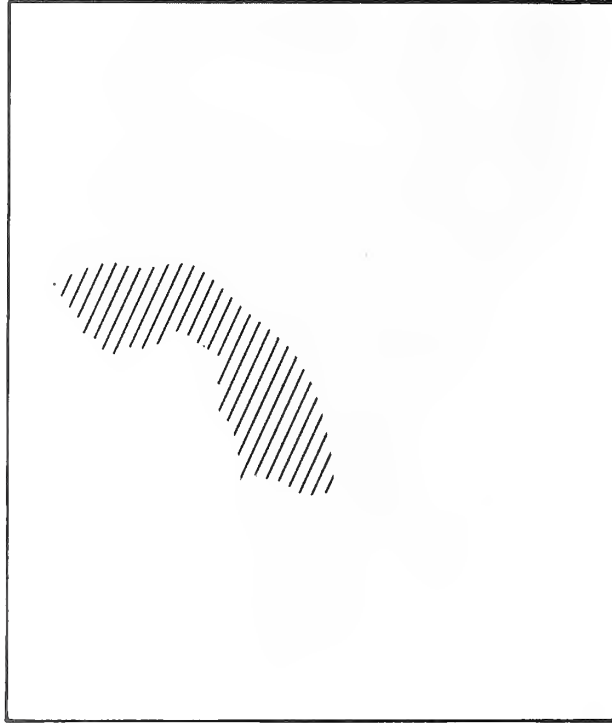


FIGURE 16. Range of distribution of *Crocodylus cataphractus*.

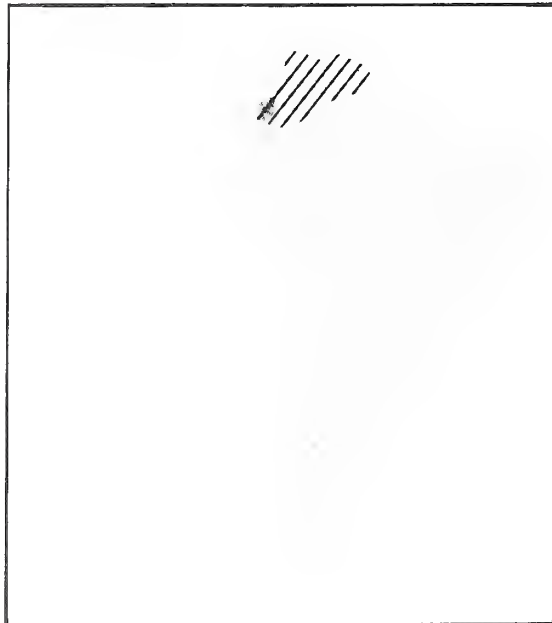


FIGURE 17. Range of distribution of *Crocodylus intermedius*.

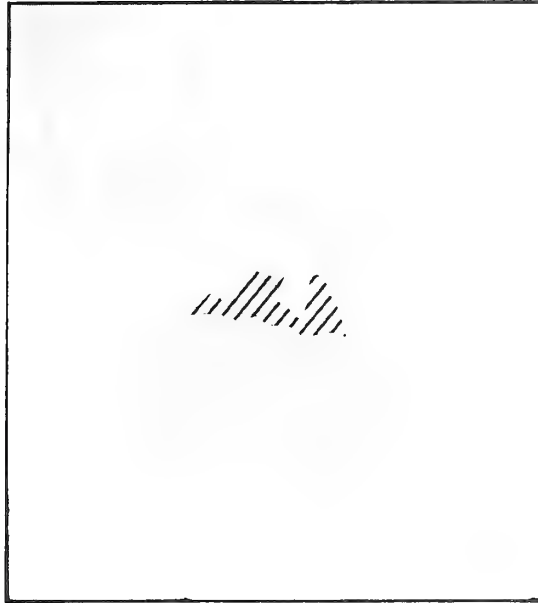


FIGURE 18. Range of distribution of *Crocodylus johnsoni*.

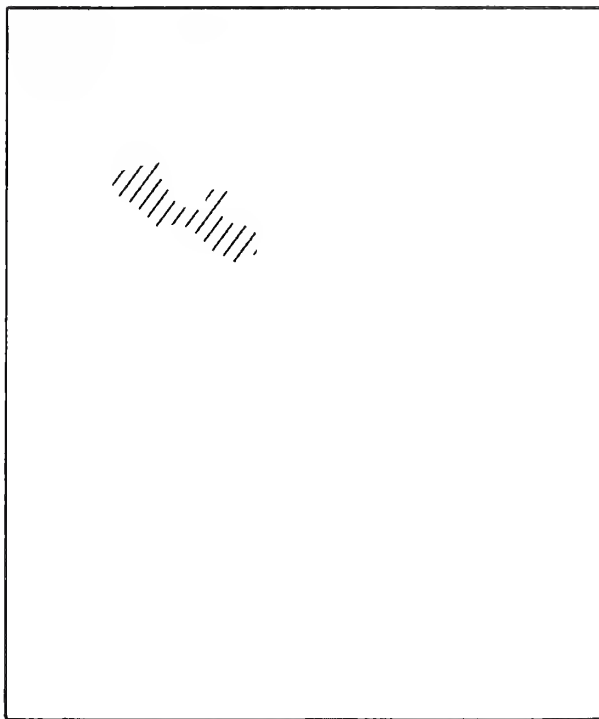


FIGURE 19. Range of distribution of *Crocodylus moreletii*.

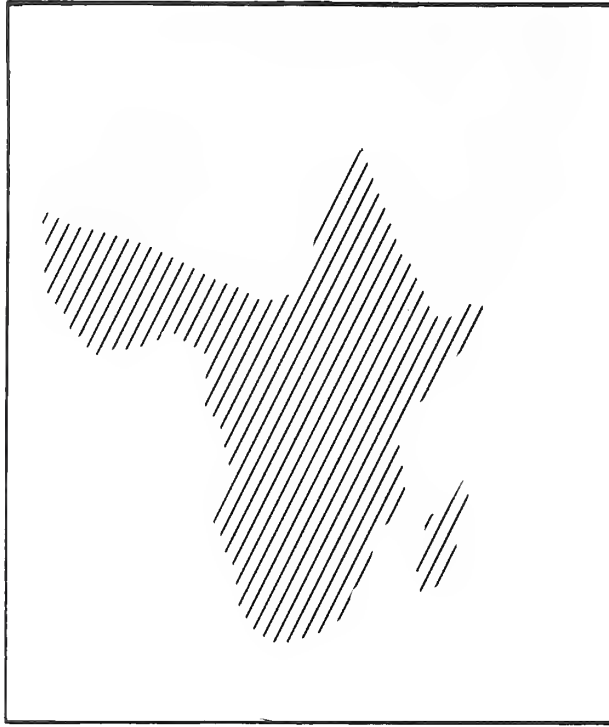


FIGURE 20. Range of distribution of *Crocodylus niloticus*.

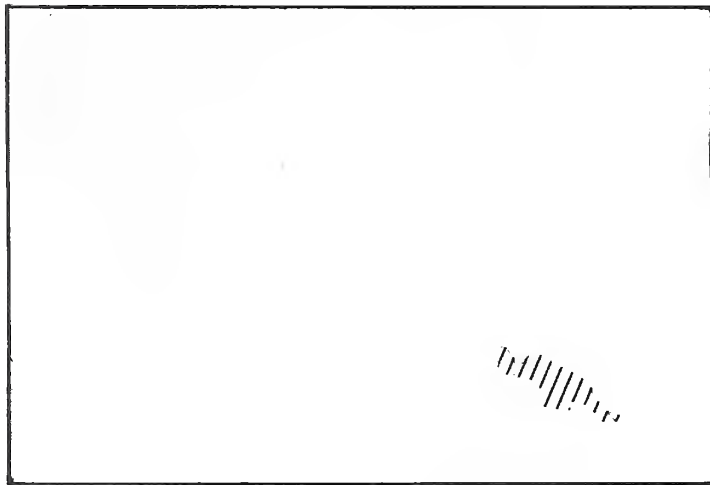


FIGURE 21. Range of distribution of *Crocodylus novaeguineae novaeguineae*.



FIGURE 22. Range of distribution of *Crocodylus novaeguineae mindorensis*.



FIGURE 23. Range of distribution of *Crocodylus palustris palustris*.



FIGURE 24. Range of distribution of *Crocodylus palustris kimbula*.

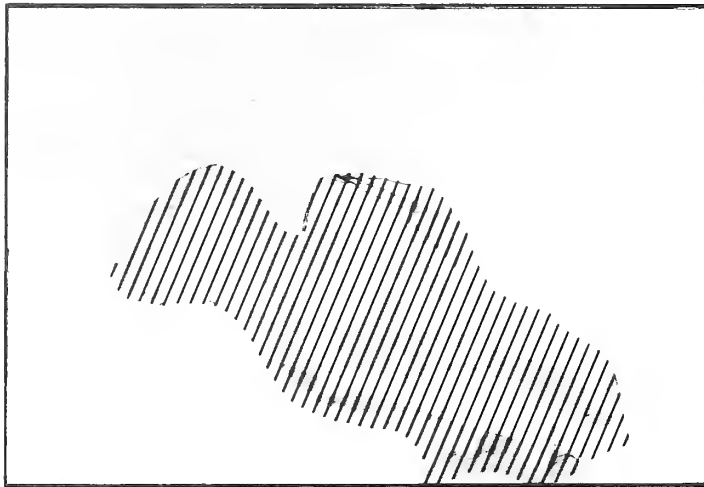


FIGURE 25. Range of distribution of *Crocodylus porosus*.

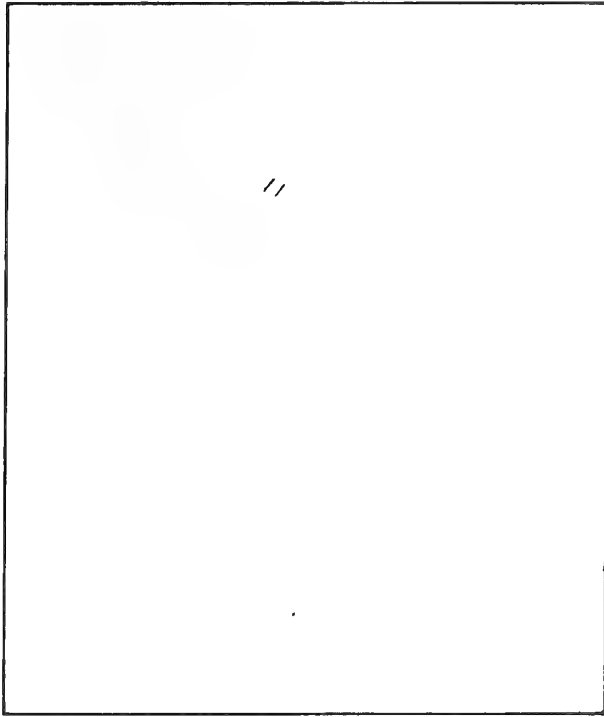


FIGURE 26. Range of distribution of *Crocodylus rhombifer*.

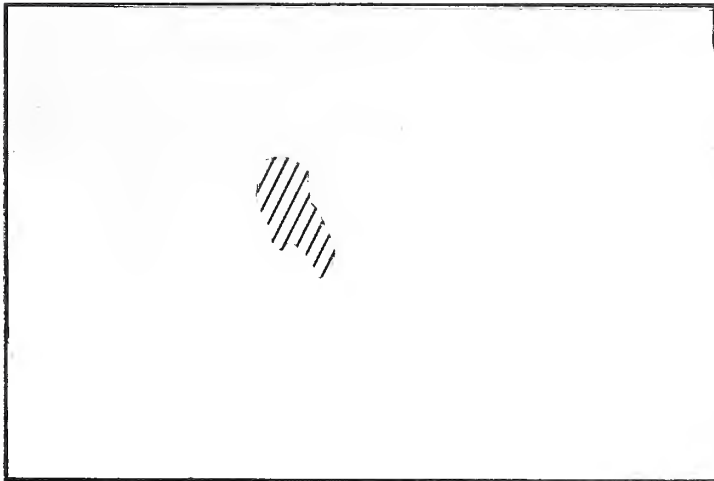


FIGURE 27. Range of distribution of *Crocodylus siamensis*.

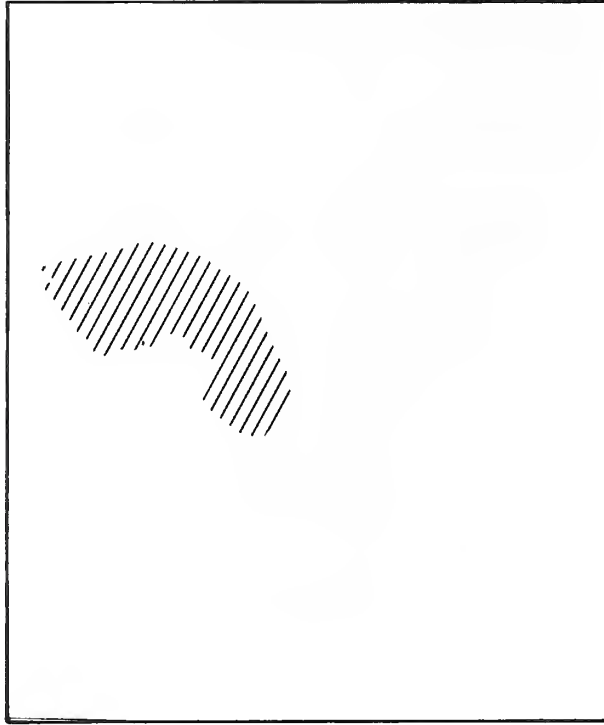


FIGURE 28. Range of distribution of *Osteolaemus tetraspis tetraspis*.

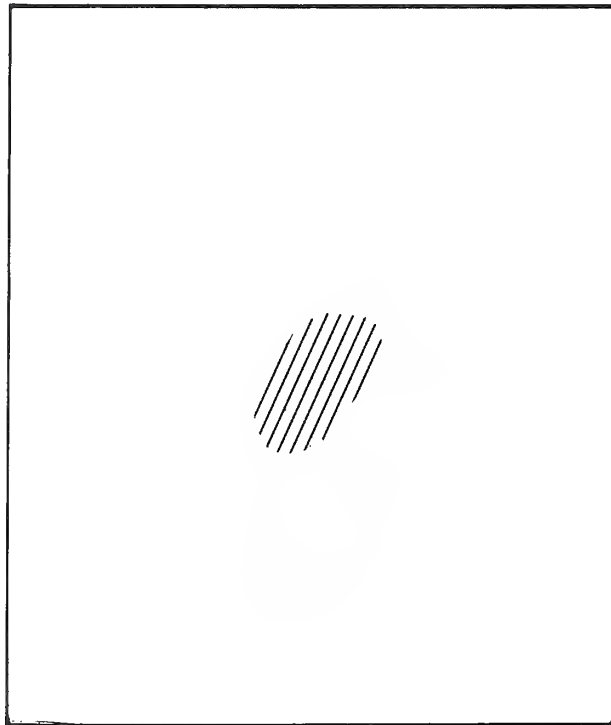


FIGURE 29. Range of distribution of *Osteolaemus tetraspis osborni*.

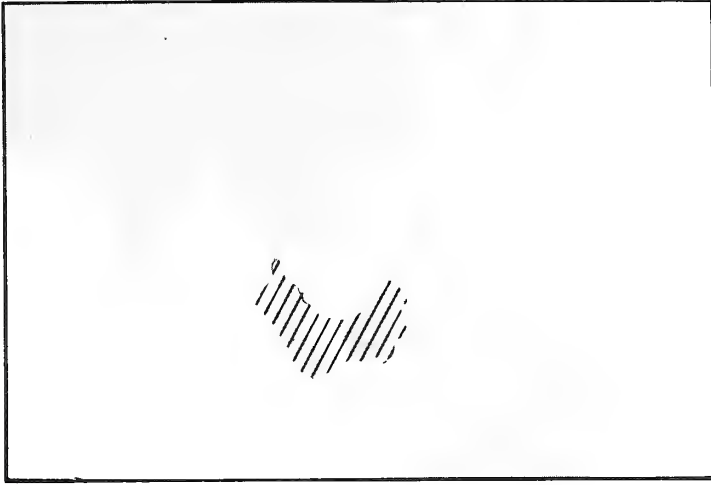


FIGURE 30. Range of distribution of *Tomistoma schlegelii*.

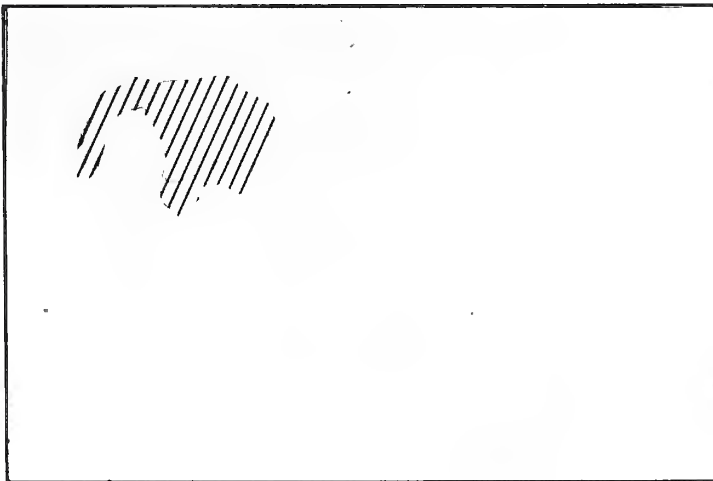


FIGURE 31. Range of distribution of *Gavialis gangeticus*.

NEWS AND NOTES

Observations on the Status of the Giant Armadillo,
Priodontes giganteus, in Paraguay

DURING MARCH AND APRIL of 1972 while under a grant from the American Philosophical Society (Philadelphia) investigating the Pichiy armadillo, *Zaedyus pichiy caurinus*, and the La Plata three-banded armadillo, *Tolypeutes matacus*, of northern Argentina and Paraguay, certain facts regarding the status of the giant armadillo, *Priodontes giganteus*, came to light.

Two adult armadillos had been exhibited in the Cordoba, Argentina, Zoological Gardens during the previous two years. Both animals came from the province of Salta, Argentina, and both exhibited gunshot wounds on arrival. Neither animal lived longer than several weeks and both expired from septicemia as a result of their wounds, despite intensive therapy (Dr. Carlos A. Rickard, pers. comm.). This species is irregularly available from the Province of Salta where it is reported to be uncommon.

During 1971 and 1972, at least four giant armadillos were captured in Paraguay (H. Stellfeld, pers. comm.; and C. Mulkey and J. Mulkey, pers. comm.). Of these, one adult male was eventually exported to a European Zoo from Asuncion, where it later died. Two animals, one male and one female, were captured and eaten by the Moro Indians in the area of Mariscal Estigarribia. One animal, a male, was captured by local people near the Bolivian border and was also eaten.

Throughout its range in Paraguay, the giant armadillo is nowhere common and there do not appear to be any population centers. The range appears to be broken and discontinuous. Within its range, the armadillo is a favored food item and a valuable source of protein for the various inhabitants (D. A. Meritt, Jr., unpublished observations). From all reports, the armadillo appears solitary and no observers had seen more than one animal at any one time.

There is at present no law protecting this species in Paraguay and there are no immediate plans to implement such legislation. A health certificate from the Departamento de Accion y Control Pecuario of the Ministerio de Agricultura y Ganaderia is the only necessary document for legal ex-

port of this species from Paraguay. During this so-called breeding season of November to April, all mammal export permits are prohibited, but the issuing of the health papers needed for export occurs.

Although animal dealers in Asuncion are aware of the potential value of this animal for export, few reach this animal export center. The animal is much more valuable to the local people as food than as a live export item. There are also difficulties in containing this live animal in existing animal facilities because of its strength and talents for escape.

The status of this species in Paraguay is almost certainly critical. There is a sparsity of information regarding its natural history and reproductive biology, and there are no current field studies of the species in progress.

These observations were obtained through personal interviews and discussions as well as actual field work while in Paraguay.

Within the near future we are hopeful of conducting an indepth study of the giant armadillo to gain insight into the life style of this unique mammal. Currently, a young adult male is under observation and study at the Lincoln Park Zoological Gardens, Chicago, Illinois, and continues to do well.

DENNIS A. MERITT, JR., Lincoln Park Zoological Gardens, Chicago, Illinois 60614

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