LITERATURE CITED

BENSON, A. A., AND L. MUSCATINE. 1974. Wax in coral mucus: Energy transfer from corals to reef fishes. Limnol. Oceanog. 19:810–814.
HOBSON, E. S. 1968. Predatory behavior of some shore fishes in the Gulf of California. U.S. Dept. Interior, Fish Wildl. Serv. Res. Rpt. 73.
———. 1974. Feeding relationships of teleostean fishes on coral in Kona, Hawaii. Fish. Bull. 72:915–1031.
LEWIS, R. 1970. Fish cutaneous mucus: A source of skin surface lipid. Lipids 5:947–949.
REESE, E. S. 1977. Coevolution of corals and coral feeding fishes of the family Chaetodontidae. Proc. Third Internat. Coral Reef Symp. 1:267–274.
SPRINGER, V. G., AND W. F. SMITH-VANIZ. 1972. Mimetic relationships involving fishes of the family Blenniidae. Smithsonian Contrib. Zool. 112.
WICKLER, W. 1960. Aquarienbeobachtungen an *Aspidontus* einem ektoparasitischen Fisch. Zeit. fur Tierpsychol. 17:277–291.

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HERPETOLOGICAL NOTES

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AMPULLARID GASTROPOD—STAPLE FOOD OF *CAIMAN LATIROSTRIS*?—Crocodilians are opportunistic predators, eating whatever available prey that can be overpowered. Scattered reports list the food items for the different species of Crocodylia (Cott, 1961; Corbet, 1959a, b; Neill, 1971; Valentine et al., 1972; Diefenbach, 1974). These reports are based on analysis of stomach contents of animals either killed for this purpose or poached. Several species of Crocodylia are on the brink of vanishing (including *Caiman latirostris*) and killing animals for analysis of their diet is at best of doubtful scientific value, especially of a species whose recruitment is unknown. Crocodilians are particularly susceptible to this approach (Gans and Pooley, 1976). There is evidence from these reports of a shift in prey items and/or prey size with age. Insects are thought to be an important factor in the dietary budget of young (<1 m TL) *Crocodylus niloticus* (Corbet, 1959a; Cott, 1961). Adult (>1 m TL) animals shift to prey such as fishes, birds and mammals.

There is apparently a correlation between reliance on fish and the slenderness of the snout. Thus *Gavialis gangeticus* feeds almost exclusively on live fish (Neill, 1971), while *C. niloticus* and other Crocodylia with more slender snouts are supposedly able to harvest significant amounts of the available fish biomass. Blunt snouted Crocodylia would theoretically be less efficient in catching moving prey underwater because of the smaller area swept by the jaws. *Caiman latirostris* has the shortest and most massive snout among Recent Archosauria (Neill, 1971). Based on morphological grounds and the physical laws of curvilinear and rotational motion *Caiman latirostris* should be the least efficient at catching live, moving fish. The radius of gyration is larger when more mass is distributed distally (Hildebrand, 1974:ch. 14). Their massive heads and snouts would require larger forces (hence more powerful neck muscles) to accelerate to speeds similar to the ones attained at the tip of the jaw of a gharial or crocodile. Measurements of the sideways "fish-catching," underwater strike, of different living Crocodylia would provide comparative and clarifying data to elucidate the strategies developed by the short snouted species to compensate for the consequences of this morphological trait.

Remnants of aquatic molluscs, such as shell fragments and/or opercula have been found in the stomach of crocodilians, including *Caiman latirostris* (Hensel, 1868). How relevant are molluscs in the dietary intake of *C. latirostris*? During a field survey along the eastern freshwater system of Rio Grande do Sul I found seven poached specimens left on the shore. These findings were made during the spring and summer of 1975 and 1976. All of these clandestinely killed animals were longer than 1.2 m. I could sex three animals, one male and two females. Four animals came from a string of lagoons emptying into the Atlantic at the resort town of Tramandai (ca. 30°S, 50°W), and three from "Casamento Lagoon," a bulge of Patos Lagoon, the largest mass of water in southern Brazil. All seven contained variable amounts of

shell fragments and opercula of *Pomacea* (formerly *Ampullarius*), a common freshwater prosobranch snail. The large male, measuring 2.2 m and estimated weight of 30 kg, contained more than 25 barely digested snails, hinting that he ate less than 24 hours before being killed. All the whole opercula were collected in the hope of establishing the correlation, if any, between operculum size and snail biomass. Of the seven animals only one had fish remains (scales) in the stomach, and it came from a site of recent heavy fish mortality.

In my laboratory enclosure *C. latirostris* feed on bottom-dwelling ampullarians. Four animals habituated to my presence and hand fed were intensively watched. They often engaged in the bottom scooping behavior already described (Brazaitis, 1969). I used the frequency of this trait as a clue to place ampullarians in the tank. They were captured and eaten with the swallowing process taking place either underwater or with the head above water. The relative size of the prey appeared to be the determinant factor of whether swallowing was under or above water. Small snails were immediately gulped after capture, while larger ones were swallowed with the caiman's head above water. Apparently inertial feeding (Gans, 1969) was required to handle prey above some size limit.

These feeding habits and the feeding niche of *C. latirostris* may explain the occurrence of stones (gastroliths) and other nonfood objects frequently found in the stomach of many crocodilians. In *C. latirostris* at least, the "bottom scooping" feeding habit for catching snails could lead to the accidental ingestion of pebbles and other assorted items. It is remarkable that no pebbles were found in the seven animals; all came from an area where the bottom sediments are nearly devoid of stones. The bed of the lagoons consists mainly of organic sediments interspersed with coarse (<2 mm diameter) sand and silt (Martins and Gamermann, 1967; L. Martins, pers. comm.; pers. obs.).

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LITERATURE CITED

BRAZAITIS, P. 1969. The occurrence and ingestion of gastroliths in two captive crocodilians. Herpetologica 25:63–64.
CORBET, P. S. 1959a. Notes on the insect food of the Nile crocodile in Uganda. Proc. Roy. Ent. Soc. Lond. 34A:17–22.
———. 1959b. The food of a sample of crocodiles (*Crocodylus niloticus* L.) from Lake Victoria. Proc. Zool. Soc. Lond. 133:561–572.
COTT, H. B. 1961. Scientific results of an inquiry into the ecology and economic status of the Nile crocodile (*Crocodilus niloticus*) in Uganda and Northern Rhodesia. Trans. Zool. Soc. Lond. 29:211–356.
DIEFENBACH, C. O. DA C. 1974. Thermal regime and gastric function in *Caiman crocodilus* (Crocodylia: Reptilia). Unpubl. Ph.D. Thesis, State Univ. of New York at Buffalo.
GANS, C. 1969. Comments on inertial feeding. Copeia 1969:855–857.
———, AND A. C. POOLEY. 1976. Commentary—research in crocodiles? Ecology 57:839–840.
HENSEL, R. 1868. Beiträge zur Kentniss der Wirbelthiere Südbrasiliens. Archiv. f. Naturgesch. XXIV Jahrg. 4:323–375.
HILDEBRAND, M. 1974. Analysis of vertebrate structure. John Wiley and Sons, New York.
MARTINS, L. R., AND N. GAMERMANN. 1967. Contribuição a sedimentologia de Lagoa dos Patos—III—Granulometria da parte norte e media. Iheringia (Porto Alegre) Ser. Geol. 1:77–86.
NEILL, W. T. 1971. The last of the ruling reptiles. Columbia Univ. Press, New York.
VALENTINE, J. M., J. J. R. WALTHER, K. M. McCARTNEY AND L. M. IVY. 1972. Alligator diets on the Sabine National Wildlife Refuge, Louisiana. J. Wildl. Manag. 36:809–815.

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EVIDENCE FOR A ROLE FOR OLFACTORY CUES IN THE FEEDING RESPONSE OF WESTERN TOADS, *BUFO BOREAS*.—Although it has been generally assumed that anurans rely principally, if not entirely, on visual cues in locating and capturing prey (Bragg, 1957; Ewert, 1976; Ingle, 1968, 1971, 1973; Maturana et al., 1960; Pigarev et al., 1972), recent work has indicated that the feeding response in some species may be initiated and/or