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Food and Feeding Behavior of the Turtle, *Dermatemys mawei*, in Belize

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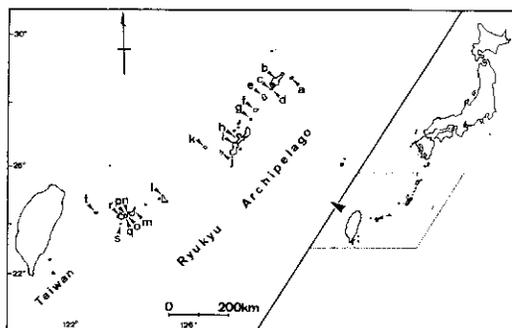


FIG. 1. Localities of specimens of *Hemidactylus* examined in the present study. See the text for names of islands indicated alphabetically.

dal rings by radiography. Voucher materials were deposited in the herpetological collection of Department of Zoology, Kyoto University.

All the specimens (13) from Kikaijima, Amamioshima, Ukejima, and Yorojima lacked dorsal tubercles and caudal scale rings. Moreover, preanal and femoral pores in males formed a discontinuous series. So, they are identified as *H. bowringii*. The remainder differed from this species in having a continuous row of preanal and femoral pores, and/or four to eight longitudinal rows of dorsal tubercles. Of these, 417 specimens exhibited caudal annulations of enlarged conical scales, and were identified as *H. frenatus*, whereas the others (310) wholly or partially lacked such rings. Investigations by radiography revealed that all the latter animals had an unsegmented rod-like column instead of normal vertebrae in portions where caudal annulations were lacking.

Following Bastinck (1984, 1985), it is highly probable that the ringless specimens represent *H. frenatus* with regenerated tails; not a single specimen with an original tail was found to conform to Okada's (1936) description of *H. okinawensis*. Therefore, the probability is that Okada (1936) described this species on the basis of *H. frenatus* with a regenerated tail, and *H. okinawensis* Okada, 1936, is here regarded as a junior synonym of *H. frenatus* Duméril et Bibron, 1836.

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#### Food and Feeding Behavior of the Turtle, *Dermatemys mawei*, in Belize

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The Central American river turtle *Dermatemys mawei* is known to be totally herbivorous as an adult, feeding principally upon aquatic vegetation, fallen leaves, and fruit (Lee, 1969; Alvarez del Toro, 1972, 1982; Campbell, 1972; Alvarez del Toro et al., 1979). Captive adults are reported to accept fish occasionally and small captive specimens are reported to readily eat raw meat and fish (Lee, 1969; Alvarez del Toro, 1972; Alvarez del Toro et al., 1979; Murphy and Collins, 1983). During the course of surveys conducted for this species throughout Belize in January through April 1984 (Moll, 1986), I was able to collect information concerning specific food choices and feeding behavior in wild adults and juveniles from different habitat types. Data were obtained from turtles collected from the Belize River between Burrell Boom, Belize District and San Ignacio, Cayo District, in central Belize; from the estuarine section of the Rio Grande River, Toledo District, in southern Belize; and from Progresso Lagoon, a large freshwater lake in Corozal District, northern Belize.

Stomachs were flushed (Legler, 1977) and the animals released alive at each capture site. Data from the Belize River were supplemented with stomach contents from butchered animals in the Belize City market that were collected in the Belize River near Burrell Boom. Contents were preserved in 70% ethanol and later analyzed taxonomically and volumetrically; frequency of occurrence of food items was also determined. As there were no important qualitative

TABLE 1. Stomach contents (percent volume and percent frequency) of 164 adult *Dermatemys mawei* from river, lagoon, and estuarine habitats in Belize.

Food item	Belize R. N = 82		Progresso Lagoon N = 58		Rio Grande Estuary N = 24	
	% vol	% F	% vol	% F	% vol	% F
<i>Paspalum peniculatum</i>	60.2	91.5	62.2	86.2	48.0	83.3
<i>Najas</i> sp.	12.3	34.8	6.8	60.3	3.3	50.0
<i>Elodea densa</i>	4.8	14.6	6.4	62.1	—	—
<i>Eichornia azurea</i>	4.2	12.2	—	—	2.8	29.2
<i>Pontederia rotundifolia</i>	2.8	11.0	3.2	17.2	—	—
<i>Ceratophyllum</i> sp.	1.0	7.3	3.0	20.7	—	—
<i>Pistia stratioides</i>	1.0	11.0	2.1	10.3	—	—
<i>Myriophyllum</i> sp.	0.8	2.4	2.1	10.3	1.5	12.5
<i>Lemna minor</i>	1.6	2.4	—	—	—	—
<i>Spirodela polyrhiza</i>	1.4	3.7	—	—	—	—
Misc. tree leaves	0.9	1.2	—	—	1.0	8.3
<i>Thalassia testudinatum</i>	—	—	—	—	1.0	8.3
<i>Sagittaria latifolia</i>	—	—	1.0	8.6	—	—
<i>Ficus radula</i> and sp. (fruit)	7.0	43.9	—	—	—	—
<i>Mangifera</i> sp. (fruit)	0.5	6.0	—	—	—	—
Chlorophyta	trace	15.9	trace	43.0	—	—
<i>Utricularia mixta</i>	—	—	1.0	10.3	—	—
Mangrove leaves	—	—	—	—	38.5	100
Insects	trace	7.3	trace	6.9	trace	12.5
Unidentified	1.5	43.9	12.2	86.2	3.9	50

differences observed in the stomach contents of adult males and females these samples were combined for analysis. Juveniles (under 35 mm carapace length) were considered separately although their stomach contents also appeared very similar to those of adults.

Adults of both sexes and juveniles in Belize are evidently strictly herbivorous, but dietary composition may vary somewhat between habitats, and probably depends on food availability and differences in feeding behavior (Tables 1, 2). Traces of insect remains found in some individuals at each study area probably represent material secondarily ingested in the course of herbivory.

The most important food in specimens examined from all three habitats was the emergent aquatic grass *Paspalum peniculatum*, which forms vast beds in the

shallows of these and other aquatic habitats throughout Belize. Leaves and stems packed the digestive tracts of nearly all specimens examined, as evidenced both by flushing and by examination of fecal material from temporary captives. This grass has also been identified as an important food of Mexican *Dermatemys* (Lee, 1972; Alvarez del Toro et al., 1979). Adults and juveniles move into *Paspalum* beds soon after dark and graze through the night, sometimes in large numbers, as evidenced by trammel net collections and direct observations at Progresso Lagoon and the Belize River. The presence of foraging groups of *Dermatemys* is easily detectable by sounds from the movement of grasses being consumed and occasional splashing. Little or no foraging occurs and most animals are apparently absent from the beds during the

TABLE 2. Stomach contents of 70 juvenile *Dermatemys mawei* from river, lagoon, and estuarine habitats in Belize.

Food item	Belize R. N = 28		Progresso Lagoon N = 26		Rio Grande Estuary N = 16	
	% vol.	% F	% vol.	% F	% vol.	% F
<i>Paspalum peniculatum</i>	85.2	85.7	65.0	92.3	44.2	100
<i>Najas</i> sp.	2.4	53.6	12.2	76.9	—	—
<i>Elodea densa</i>	1.8	14.3	—	—	—	—
<i>Pontederia rotundifolia</i>	1.5	42.8	5.5	57.7	—	—
<i>Eichornia azurina</i>	0.5	7.1	—	—	—	—
<i>Lemna minor</i>	0.4	21.4	—	—	—	—
<i>Spirodela polyrhiza</i>	0.4	14.3	2.4	19.2	—	—
<i>Ficus</i> sp. (fruit)	3.4	21.4	—	—	—	—
Misc. tree leaves	2.0	28.6	4.6	73.1	10.5	87.5
Mangrove leaves	—	—	—	—	38.6	100
Insects	trace	17.9	trace	11.5	—	—
Unidentified	2.4	71.4	10.3	80.8	6.7	62.5

daylight hours. An assortment of emergent and submergent vegetation is also present in most stomachs from all three habitats, but in Progresso Lagoon and Belize River adults this contributes only about half as much volumetrically as does *Paspalum*, and in the Rio Grande estuary such material comprises only 9.6% of total volume (Table 1). Juveniles from these habitats also eat larger quantities of *Paspalum* than of all other vegetation combined (Table 2).

In the Rio Grande estuary population a significant dietary component, both by volume and frequency of occurrence, is represented by a mixture of leaves of red, white and black mangroves, *Rhizophora mangle*, *Laguncularia racemosa*, and *Avicennia germinans*, respectively (Tables 1, 2). Groups of up to 30 estuarine *Dermatemys* were observed to feed upon floating mangrove leaves and other floating material during periods of rising tide, regardless of time of day, along an approximately 0.5 km section of river. Turtles were sighted only rarely, and apparently remained submerged at other times. A similar foraging pattern has been observed in another estuarine species, *Batagur baska*, in the Perak River, Malaysia by Moll (1980), where feeding typically is associated with the occurrence of high tide, and a major food is berembang, a mangrove fruit (*Sonneratia* sp.). Diel migrations of at least 4 km are suggested by the presence of significant amounts of both *Paspalum* and mangrove leaves in the stomachs of many turtles collected in the estuary since the nearest *Paspalum* beds are located approximately this far upstream from the estuary where the red-white-black mangrove association dominates.

Another important food source utilized opportunistically are the fruits from river bank vegetation which fall into the water. In the Belize River, *Dermatemys* stomachs were occasionally filled with whole figs or pieces of figs or mangos; groups of *Dermatemys* were twice observed under fruiting fig trees, actively feeding both day and night on any figs which fell into the water. The feeding behavior was almost identical to that described in fig-eating Australian *Elseya dentata* by Legler (1976), and provides another example of the exploitation of windfall food sources previously recorded in other turtle species (see Legler, 1976).

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### The Status of an Agamid Lizard, *Japalura swinhonis chapaensis* Bourret, 1937, from Vietnam

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Bourret (1937b) described a new subspecies, *Japalura swinhonis chapaensis*, with a unique type collected from the northern part of Vietnam, and noted that it differs from the nominal subspecies from Taiwan in having a relatively longer toe IV. He also stated that *J. s. chapaensis* resembles *J. splendida* and *J. yunnanensis* from Yunnan, China. Since no additional specimens have ever been collected for that subspecies, Bourret's (1937b) type has been the only representative of *J. swinhonis* outside of Taiwan (Wermuth, 1967). However, no subsequent authors revising the taxonomy of *J. swinhonis* and its relatives have referred to that subspecies due to the difficulties in accessing the type specimen or the original description (e.g., Liang and Wang, 1976; Lou and Lin, 1983; Ota, 1989a, b). Moreover, the description was quite brief, and failed to provide states of several characters utilized in the recent classification of *Japalura*.

In the present study, I reexamined the holotype of this poorly known form, deposited in the Museum National d'Histoire Naturelle, Paris, and compared it with other members of *Japalura*. The results strongly suggest the removal of *chapaensis* from subspecific status in *J. swinhonis*.

The holotype, a female, was compared with females of the three Taiwanese species of *Japalura* previously assigned to *J. swinhonis* (i.e., *J. swinhonis*, N = 15; *J. brevipes*, N = 11; *J. mitsukurii*, N = 20; see Ota, 1988,