

erson (1988). A comparatively low influx would be expected for a species having a low FMR and, hence, a low food requirement, because the main avenue of water intake in a desert reptile is its food (Nagy and Peterson, 1988).

Discussion.—Our hypothesis that the diurnal *R. afer* would have an FMR higher than those of two species of nocturnal geckos is clearly negated by these results. The FMRs of the nocturnal geckos did not differ significantly from those of diurnal iguanid lizards, and the FMR of *R. afer* not only did not exceed these values but it was significantly lower than expected. The differences between *R. afer* and the nocturnal geckos can be illustrated by comparing the body-mass-corrected FMR value (calculated assuming the scaling exponent of 0.8 for iguanid lizards is applicable to gekkonids): *R. afer*, $0.106 \text{ kJ g}^{-0.8} \text{ d}^{-1}$; *Ptychocheilus hasselquistii*, $0.204 \text{ kJ g}^{-0.8} \text{ d}^{-1}$; *Pachydactylus bibroni*, $0.239 \text{ kJ g}^{-0.8} \text{ d}^{-1}$.

What can account for the surprisingly low FMR of *R. afer*? When they are abroad, they are alert, sprint rapidly, and are difficult to catch with a noose, so the intensity of their activity does not seem unusually low. It is possible that they select unusually low body temperatures when inactive, but the scarcity of low environmental temperatures for long periods in the retreats available in their habitat makes this unlikely. More likely is the possibility that the metabolic machinery of *R. afer* differs from that of other lizards, allowing this species to function at a much reduced FMR. Three species of lizards in the family Xantusiidae have resting (standard) metabolic rates that are about half those of most other lizards studied (Mautz, 1979), and their field metabolic rates are also about half of those expected (Mautz and Nagy, 1988). Resting metabolic rate typically accounts for about 30–60% of FMR in lizards (Peterson et al., 1990), so a 50% reduction in resting metabolism, alone, would not completely account for a 50% reduction in FMR. This suggests that these xantusiid lizards also have unusually low costs for activity.

Rhopropus afer also has a resting metabolic rate that is about half or less of that expected for a similar-sized squamate or lizard (Peterson, 1990). Thus, it seems likely that the physiology and biochemistry of energy metabolism in this species differs from that of iguanid lizards, perhaps in a manner similar to that between mammals and reptiles, where large differences in mitochondrial densities and metabolic enzyme activities are known to occur (Else and Hulbert, 1981; Hulbert and Else, 1981). All species of

xantusiid lizards thus far studied show reduced metabolic rates, suggesting low energy metabolism may be a property of that family. To date, *R. afer* is the only nonxantusiid lizard known to have low energy metabolism, and the observation that this is atypical of geckos suggests that the family Gekkonidae has much interesting diversity remaining to be explored. Such diversity may contribute importantly to understanding of the evolution of high metabolic rates and endothermy (Else and Hulbert, 1987).

Suggested measurements to help resolve these questions, pertaining to both *R. afer* geckos and to xantusiid lizards, include field determinations of 24-h behavior and body temperature patterns; the relation of SMR to body temperature; and the relative density of mitochondria and activities of key metabolic enzymes in muscle and liver tissues.

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REPRODUCTION AND BEHAVIOR OF WESTERN MUD SNAKES (FARANCIA ABACURA REINWARDTII) IN AMERICAN ALLIGATOR NESTS.—Mud snakes (*Farancia abacura*) frequent aquatic lowlands along the Atlantic Coastal Plain south through Florida, westward across the Gulf states, and northward up the lower Mississippi River Valley (Smith, 1938; McDaniel and Karges, 1983) where they prey primarily on aquatic salamanders (*Amphiuma*, *Siren*), and to a lesser extent on frogs and fish (Van Hyning, 1932; Meade, 1946; Clark, 1949). This species is behaviorally unusual in that it is one of the few snakes, aside from pythons, that exhibits maternal care during incubation (Meade 1937; Riemer, 1957; Shine, 1988). Among the few literature records of nesting in the wild is one by Deitz and Jackson (1979) who found a clutch of the eastern subspecies (*F. a. abacura*) in the nest of an American alligator (*Alligator mississippiensis*) in northcentral Florida. We report an additional four clutches of the western subspecies (*F. a. reinwardtii*) found at Lacassine National Wildlife Refuge (30°00'N, 92°50'W) in southwestern Louisiana and here provide a synopsis of known aspects of reproductive biology for mud snakes.

On 9 July 1985, an active alligator nest was discovered containing a clutch of 33 alligator eggs that we deduced were laid between 30 June and 5 July. The nest measured 170 × 160 × 58 cm and was constructed of maidencane (*Panicum hemitonon*). The eggs were covered by 30 cm of vegetation and had a core temperature of 30 C. This nest was examined again on 8 August. By that time, the nest had been degraded (probably by a raccoon, *Procyon lotor*). The nest was scattered into three clumps but partly rebuilt. No alligator eggs or eggshells were present. However, while searching for the latter, two clutches of western mud snakes were found about 1 m apart within the remaining structure (Table 1). A small female was captured and photographed at clutch 1-A and then

TABLE 1. CLUTCH CHARACTERISTICS OF WESTERN MUD SNAKES (*Farancia abacura reinwardtii*) NESTING IN AMERICAN ALLIGATOR (*Alligator mississippiensis*) NESTS AT LACASSINE NATIONAL WILDLIFE REFUGE, LOUISIANA.

Clutch number	Clutch size	Clutch mass (g)	Egg dimensions (mm)					
			Length			Width		
			Range	\bar{x}	SD	Range	\bar{x}	SD
1-A	9	61	35.8-40.3	37.2	1.5	16.7-19.1	17.7	0.8
1-B	8	71	40.2-45.4	42.5	2.0	17.6-20.5	18.8	1.0
2-A	6	39	22.7-45.6	38.6	8.1	13.3-17.0	15.9	1.3
2-B	7	74	37.1-44.6	40.2	2.6	19.5-22.0	20.6	0.9

released. This individual measured 750 mm snout-vent length (SVL) and 831 mm total length (TL). A similar-sized animal (presumably female) was seen, but not caught, at clutch 1-B. About 60 m west of this nest, we had found, on 7 Aug., a second alligator nest (115 × 110 × 28 cm), also constructed of maidencane. This nest appeared to be active but did not contain any alligator eggs and was probably a "false" nest (Webb et al., 1977). However, it also contained two clutches of mud snake eggs. These clutches were 13 cm apart and about 10 cm above water level. A small female was also observed at this second nest. On exposing the clutches the female was seen tightly coiled around the eggs of clutch 2-A. She moved her head out of sight of the viewer once the nest was opened but otherwise remained coiled and motionless until the eggs were handled. She then escaped through the bottom of the nest. This nest was visited again on 8 Aug., but the female was not present.

These alligator nests were similar in that they were both near the perimeter of a shallow 16,000 ha wet marsh impoundment bordered by a 5 m wide canal adjacent to a levee service road. An additional nine interior marsh and two levee alligator nests were found, but no mud snake clutches were observed in them. However, some may have been present and undetected because we were not specifically searching for them.

The eggs of all four clutches were adherent and parchment-like in texture. One embryo was collected from each of the nests on 8 Aug. Both embryos (LSUMZ 45811) were males and measured 113 mm SVL (135 mm TL) and 112 mm SVL (134 mm TL). Five additional eggs (one from the first and four from the second nest) were removed for artificial incubation. Eggs were placed in natural nest medium for several days, then transferred to a sealed jar and sandwiched between moist paper towels. Three eggs hatched on 8 Sept. and the remainder the next day. The sizes of these neonates agree well with previously published records for the species

(Table 2). Hatched young were released at their sibling natal sites on 15 Sept. Inspection of those nests indicated that the two clutches in the first nest failed to hatch, apparently due to flooding. Eleven eggs were opened and all were found to contain rotted embryos ranging from 143-169 TL ($\bar{x} = 157.9 \pm 8.07$ SD).

Mud snakes produce among the largest broods for colubrid snakes. Although Fitch (1970) reported a mean of 32.2 eggs for 23 clutches, considerable variation exists in clutch size and in the size of reproductive females (Fitch, 1985). The nesting female measured in this study is the smallest yet known for the species. Reproductive females up to 235 cm TL containing 104 eggs have been reported (Van Hynning, 1931). Other records for wild breeding individuals include a 183 cm female with a clutch of 40 eggs (Goldstein, 1941), a 124 cm female with 16 eggs (Clark, 1949), and a 169 cm female with 49 eggs (Riemer, 1957). The smallest of the clutches we observed ($n = 6$ eggs) agrees with the minimum egg complement for this subspecies reported by Kennedy (1959), based on in utero evidence from a 927 mm TL individual. Combining these records with those of Hahn and Wilson (1966) and our observations, there is a strong positive correlation between body size and clutch size ($\ln TL = 3.8079 + 0.3519 \ln CS$; $r^2 = 0.9319$; $n = 8$) that is much tighter than the intrapopulation samples reported by Ford and Seigel (1989) for three other species of oviparous snakes (*Elaphe guttata*, *Trimeresurus flavoviridis*, and *T. okinavensis*). Nests of *F. abacura* without attendant females have been observed in the wild containing clutches of 15-30 (Meade, 1946), 27, and nine eggs (Tinkle, 1959). Captive records (female TL and clutch size) include: 180 cm (mated with a 107 cm male), 28 (Meade, 1937); 132 cm, 18 (Meade, 1940); 142 cm, 54 (Reynolds and Solberg, 1942); and 152 cm, 22 (Meade, 1946). Previous records of western mud snake clutch sizes from Louisiana have ranged from 16-50 (Dundee and Rossman, 1989).

TABLE 2. LENGTH (TL OR SVL; mm) AND MASS (g) OF NEONATE MUD SNAKES (*Farancia abacura*) FROM THIS STUDY AND REPORTED IN LITERATURE.

TL	SVL	n	Mass	Source
222 (♂)	201	1	6.0	This study
164 (♀)	164	1	2.5	
210 (♂)	188	1	4.8	
245 (♂)	218	1	8.0	
239 (♀)	203	1	8.0	
158.8-241.3		19		Meade, 1937
204		1	4.8	Conant and Downs, 1940
251		1	6.2	
≈203		9		Meade, 1940
182-234		9		Goldstein, 1941
($\bar{x} = 209.7$)				
202		1	5	Reynolds and Solberg, 1942
222		1	6	
230		1	8	
235-292		50		Hellman and Telford, 1956*
($\bar{x} = 265.7$)				
	213 (♂)	1		Tinkle, 1959
	248 (♀)	1		
	180-260	98		Semlitsch et al., 1988
	142-185 (♂)*	10		Hahn and Wilson, 1966
	($\bar{x} = 167.2$)			
	170-188 (♀)*	10		
	($\bar{x} = 180.5$)			
	177-190 (♂)*	26		
	($\bar{x} = 184.3$)			
	187-204 (♀)*	18		
	($\bar{x} = 196.4$)			

* Estimated by us about one month of age.

† From same clutch.

‡ From second larger clutch.

Mud snakes are reported to nest in July and Aug.; hatching occurs in Sept. and Oct. (Meade, 1946; Tinkle, 1959). Semlitsch et al. (1989) reviewed the timing of annual emergence of juvenile mud snakes at aquatic habitats in South Carolina and found only a small percentage (16%) of captured individuals entering aquatic habitats in Sept.-Oct. We suspect that this percentage would be greater in more southerly latitudes where neonates experience a longer growing season with autumn feeding and growth prior to hibernation.

The distribution of mud snakes broadly overlaps that of alligators and the approximate two-month incubation fits well with a strategy of commensal nesting with alligators, whose eggs have about a nine-week incubation period (Jönänen, 1969). Commensal nesting in alligator nests has also been reported for several turtles [*Pseudemys* (= *Chrysemys*) *nelsoni*, *Apalone* (= *Trionyx*) *ferox*, *Kinosternon subrubrum*—Deitz and Jackson, 1979]. This strategy may provide nesting snakes and turtles, as well as their eggs, with

a degree of protection from egg predators and provide an excellent medium for egg incubation, thus decreasing costs of maternity (see review by Shine, 1988). This is particularly true if the nest is actively defended by an adult crocodilian, because depredation rates are markedly higher in undefended nests (Metzen, 1977; Crawshaw, 1991).

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FEEDING TECHNIQUE OF JUVENILE *TROPIDODRYAS STRIATICEPS*: PROBABLE CAUDAL LURING IN A COLUBRID SNAKE.—Caudal luring, the wriggling movements of a conspicuous tail tip made by an otherwise cryptically colored snake in the presence of prey, has been reported for several species of Boidea, Viperidae, and Elapidae (reviews in Neill, 1960; Pough, 1988). We are not aware of any record of this behavior among Colubridae, and here we report and comment on caudal luring, feeding behavior, and diet of *Tropidodryas striaticeps*, a neotropical colubrid snake.

Tropidodryas striaticeps and *T. serra*, the two recognized species, are semiariboreal, apparently diurnal snakes from the Atlantic Forest of southeastern Brazil, preying on lizards, birds, and rodents (Müller, 1970; Thomas and Dixon, 1977). Their dorsal color pattern varies from greenish gray to yellowish brown, with darker oblong and angular blotches resulting in a cryptic pattern (Fig. 1). The tail of juveniles is whitish to yellowish and has flared scales (Thomas and Dixon, 1977; see also Fig. 1). Based on the appearance of the tail of juveniles, caudal luring behavior was suspected for *Tropidodryas* (Sazima, 1992).