

nesting at Buck Island (*pers. obs.*). To estimate the drag associated with our attachment assembly further studies of the hydrodynamic features should be done within a flume channel (Watson and Granger, 1998).

Our results show that the use of base plates and epoxy is a suitable technique for repetitive data-logger deployments to study interesting female sea turtles.

*Acknowledgments.* — This work was funded by the Deutsche Forschungsgemeinschaft through a grant to R. Wilson (DFG Wi 1023/5-1), by the Institut für Meereskunde an der Universität Kiel and supported by the National Park Service, Buck Island Reef National Monument, Christiansted. All necessary research permits were obtained. We would like to thank R. Wilson and D. Adelung for supervision and advice throughout the project. Special thanks are due to Z.-M. Hillis-Starr, B. Phillips, J. Tutein, and the NPS volunteer teams for their extraordinary support. We are grateful to the staff of the Deutsches Meeresmuseum in Stralsund for providing a sea turtle carapace and to S. Garthe and the anonymous reviewers for constructive comments on the manuscript.

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Received: 24 November 2001

Revised and Accepted: 17 October 2002

## Preliminary Observations on Reproductive Parameters of the Sulawesi Forest Turtle (*Leucocephalon yuwonoi*) in Captivity

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The Sulawesi forest turtle was described as *Geoemyda yuwonoi* (McCord et al., 1995), and later assigned to the new genus *Leucocephalon* (McCord et al., 2000). The species has featured in the pet trade and Southeast Asian food markets for a number of years, but very few natural history data have been reported. Platt (1998), Platt et al. (2001), and Hagen and Ching (in press) made some field observations, but no reproductive data have been presented. Because of its restricted geographic range and ongoing exploitation, *Leucocephalon yuwonoi* has been listed as Critically Endangered by the IUCN Red List of Threatened Species (IUCN, 2002) and assigned to CITES Appendix II. It has been targeted as a priority species by the recently formed IUCN/SSC Turtle Survival Alliance, and a Taxon Management Group for the species has been established.

Small numbers of *Leucocephalon* have been imported into the United States, and approximately 60 live specimens are known to exist in several zoological institutions and private collections. Successful captive breeding has not previously been reported.

Data for eggs from 15 clutches laid by 7 captive female *Leucocephalon* are presented in Table 1. Based on these data, it appears that the typical clutch for this species consists of one, relatively large egg (mean egg mass = 45.4 g, s.d. = 6.02 g,  $n = 16$ ; mean egg length = 60.8 mm, s.d. = 6.9 mm,  $n = 18$ ; mean egg width = 32.4 mm, s.d. = 2.5 mm,  $n = 18$ ). Three of 15 clutches included 2 eggs. The eggshell is hard and calcareous.

Female 1, captive since August 1998, is the only individual to have produced more than one clutch. Eggs were laid in August 1998, January 1999, May, October, and December 2001, April and July 2002, and February and May 2003. The December 2001 and May 2003 clutches each included 2 eggs. Most of the other females described herein have been in captivity for less than one year, and more data are needed before accurate statements can be made about clutch frequency.

All clutches produced by female 1 since October 2001 have been buried 4 cm deep in a nest box containing 10 cm of sphagnum peat. Nest construction has not been observed. All other eggs were laid openly in the enclosures. Induction of oviposition with oxytocin was successful in some, but not all cases, possibly due to environmental stressors or pathology. One debilitated female required surgical removal of the egg.

**Table 1.** Clutch size, female straight carapace length (CL), mass, egg mass, and egg size for 15 clutches of eggs laid by 7 captive Sulawesi forest turtles (*Leucocephalon yuwonoi*).

	Clutch Size	Female		Egg	
		CL (mm)	Mass (g)	Mass (g)	Size (mm)
Female 1	1	202	1420	52	67 x 37
	1	202	1460	40	53 x 34
	1	205	1510	46	53 x 34
	1	205	1520	46	56 x 31
	2	206	1520	47	55 x 30
				28	44 x 28
				45	65 x 32
				48	61 x 30
				49	63 x 34
				46	63 x 33
Female 2	1	187	1200	37	64 x 29
	1	175	—	52	67 x 36
Female 3	1	—	—	—	71 x 32
Female 4	1	—	—	—	57 x 30
Female 5	2	229	1600	50	65 x 31
				45	57 x 30
Female 6	1	—	—	47	70 x 34
Female 7	1	190	—	48	63 x 35

Attempts to hatch *Leucocephalon* eggs have to date been unsuccessful. No embryonic development was observed in any of the eggs described here. It is possible that embryos may be damaged by prolonged oviductal retention during collection and importation. It is also possible that incubation parameters have been incorrect, that the eggs were infertile, or that the eggs require an embryonic diapause of some length.

Single egg clutches have been documented in a number of chelonian species, including *Malacochersus tornieri* and *Chersina angulata* (Loveridge and Williams, 1957), *Pyxis arachnoides* and *Geoemyda spengleri* (*pers. obs.*), *Platemys platycephala* (Medem, 1983), and *Rhinoclemmys* spp. (Medem, 1962; Castaño-Mora and Medem, 1983). Some of these species may oviposit several times per year.

The ongoing collection of *Leucocephalon* for both the Southeast Asian food trade and the international pet trade is of particular concern in light of its apparently low fecundity. Both *in situ* and *ex situ* conservation efforts will be needed to ensure the survival of the species. Field studies of the species to document its natural history, distribution, and other ecological parameters are also important.

**Acknowledgments.**—The author thanks James Barzyk, Dwight Lawson, and David Martini for contributing data from their captive *Leucocephalon*.

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Received: 10 December 2001

Revised and Accepted: 12 June 2003

*Chelonian Conservation and Biology*, 2003, 4(3):721-725  
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## Population Ecology of Musk Turtles (*Sternotherus odoratus*) in a Lake in Virginia

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*Sternotherus odoratus*, commonly known as the musk turtle or stinkpot turtle, is an aquatic chelonian found through much of eastern North America, from the southern provinces of Canada to as far south as Florida and Texas in the United States (Ernst et al., 1994). Throughout its range, studies have documented a wide range of musk turtle population densities in both lacustrine and riverine habitats (Mahmoud, 1969; Congdon et al., 1986; Ernst, 1986; Mitchell, 1988; Dodd, 1989). Body size of musk turtles correlates positively with latitude (Tinkle, 1961) but sexual dimorphism in size is rarely observed (Risley, 1930; Tinkle, 1961; Wade and Gifford, 1965; Mitchell, 1988; Dodd, 1989). Further, musk turtles generally display site fidelity and limited home ranges within aquatic habitats (Williams, 1952; Mahmoud, 1969; Ernst, 1986; Mitchell, 1988). Among populations, sex ratios vary from female-biased (Risley, 1933; Cagle, 1942; Dodd, 1989) to even (Mahmoud, 1969; Mitchell, 1988) to male-biased (Ernst, 1986; Edmonds and Brooks, 1996). Departures from even sex ratios are thought