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	Female		Egg	
	Size	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
	1	206	1520	45	65 x 32
	1	206	1510	48	61 x 30
	1	206	1520	49	63 x 34
	2	206	1530	46	63 x 33
				—	58 x 33
Female 2	1	187	1200	37	64 x 29
Female 3	1	175	—	52	67 x 36
Female 4	1	—	—	—	71 x 32
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*.

Literature Cited

Castaño-Mora, O.V. and Medem, F. 1983. Datos preliminares sobre la reproduccion de *Rhinoclemmys melanosterna* Gray (Reptilia: Quelonia: Emydidae). Lozania (Acta Zoologica Colombiana) 47:1-5.

Hagen, C. and Ching, I.Y.S. In press. Field report on the distribution, natural history and exploitation of *Leucocephalon yuwonoi* in central Sulawesi, Indonesia. Chelonian Conservation and Biology.

IUCN. 2002. 2002 IUCN Red List of Threatened Species. Gland, Switzerland: IUCN (www.redlist.org).

Loveridge, A. and Williams, E.E. 1957. Revision of the African tortoises and turtles of the suborder Cryptodira. Bulletin of the Museum of Comparative Zoology 115(6):163-557.

McCord, W.P., Iverson, J.B., and Boeadi. 1995. A new batagurid turtle from northern Sulawesi, Indonesia. Chelonian Conservation and Biology 1(4):311-316.

McCord, W.P., Iverson, J.B., Spinks, P.Q., and Shaffer, H.B. 2000. A new genus of geoemydid turtle from Asia. Hamadryad 25(2):86-90.

Medem, F. 1962. La distribucion geografica y ecologia de los Crocodylia y Testudinata en el Departamento del Choco. Revista de la Academia Colombiana de Ciencias Exactas Fisicas y Naturales 11(44):279-303.

Medem, F. 1983. Reproductive data on *Platemys platycephala* (Testudines: Chelidae) in Colombia. In: Rhodin, A.G.J. and Miyata, K. (Eds.). Advances in Herpetology and Evolutionary Biology. Essays in Honor of Ernest E. Williams. Cambridge, MA: Museum of Comparative Zoology, pp. 429-434.

Platt, S.G. 1998. Results of a survey to determine the status of *Indotestudo forstenii* in Sulawesi, Indonesia. Report to Wildlife Conservation Society.

Platt, S.G., Lee, R.J., and Klemens, M.W. 2001. Notes on the distribution, life history, and exploitation of turtles in Sulawesi, Indonesia, with emphasis on *Indotestudo forstenii* and *Leucocephalon yuwonoi*. Chelonian Conservation and Biology 4(1):154-159.

Received: 10 December 2001
Revised and Accepted: 12 June 2003

Chelonian Conservation and Biology, 2003, 4(3):721–725

Population Ecology of Musk Turtles (*Sternotherus odoratus*) in a Lake in Virginia

Alison M. Holinka[1], Radhika Dave[1], and Randolph M. Chambers[1]

[1]*Biology Department, College of William and Mary, Williamsburg, Virginia 23187 USA*
[E-mail: alholinka@hotmail.com; Fax: 757-221-5076]

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 to be a consequence of capture methods (Ream and Ream, 1966), differential habitat preference by sex (Dodd, 1989), and other environmental effects (Edmonds and Brooks, 1996).

In addition to painted turtles (*Chrysemys picta*), the musk turtle appears to be one of the numerically dominant chelonian species occurring in small, man-made impoundments in North America. These landscape elements number over 3500 in Virginia alone, yet the populations of musk turtles occupying impoundments have not been adequately described. To date, Mitchell (1988) has conducted the only study of musk turtles on the mid-Atlantic Coastal Plain of Virginia. His study of Laurel Lake, Henrico Co., revealed an abundant, sexually balanced population of 194 musk turtles/ha (Mitchell, 1988). Here we present the findings of a six-month study on the population ecology of the musk turtle in a southeastern Virginia lake for comparison to previous studies.

Methods. — Lake Matoaka is a 16.3 ha impoundment located on the campus of the College of William and Mary in southeastern Virginia. Originally created as a millpond between 1700 and 1750 (Sacks, 1984), the lake has a mean depth of 2.5 m, with separate eastern and western arms (Fig. 1). A large portion of the watershed surrounding the western arm of the lake is forested, whereas the eastern arm is dominated by land developed by the college. Turtles inhabiting the lake include snapping turtles (*Chelydra serpentina*), painted turtles (*C. picta*), red-eared sliders (*Trachemys scripta elegans*), yellow-bellied sliders (*Trachemys scripta scripta*), and musk turtles.

All turtles for this study were captured using 60 cm x 60 cm x 53 cm crabpots. The crabpots were either left unbaited or baited with canned tunafish or live female musk turtles. Crabpots were incompletely submerged in the littoral zone of the lake, thereby allowing trapped turtles access to air. Over the time of study from 1 June through 14 December 2001, crabpots were checked periodically, with trapping periods ranging from 1 to 6 days. To complete a general survey of the littoral zone of the lake, trapping was conducted in 10 locations (Fig. 1). Crabpots remained at a single location for periods ranging from 11 to 148 days.

All turtles were processed at their capture location. Maximum carapace length (CL) and width (CW) were measured with a caliper to the nearest mm. Turtle mass was measured with a spring scale to the nearest 5 g. Turtle sex, determined by the presence/absence of rough scales behind the rear knees (Risley, 1930), was recorded for all turtles captured after 13 July. Any unusual marking or body damage was noted. Each turtle was given a unique identifying number by notching the marginal scutes (Cagle, 1939) and released near the point of capture. All recaptured turtles were sexed and measured for CL, CW, and mass.

The musk turtle population in Lake Matoaka was estimated using the Schnabel method (Cox, 2002). Carapace lengths of male and female turtles were compared using a t-test. Movements of individual turtles were estimated by computing the straight-line distances between consecutive capture and recapture locations. Finally, sex ratios of turtles

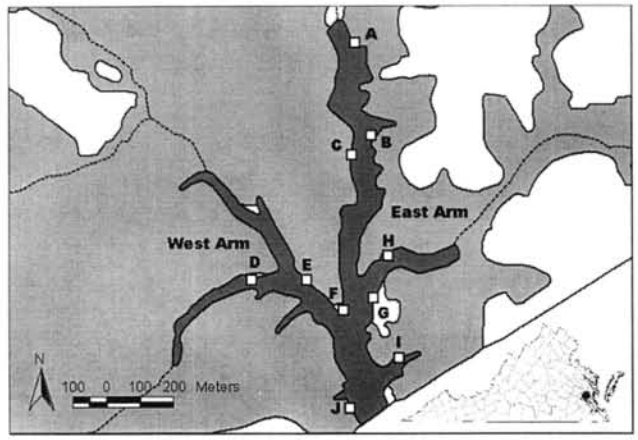

Figure 1. Site map of Lake Matoaka located on the campus of the College of William and Mary, Williamsburg, in southeastern Virginia, USA. Letters refer to turtle trapping locations in the littoral zone. Land dominated by forest is lightly shaded; cleared land is white.

from each of the 10 trapping locations were compared to unity and to each other using a Chi-square goodness-of-fit test.

Results. — A total of 651 individual musk turtles were captured with an additional 627 recaptures for a total of 1278 captures. Although each turtle was on average captured twice, 366 individuals were captured only once while others were captured multiple times. Two male turtles were captured 19 times each.

A population estimate was obtained from the capture-recapture data. Movement of trap locations over time coupled with a fairly high level of turtle site fidelity created unequal catchability among turtles (Eberhardt, 1969) and prohibited pooling all of the data to obtain a single population estimate for the lake. Instead an estimate of turtle population at each of the 10 trapping locations was computed, including each turtle only at its most common capture site so that no turtles recaptured from multiple locations were used more than once in a population estimate. A total population estimate for the lake was obtained by summing the 10 location estimates derived using the Schnabel technique (Cox, 2002). The total musk turtle population of the lake was calculated to be 1289 (95% confidence interval, 878–1959). This computes to a

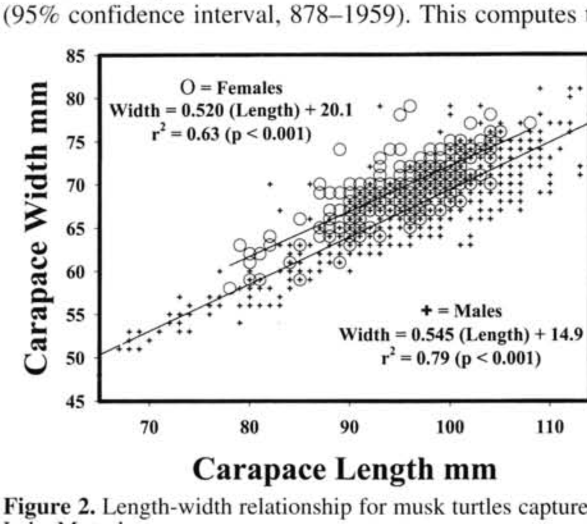

Figure 2. Length-width relationship for musk turtles captured in Lake Matoaka.

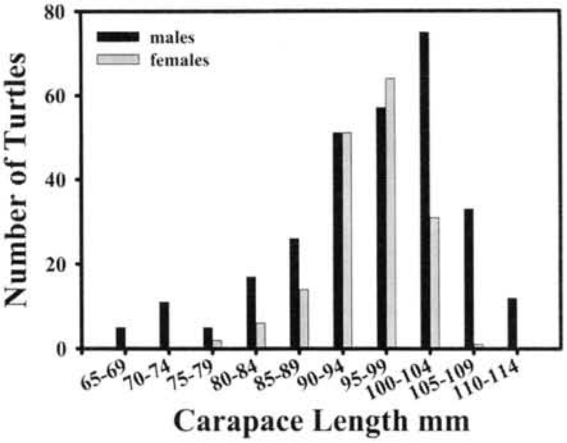

Figure 3. Frequency histogram of size classes of musk turtles captured in Lake Matoaka.

musk turtle density of 79 turtles/ha of lake (95% confidence interval, 54–120/ha).

There was no significant difference in mean CL between the two sexes (males 95.6 mm, females 94.5 mm, t-test $p = 0.15$). Morphologically, however, the CL of large males tended to be much greater than their CW, whereas the CL and CW of females were closer in magnitude (Fig. 2). There was a broader size range of male turtles versus female turtles; male turtles as small as 65 mm and up to 114 mm in CL were captured, but no female turtles smaller than 78 mm or larger than 108 mm were captured (Fig. 3).

Most turtles displayed site fidelity. Of the 285 turtles captured two or more times, 226 were always recaptured in the same sampling location as originally captured. For example, the two male turtles captured 19 times and other males captured 13 and 14 times were always recaptured at their original trapping location. However, 64 instances were recorded when turtles moved between trapping locations. Turtles tended not to move across open water as documented by the few numbers of capture/recaptures from opposite sides of the lake. Instead, they moved laterally through the littoral zone, and the number of turtles recaptured at different locations was generally lower for sites farther apart (Fig. 4). A notable

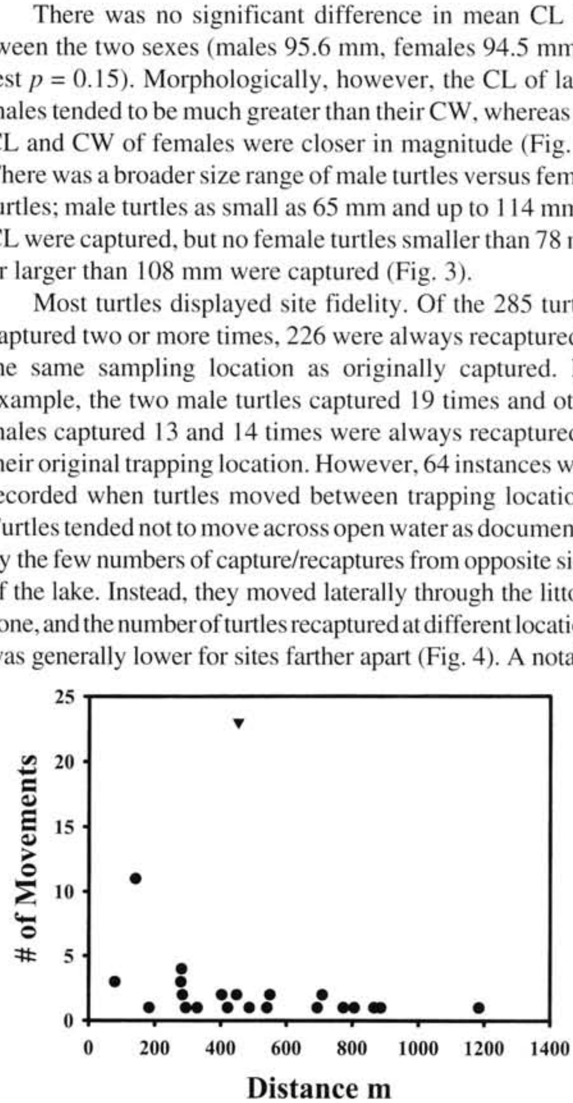

Figure 4. Frequency of distances between trapping locations for musk turtles captured multiple times in Lake Matoaka. ● = number of movements between any two locations, ▼ = number of movements between locations B and H.

exception to this trend was the observation that 18 turtles traveled 450 m between trapping locations B and H, with 5 turtles completing a round trip from B to H and back to B.

For the 651 original captures, the male to female ratio in Lake Matoaka differed significantly from unity (1.73:1, $p < 0.0001$). Likewise, of the 285 recaptured turtles, 190 were male and 95 were female, a ratio not significantly different from that of the original captures. The sex ratio for all captures, however, was significantly different from the single capture sex ratio (2.51:1.00, $p < 0.0001$), indicating that males were more likely to be recaptured multiple times than females. Further, sex ratio varied by trapping location (Table 1). One location from the eastern arm of the lake (A) had a uniform sex ratio significantly different from that of the rest of the lake. The two sampling locations from the western arm of the lake (D and E) were skewed significantly toward males (3.63:1 and 7.00:1, respectively).

Discussion. — The estimated range of 54–120 musk turtles/ha in Lake Matoaka falls well within the reported range of literature values of 7.5–700/ha (Mahmoud, 1969; Congdon et al., 1986; Ernst, 1986; Mitchell, 1988; Dodd, 1989). Variation in estimates of turtle density may be a function of both trapping technique and habitat quality. For example, Mitchell (1988) found a population density of 194 musk turtles/ha in an urban Virginia lake complex, only 80 km from Lake Matoaka. The difference in estimated density between Mitchell's and the present study were probably due to differences in capture techniques. The funnel traps used by Mitchell allowed him to sample smaller turtles. Conversely, the wire mesh of our crabpot traps was large enough to allow turtles up to a CW of 50 mm to escape. Thus, this study was unable to sample as broad a range in size classes as Mitchell (1988). This inability to retain smaller turtles was manifest in a larger mean CL of male and female stinkpot turtles in Lake Matoaka (95.6 and 94.5 mm, respectively, compared to 79.0 and 79.4 mm in Mitchell's study). Also, turtle density tends to be higher in lakes with fewer fish predators and more emergent vegetation (Congdon et al., 1986). Trees line the immediate shoreline of Lake Matoaka. The littoral zone in the lake, however, forms only a narrow band of emergent vegetation due to steep slopes on the lake bottom, so much of Lake Matoaka may be poor habitat for musk turtles. Further, fishing is illegal on Lake Matoaka, and

Table 1. Sex ratios based on single captures of musk turtles (*S. odoratus*) at 9 locations on Lake Matoaka, Williamsburg, Virginia. * indicates a sex ratio that varies significantly from the overall single capture ratio of 1.73:1 ($p < 0.05$).

Location	Males	Females	Ratio
A	34	34	1.00:1*
B	91	55	1.65:1
C	18	10	1.80:1
D	35	5	7.00:1*
E	40	11	3.63:1*
F	16	12	1.33:1
G	21	18	1.17:1
H	44	35	1.26:1
I	23	18	1.28:1

the population of potential fish predators may negatively influence turtle population size (Ernst, 1986; Jordan and Arrington, 2001).

Body size of musk turtles follows the general ecological pattern of increasing body size with increasing latitude (Tinkle, 1961). Average CL of musk turtles in Lake Matoaka was greater than in Alabama (Dodd, 1989), similar to Michigan (Risley, 1933), and less than Ontario (Edmonds and Brooks, 1996). Differences in trapping techniques among studies could affect this finding, e.g., in the current study the absence of data on turtles less than 65 mm CL most likely resulted in an artificially high mean CL. On the other hand, differences in population age structure could also explain the observed variation in body size among study sites. Turtle CL generally corresponds with age, and stinkpots with a CL over 80 mm are probably at least 10 years old (Risley, 1933). The Lake Matoaka sample may simply represent a subset of the total population that includes mostly older turtles.

Although most studies of musk turtles have not observed sexual dimorphism with respect to mean CL (Risley, 1930; Tinkle, 1961; Wade and Gifford, 1965; Mitchell, 1988; Dodd 1989), the CL of the largest males commonly exceeds that of the largest females. The largest male and female stinkpots captured in Lake Matoaka were 114 and 108 mm, respectively. Similarly, Ernst (1986) found the largest male and female musk turtles from a lake in Lancaster County, Pennsylvania were 116 and 103 mm, respectively. Risley (1930) found that the largest male and female from a lake in Ann Arbor, Michigan were 119 and 109 mm, respectively. Larger CL in turtles generally indicates greater age, but male versus female longevity in these populations is unknown. Interestingly, male musk turtles have significantly greater mean CL than females in Ontario, the northernmost limit of their range (103.6 vs. 98.7 mm) (Edmonds and Brooks, 1996), whereas females occasionally average greater CL than males near the southernmost limit of their range (Tinkle, 1961; Gibbons, 1970). The observed sexual dimorphism with larger males may be explained by a limit on female CL based on differential energy allocation for growth and reproduction. After a certain period of growth, sexually mature female musk turtles must devote a relatively larger amount of energy to reproductive processes, while males can continue to devote energy to growth (Edmonds and Brooks, 1996). Southern female musk turtles are close in size to their northern counterparts, but southern males reach sexual maturity at a size smaller than northern males. If southern females must reach a minimum body volume (length x width x height) to accommodate internal egg production (Risley, 1930), sexual dimorphism with larger females in southern musk turtle populations could result.

The majority of the musk turtles in Lake Matoaka displayed site fidelity and apparently small home range sizes. Of the 285 turtles captured multiple times, only 58 turtles were captured in multiple locations. Musk turtles tend to return toward their initial point of capture (Williams, 1952; Ernst, 1986; Mitchell, 1988), indicating limited movement and thus a possible definitive activity range (Mahmoud, 1969). In an Oklahoma river, male turtles traveled farther than females (averaging 67.6 and 44.5 m, respectively), yet had a smaller average activity range (0.024 ha vs. 0.049 ha for females) (Mahmoud, 1969). In a Pennsylvania lake, males and females had mean home ranges of 1.75 and 0.94 ha, respectively (Ernst, 1986).

Both distance and environment between trapping locations affected observed musk turtle movement in Lake Matoaka. Musk turtles generally follow the shoreline during migrations and do not tend to cross open bodies of water even though they are capable of limited swimming (Williams, 1952). Only three turtles traveled the 80 m between locations B and C on the opposite shores of the lake, but 11 turtles traveled between locations E and F, a longer shoreline distance of 140 m. Further, a much larger number of turtles traveled between shoreline locations B and H, a distance of 450 m. The timing and direction of movement was variable throughout the sampling period and equal between male and female turtles. Lengthy migrations between lake locations have not yet been reported for musk turtles. Further research is necessary to determine whether these movements are related to resource availability or other environmental factors.

Female-biased sex ratios (male:female < 1:1) have been reported from musk turtle populations in Michigan (Risley, 1933), Indiana (Cagle, 1942), and Alabama (Dodd, 1989). Balanced (1:1) sex ratios have been found for populations in Oklahoma (Mahmoud, 1969) and Virginia (Mitchell, 1988). From almost every location sampled in Lake Matoaka, however, we observed a significant male-biased sex ratio (> 1:1). Male-biased sex ratios likewise have been found for musk turtle populations in Pennsylvania (Ernst, 1986) and Ontario (Edmonds and Brooks, 1996). The observed variation in sex ratios among these studies could be due to differences in sampling method or trapping location. For example, male turtles may be preferentially attracted to net traps (such as those used by Mahmoud, 1969; Ernst, 1986; Mitchell, 1988; Dodd, 1989) and to other individuals already captured (Ream and Ream, 1966; AMH, *pers. obs.*). Further, male or female musk turtles may have a preference for certain types of habitats (Dodd, 1989), perhaps due to feeding or breeding behaviors. In our study, the sex ratio of turtles captured multiple times was equal to that of turtles captured only once, but males were recaptured a greater number of times than females. The four most "trap-happy" turtles (captured 19, 19, 14, and 13 times) were all males. Because not all areas of the lake were sampled evenly or at the same times, perhaps more extensive trapping—either spatially or temporally—was completed in male-preferred habitats, leading to the male:female sex ratio > 1.

Finally, a disproportionately larger number of male turtles were captured from the west arm of Lake Matoaka (locations D and E) relative to captures from the east arm of the lake (Table 1). We suspect the influence of local environmental factors on nesting habitats may have contributed to this discrepancy. Approximately one-half of the Lake Matoaka watershed has been converted from forest to developed regions, but fairly extensive tracts of second-growth forest still exist west of the lake. To the east, modification of college grounds and other human activities have converted the upland forest to private and commercial land use. These anthropogenic changes have been shown to significantly increase the temperature of streams draining into Lake Matoaka by almost 2ºC (Murphy et al., unpubl. data). Less shading by forest may also increase soil temperatures, which in turn would affect sex determination of incubating turtle eggs (Janzen, 1994). Soil temperatures where female turtles nest may be lower in the undeveloped watershed surrounding the western arm of the lake, relative to the more developed eastern arm. Incubation temperature differences of 1–2ºC have been shown to yield variation in the proportion of male musk turtle hatchlings from 23 to 94% (Vogt et al., 1982; Ewert and Nelson, 1991). Since most musk turtles generally show site fidelity, differences in hatchling sex ratios may contribute to location-specific variation in sex ratio of the adults.

Acknowledgments. — Thanks to Adam Spiller for his aid in the field and to Timothy Russell for GIS assistance. This research was funded in part by the Environmental Science and Policy Cluster at the College of William and Mary and is publication #002 of the W.M. Keck Environmental Field Laboratory.

LITERATURE CITED

CAGLE, F.R. 1939. A system for marking turtles for future identification. Copeia 1939:170-172.

CAGLE, F.R. 1942. Turtle populations in Southern Illinois. Copeia 1942:155-162.

CONGDON, J.D., GREENE, J.L., AND GIBBONS, J.W. 1986. Biomass of freshwater turtles: a geographic comparison. American Midland Naturalist 115:165-173.

COX, G.W. 2002. General Ecology Laboratory Manual. New York, NY: McGraw-Hill Higher Education, 312 pp.

DODD, C.K., JR. 1989. Population structure and biomass of *Sternotherus odoratus* (Testudines: Kinosternidae) in a northern Alabama lake. Brimleyana 15:47-56.

EBERHARDT, L.L. 1969. Population estimates from recapture frequencies. Journal of Wildlife Management 33:28-39.

EDMONDS, J.H. AND BROOKS, R.J. 1996. Demography, sex ratio, and sexual size dimorphism in a northern population of common musk turtles (*Sternotherus odoratus*). Canadian Journal of Zoology 74:918-925.

ERNST, C.H. 1986. Ecology of the turtle, *Sternotherus odoratus*, in Southeastern Pennsylvania. Journal of Herpetology 20:341-352.

ERNST, C.H., LOVICH, J.E., AND BARBOUR, R.W. 1994. Turtles of the United States and Canada. Washington, DC: Smithsonian Institution Press, 578 pp.

EWERT, M.A. AND NELSON, C.E. 1991. Sex determination in turtles: diverse patterns and some possible adaptive values. Copeia 1991(1):50-69.

GIBBONS, J.W. 1970. Reproductive characteristics of a Florida population of musk turtles (*Sternotherus odoratus*). Herpetologica 26:268-270.

JANZEN, F.J. 1994. Vegetational cover predicts the sex ratio of hatchling turtles in natural nests. Ecology 75(6):1593-1599.

JORDAN, F. AND ARRINGTON, D.A. 2001. Weak trophic interactions between large predatory fishes and herpetofauna in the channelized Kissimmee River, Florida, USA. Wetlands 21:155-159.

MAHMOUD, I.Y. 1969. Comparative ecology of the kinosternid turtles of Oklahoma. Southwestern Naturalist 14:31-66.

MITCHELL, J.C. 1988. Population ecology and life histories of the freshwater turtles *Chrysemys picta* and *Sternotherus odoratus* in an urban lake. Herpetological Monographs 2:40-61.

REAM, C. AND REAM, R. 1966. The influence of sampling methods on the estimation of population structure in painted turtles. American Midland Naturalist 75: 325-338.

Risley, P.L. 1930. Anatomical differences in the sexes of the musk turtle, *Sternotherus odoratus* (Latreille). Papers of the Michigan Academy of Science, Arts, and Letters 11: 445-464.

RISLEY, P.L. 1933. Observations on the natural history of the common musk turtle, *Sternotherus odoratus*. Papers of the Michigan Academy of Science, Arts, and Letters 17:685-711.

SACKS, D. 1984. The history of the William and Mary campus. Honors Thesis, College of William and Mary.

TINKLE, D.W. 1961. Geographic variation in reproduction, size, sex ratio and maturity of *Sternotherus odoratus*. Ecology 42:68-76.

VOGT, R.C., BULL, J.J., MCCOY, C.J., AND HOUSEAL, T.W. 1982. Incubation temperature influences sex determination in kinosternid turtles. Copeia 1982:480-482.

WADE, S.E. AND GIFFORD, C.E. 1965. A preliminary study of the turtle population of a northern Indiana lake. Proceedings of the Indiana Academy of Science 74:371-374.

WILLIAMS, J.E. 1952. Homing behavior of the painted turtle and muskturtle in a lake. Copeia 1952(2):76-82.

Received: 29 March 2002
Revised and Accepted: 17 March 2003

Chelonian Conservation and Biology, 2003, 4(3):725–727

Axial Bifurcation in a Bicephalic *Chelonia mydas* Embryo

CHEONG H. DIONG[1], LENNY K.A. TAN[2], AND CHARLES M.U. LEH[3]

[1]*Division of Natural Sciences, National Institute of Education, Nanyang Technological University, 1 Nanyang Walk, 637616 Singapore [E-mail: chdiong@nie.edu.sg; Fax: 65-68969434];*
[2]*Department of Diagnostic Radiology, National University of Singapore, 5 Lower Kent Ridge Rd., 119074 Singapore [E-mail: lennytan@nus.edu.sg];*
[3]*Sarawak Museum, Kuching, Sarawak, Malaysia [E-mail: lehmu@tm.net.my]*

Developmental anomalies in reptiles are reported only occasionally and have received little attention in general (Cunningham, 1937; Davies, 1974; Branch, 1979; Bellairs and Kamal, 1981; Miller, 1985). In marine turtles, the incidence of developmental abnormalities appears to be low, judging from the scant literature on the subject. Of the abnormalities known to occur in turtles, the common ones are albinism, pigmentation or pattern variations, malformation in scute patterns, size reduction or loss of body parts, malocclusion of jaws, twinning (Harrisson, 1963; Bellairs, 1983; Miller, 1985; Chan, 1985; Frye, 1991), and a recent case of conjoined twins (Haft, 1994). In this note, we describe, what is to our