Apalone spinifera (Spiny Softshell), Chelydra serpentina (Snapping Turtle), and Sternotherus odoratus (Eastern Musk Turtle) Homing Behavior.

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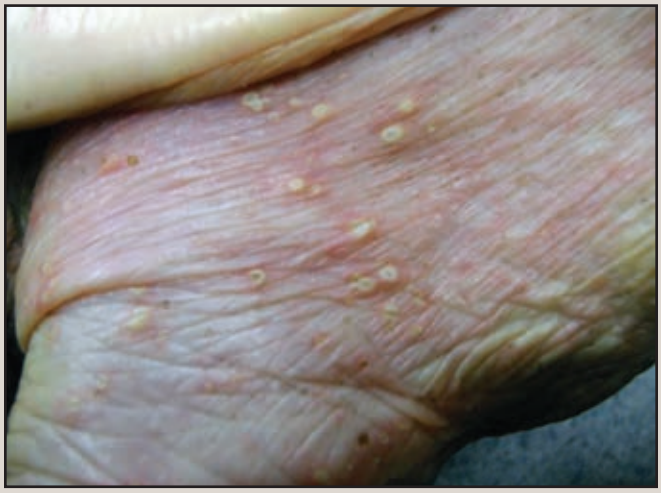

FIG. 1. Raised pustules from fire ant stings on the left inguinal area on a female *Apalone ferox*.

g) attempting to nest in a fire ant mound adjacent to a drainage impoundment on the Santa Fe College campus, Gainesville, Alachua Co., Florida, USA (29.680072°N, 82.436349°W; WGS 84). Numerous stings by the fire ants had accumulated on the skin of her head, forelimbs, and hindlimbs. Each sting formed the typical raised pustule commonly observed on humans after fire ant stings (Fig. 1). The female was in the process of laying her eggs but was caught before she completed the process and was returned to the pond after being measured. This is the first report of an *A. ferox* attempting to lay eggs in a fire ant mound (Meylan and Moler 2006. *In* P. A. Meylan [ed.], Biology and Conservation of Florida Turtles, Chelonian Res. Monogr. 3, pp. 160–168). We thank Matt Kail for help with this observation.

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***APALONE SPINIFERA* (Spiny Softshell Turtle). CHELONIOPHAGY.** Turtles of the family Trionychidae are predominately carnivorous and known to consume a wide range of prey items. In the wild, some species (*Aspideretes gangeticus* and *Lissemys punctatus*) have been known to occasionally include turtles in their diets (Moll and Moll 2004. The Ecology, Exploitation and Conservation of River Turtles. Oxford University Press, New York. 303 pp.). Herein we present the first documentation of the Spiny Softshell as a cheloniophage. On 3 April 2010 at 1242 h in Leonhardt Lagoon, Dallas Co., Texas, USA (32.777428°N, 96.761484°W), an adult *Apalone spinifera* was photographed as it emerged from the water onto a basking surface. In its jaws was a hatchling Red-eared Slider (*Trachemys scripta elegans*) (Fig. 1). Ingestion was not observed, as the *A. spinifera* returned to the water, still holding its prey, within three minutes of its emergence. A photo voucher has been deposited at the University of Texas at Arlington Digital Collection UTADC 7649.

PHOTO BY JULIE COLLINS

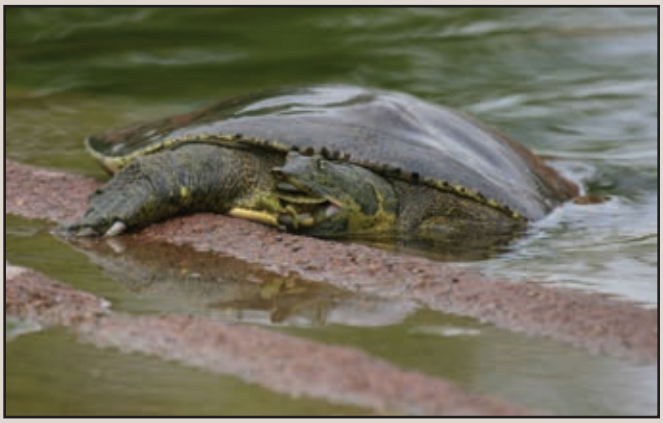

FIG. 1. Adult *Apalone spinifera* holding a hatchling *Trachemys scripta elegans* in its mouth.

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***APALONE SPINIFERA* (Spiny Softshell), *CHELYDRA SERPENTINA* (Snapping Turtle), and *STERNOTHERUS ODORATUS* (Eastern Musk Turtle). HOMING BEHAVIOR.** Homing ability (i.e., the ability of a species to return to a home range after being moved or displaced) has been reported in several freshwater turtle species, for example: *Chrysemys picta* (Cagle 1944. Univ. Michigan Mus. Zool. Misc. Publ. No. 61:1–34); *Terrapene ornata ornata* (Legler 1960. Univ. Kansas Publ. Mus. Nat. Hist. 11:527–669); *Graptemys pulchra* (Shealy 1976. Bull. Florida St. Mus. Biol. Sci. 21:47–111); *Trachemys scripta elegans* (Tucker and Lamer 2008. Chelon. Conserv. Biol. 7[1]:145–149); *Sternotherus odoratus* (Andres and Chambers 2006. Amer. Midl. Nat. 156:45–51; Smar and Chambers 2005. Southeast Nat. 4[3]:527–532; Williams 1952. Copeia 1952:76–82); and *Glyptemys insculpta* (Carroll 1978. Copeia 1978:117–126).

Little is known about the homing ability of *Apalone spinifera* and *Chelydra serpentina*. *A. spinifera* has been found to possess the orientation mechanisms required for long migrations (DeRosa and Taylor 1980. Behav. Ecol. Sociobiol. 7[1]:15–23; DeRosa and Taylor 1982. Copeia 1982:394–399). Female *C. serpentina* may undertake extensive nesting migrations, traveling 4–14 km away from their home range, often to sites upriver, but return to their original home range once nesting is completed (Obbard and Brooks 1980. Herpetologica 36[2]:158–162). To our knowledge, there are no published reports of *C. serpentina* demonstrating homing behavior after being released in an unfamiliar location.

In August and September 2010, as part of turtle rescue and recovery efforts following an oil spill affecting approx. 57 km of the Kalamazoo River in Calhoun and Kalamazoo counties, Michigan, USA, five adult *A. spinifera* (three males and two females), six adult *C. serpentina* (three males and three females), and five *S. odoratus* (three males and two females) were captured in the Kalamazoo River. Captures were made using a combination of hoop traps and hand collecting from multiple locations within the spill area. Turtles were cleaned of oil, implanted with a passive integrated transponder (PIT) tag, and released. Due to crude oil contamination at their original capture location, it was necessary to release turtles various distances from their original capture location in areas not affected by the oil. Release locations were chosen based on the presence of suitable habitat and distance from contamination. Each of the following turtles was subsequently recaptured and all exhibited presumed homing behavior.

Apalone spinifera.—An adult female *A. spinifera* (35.2 cm straight-line carapace length [SCL], 3800 g) was captured on 27 August 2010 (42.3046°N, 85.1363°W; NAD83) and housed overwinter in a wildlife rehabilitation facility. The turtle was

released on 12 May 2011 in the Kalamazoo River (42.2933°N, 85.1235°W), approximately 2.4 linear channel km from its original capture location. It was recaptured on 10 August 2011 in the Kalamazoo River (42.3062°N, 85.1384°W) approx. 1.9 linear channel km downstream of its release point and less than 0.5 linear channel km from its original capture location.

An adult male *A. spinifera* (16.5 cm SCL, 426 g) was captured on 27 August 2010 (42.3022°N, 85.1329°W) and released on 30 August 2010 in Rice Creek (42.2952°N, 84.8873°W), a small tributary of the Kalamazoo River, approximately 25.25 linear channel km from its original capture location. The turtle was recaptured on 23 June 2011 in the Kalamazoo River (42.3021°N, 85.1328°W), having traveled approx. 25.25 linear channel km downstream (8.0 linear channel km Rice Creek; 17.25 linear channel km Kalamazoo River) of its release point, crossing a 4.57 m retired hydroelectric dam, where it was recaptured less than 20 m from its original capture location.

An adult female *A. spinifera* (31.5 cm SCL, 2500 g) was captured on 29 August 2010 (42.3606°N, 85.2988°W) and released on 9 September 2010 in the South Branch of the Kalamazoo River (42.2028°N, 84.7945°W), approximately 64.5 linear channel km from its original capture location. The turtle was recaptured on 30 July 2011 in the Kalamazoo River (42.2703°N, 85.0618°W), having traveled approx. 37.5 linear channel km downstream of its release point and crossing three retired hydroelectric dams (2.12 m, 4.27 m, and 4.57 m respectively), where it was recaptured approx. 27 linear channel km from its original capture location.

An adult male *A. spinifera* (19.7 cm SCL, 632 g) captured on 2 September 2010 (42.3026°N, 85.1809°W) was released on 9 September 2010 in the South Branch of the Kalamazoo River (42.2028°N, 84.7945°W), approximately 48.8 linear channel km from its original capture location. The turtle was recaptured on 1 September 2011 in the Kalamazoo River (42.3045°N, 85.1481°W), having traveled approx. 45.4 linear channel km downstream of its release point and crossing three hydroelectric dams (2.12 m, 4.27 m, and 4.57 m respectively), where it was recaptured approx. 3.4 linear channel km from its original capture location. To our knowledge, this is one of the longest homing movements reported for a freshwater turtle in the United States.

Another adult male *A. spinifera* (17.2cm SCL, 432 g) was captured on 23 September 2010 (42.2725°N, 85.0658°W) and released on 24 September 2010 in the Kalamazoo River (42.2886°N, 85.4059°W), approximately 43.5 linear channel km from its original capture location. The turtle was recaptured on 12 July 2011 in the Kalamazoo River (42.3526°N, 85.2845°W) approx. 19.5 linear channel km upstream of its release point and approx. 24 linear channel km from its original capture location.

Apalone spinifera has been shown to move up to 13.7 km between activity areas (Galouis et al. 2002. J. Herpetol. 36(3):402–411). However, to our knowledge, this is the first report of presumed homing behavior. Three individuals reported here made movements of nearly two to three times the distance reported by Galouis et al. (*op. cit.*) (25.25 km, 37.5 km, and 45 km, respectively), representing to our knowledge the furthest reported movement of *A. spinifera*.

Chelydra serpentina.—An adult female *C. serpentina* (24.2 cm SCL, 3.8 kg) was captured on 26 April 2011 (42.3021°N, 85.1370°W; NAD 83) and released on 11 May 2011 in the Kalamazoo River (42.2932°N, 85.1235°W), approximately 2.1 linear channel km from its original capture location. The turtle was recaptured on 20 June 2011 in the Kalamazoo River (42.3062°N, 85.1384°W) approx. 2.0 linear channel km downstream of its release point and less than 100 m from its original capture location.

An adult male *C. serpentina* (39.5 cm SCL, 12.4 kg) was captured on 10 July 2011 (42.3058°N, 85.14571°W) and released on 20 July 2011 (42.3085°N, 84.1398°W), approximately 0.9 linear channel km from its original capture location. The turtle was recaptured on 16 September 2011 in the Kalamazoo River (42.3046°N, 85.1481°W) approx. 0.7 linear channel km downstream of its release point and approx. 200 m from its original capture location.

An adult male *C. serpentina* (31.0 cm SCL, 7.1 kg) was captured on 18 August 2010 (42.2699°N, 85.0614°W) and an adult female (28.5 cm SCL, 6.0 kg) was captured on 2 October 2010 (42.2702°N, 85.0611°W), approx. 40 m from where the male caught on 18 August had been captured. Both turtles were released on 12 May 2011, approx. 2.0 linear channel km from their original capture locations (42.2742°N, 85.0813°W). Both turtles were recaptured on 2 August 2011 in the same trap in the Kalamazoo River (42.2728°N, 85.0660°W), approx. 1.9 km upstream from their release point and less than 200 m from their original capture locations.

An adult male *C. serpentina* (28.5 cm SCL, 5.2 kg) was captured on 21 September 2010 (42.2927°N, 85.1205°W) and an adult female (23.0 SCL, 3.1 kg) was captured on 22 September 2010 (42.3361°N, 85.2272°W). Both were released on 27 September 2010 in the same location in the Kalamazoo River (42.3357°N, 85.3455°W), approx. 29.4, and 15.5 linear channel km, respectively, from their original capture locations. Both turtles were recaptured on 18 July 2011 in the Kalamazoo River in the same trap (42.2863°N, 85.4083°W), approx. 9.5 linear channel km downstream from their release point. Both turtles traveled the "wrong" direction from their original capture location; however, it appeared they both traveled together downstream. To our knowledge, this is the first report of both sexes of *C. serpentina* apparently moving a long distance together.

Although *C. serpentina* exhibits some degree of natal homing ability, prior to this note no examples of homing ability from relocation have been reported. Female *C. serpentina* have been known to migrate great distances to nest. Obbard and Brooks (*op. cit.*) reported one individual traveled 16 km round trip. Two individuals reported here (one male and one female) traveled approximately 9.5 km, representing to our knowledge the furthest reported movement of *C. serpentina* not associated with nesting.

Sternotherus odoratus.—An adult male *S. odoratus* (11.1 cm SCL, 158 g) was captured on 21 September 2011 (42.2668°N, 85.0536°W; NAD83) and was housed overwinter in a wildlife rehabilitation facility. The turtle was released on 12 May 2011 in the Kalamazoo River (42.2933°N, 85.1235°W), approximately 6.3 linear channel km from its original capture location. It was recaptured on 26 August 2011 in the Kalamazoo River (42.2701°N, 85.0623°W) approx. 5.6 linear channel km upstream of its release point and less than 0.7 linear channel km from its original capture location.

An adult female *S. odoratus* (10.1 cm SCL, 181 g) was captured on 14 October 2010 (42.2702°N, 85.0610°W) and was housed overwinter in a wildlife rehabilitation facility. The turtle was released on 12 May 2011 in the Kalamazoo River (42.2743°N, 85.0813°W), approximately 2.1 linear channel km from its original capture location. It was recaptured on 1 September 2011 in the Kalamazoo River (42.2703°N, 85.0618°W) approx. 2.0 linear channel km upstream of its release point and less than 60 m from its original capture location.

An adult male *S. odoratus* (10.6 cm SCL, 170 g) was captured on 6 October 2010 (42.3494°N, 85.2688°W) and released on 8 October 2010 in the Kalamazoo River (42.3504°N, 85.2759°W), approximately 0.7 linear channel km from its original capture location. The turtle was recaptured on 10 October 2010 in the Kalamazoo River (42.3494°N, 85.2683°W) approx. 0.67 linear channel km upstream of its release point and less than 30 m from its original capture location.

An adult male *S. odoratus* (11.2 cm SCL, 200 g) was captured on 17 October 2010 (42.2769°N, 85.0680°W) and was housed overwinter in a wildlife rehabilitation facility. The turtle was released on 11 May 2011 in the Kalamazoo River (42.2743°N, 85.08133°W), approximately 1.2 linear channel km from its original capture location. It was recaptured on 30 August 2011 in the Kalamazoo River (42.2702°N, 85.0610°W) approx. 2.0 linear channel km upstream of its release point and 0.8 linear channel km from its original capture location. Although close to its original capture location, this turtle moved 1.2 km past its original capture location before recapture.

An adult female *S. odoratus* (9.9 cm SCL, 168 g) was captured on 14 October 2010 (42.2702°N, 85.0610°W) and was housed overwinter in a wildlife rehabilitation facility. The turtle was released on 12 May 2011 in the Kalamazoo River (42.2743°N, 85.0813°W), approximately 2.1 linear channel km from its original capture location. The turtle was recaptured on 1 September 2011 in the Kalamazoo River (42.2957°N, 85.1242°W). It had traveled downstream approximately 6.7 linear channel km from its release point and approximately 4.6 linear channel km past where it was originally captured.

Three previous studies (Williams, *op. cit.*; Smar and Chambers, *op. cit.*; Andres and Chambers, *op. cit.*) all conducted in lentic habitats (lakes, ponds), demonstrate the homing ability and site philopatry of *S. odoratus* at average distances of about 200–1100 m. To our knowledge no previous reports discussed movements or homing abilities of *S. odoratus* in lotic habitats. Two individuals reported here (one male and one female) traveled approximately 6.7 and 5.6 linear channel km, respectively, representing to our knowledge the furthest reported movement of *S. odoratus*.

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***CHRYSEMYS PICTA PICTA* (Eastern Painted Turtle). LORDOSIS.** The most commonly reported morphological malformation of the spine in freshwater turtles is kyphosis. Most cases involve vertebrals 2 or 3 resulting in a dorsally convex hump of varying sizes on the carapace (Rhodin et al. 1984. Brit. J. Herpetol. 6:369–373; Tucker et al. 2007. Herpetol. Rev. 38:337; Iverson 2007 Herpetol. Rev. 38:334). The frequency of occurrence of kyphosis in natural populations, however, is low with a range of < 0.1–0.5% in sea turtles (Rhodin et al. 1984, *op. cit.*) and 0.004–2.56% in freshwater turtles (J. Iverson, pers. comm.). The opposite of kyphosis is lordosis ("sway-back"). This is a concave deformity of the spine in the sagital plane at the approximate middle of the carapace (Rhodin et al. 1984, *op. cit.*). Previous cases of chelonian lordosis have been reported only for sea turtles. This

FIG. 1. A male *Chrysemys picta picta* from an urban lake in Henrico County, Virginia with lordosis.

malformation occurs in *Caretta caretta*, *Chelonia mydas* (or *Eretmochelys imbricata*, identification unclear), and *Lepidochelys olivacea* (Deraniyagala 1939. The Tetrapod Reptiles of Ceylon. Vol 1. Testudines and Crocodilians. London; Rhodin et al. 1984, *op. cit.*; Glazebrook and Campbell 1990. Diseases Aquat. Org. 9:83–95; Kochinsky et al. 1995. Herpetopathologia 2:105–120; Oros et al. 2005. Diseases Aquat. Org. 63:13–24). All observations have been of single individuals in samples ≥ 93. A thorough review of shell malformations in turtles is in Rothschild et al. (2013. *In* Brinkman et al. [eds.], Morphology and Evolution of Turtles, pp. 501–534. Springer Publ. Co., New York) but he only notes the lordosis cases in Rhodin et al. (1984, *op. cit.*). On 24 August 1979, I captured an adult male *C. p. picta* (77 mm CL, 75 mm PL, 65 g) in an urban pond in Henrico Co., Virginia, USA, with lordosis (Fig. 1). This turtle was part of a study of the population ecology of *C. picta* and *Sternotherus odoratus* and was the only turtle with this type of malformation in 818 *C. picta* marked during 1979–1981 (Mitchell 1988. Herpetol. Monogr. 2:40–61). The male was marked and released but never recaptured. This may be the only case of lordosis in freshwater turtles reported to date.

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***CHRYSEMYS PICTA* (Painted Turtle) and *CHELYDRA SERPENTINA* (Snapping Turtle). INTERSPECIFIC INTERACTIONS.** A recently reported case of commensalism between *Chrysemys picta* and *Chelydra serpentina* involved the former feeding on scraps of food made available by the latter (Himes 2013. Herpetol. Rev. 44:501). Other reported interactions between these species include predation by *Chelydra* on *Chrysemys* (Ernst and Lovich 2009. Turtles of the United States and Canada, 2nd ed. Smithsonian Institution Press, Washington, D.C. 827 pp.), an apparently mutualistic cleaning symbiosis by which *Chrysemys* removed algae and leeches from *Chelydra* (Krawchuk et al. 1997. Can. Field-Nat. 111:315–317), and the use of *Chelydra* for basking by *Chrysemys* (Legler 1956. Trans. Kansas Acad. Sci. 59:461–462). We observed additional interactions between *Chrysemys* and *Chelydra* in Brown Co., Wisconsin during the summer of 1991 in a stretch of the Suamico River that was mostly shallow and partially shaded by riparian forest. A high steep bank above one of the few relatively deep pools in the river (> 1.5 m deep and 22 m across when measured during a period of low water) provided a vantage point to observe the following: 6 June, 1245 h – large *Chelydra* basking on dead floating tree entered water, swam to another downed tree, and climbed up to bask without disturbing two *Chrysemys* already basking; 11 June, 1215 h – large *Chelydra*