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Salvage of Eggs from Road-Killed Red-Eared Sliders, *Trachemys scripta elegans*

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Both aquatic and terrestrial turtles of many species are known to make nesting migrations (see Cagle, 1950 and Gibbons et al., 1990 for *Trachemys scripta*; also Ernst and Barbour, 1989, and Gibbons et al., 1990, for a review). Among the hazards faced during such migrations are encounters with vehicular traffic when females attempt to cross roads (e.g., Iverson, 1977, 1980; Obbard and Brooks, 1980; Diemer, 1986; Galbraith et al., 1989). Frequently such encounters are fatal for the female and her unlaid eggs. Much biological data can be gathered by careful examination of such road-killed turtles. Iverson (1980) noted the value of road-killed tortoises (*Gopherus polyphemus*) for use in studies of reproductive ecology of the species. Galbraith et al. (1989) gathered information on the snapping turtle (*Chelydra serpentina*) from road-killed specimens.

Relatively few studies have reported results from attempts to salvage and incubate eggs from road-killed turtles, but see Lardie (1976) for the painted turtle (*Chrysemys picta*), Iverson (1977, 1980) for the gopher tortoise (*Gopherus polyphemus*) and the box turtle (*Terrapene carolina*), and R.C. Wood (*pers. comm.*) for the diamondback terrapin (*Malaclemys terrapin*). I chose to use the red-eared slider (*Trachemys scripta elegans*) as a model to further investigate the salvage and incubation of eggs from road-killed turtles. This study reports results from 32 such turtles, including hatching success for 67 eggs removed from nine turtles.

Materials and Methods. — The study included 32 turtles found struck by vehicular traffic while trying to cross Illinois Route 100 in Jersey and Madison Counties, Illinois. Thirty-one of these were dead or dying when found. One turtle survived to be released. This individual is included as a road-killed turtle because I judged its injuries extensive enough to have caused its death without human intervention.

I travelled the road at least twice daily during the nesting season. Except for instances actually witnessed, the time interval between discovery and striking was estimated by dividing the time interval between trips by 2 (= estimated death time). Estimated death time varied between 1 and 6 hours. Vehicles also kill females returning from nesting. Therefore, only females with evidence of oviducal eggs such as egg shell fragments or intact eggs are included in the study.

Except for the one injured female that survived in which oviposition was induced with oxytocin (Ewert and Legler, 1978), all other eggs were removed from the turtle's body cavity or road surface at the collection site. After placing the eggs in clean, empty, top-locking plastic bags, they were returned to the laboratory, carefully avoiding unnecessary jarring or overheating of the eggs (Limpus et al., 1979).

Wet mass (to 0.01 g) of eggs was determined with an electronic balance, and length and width (to 1 mm) of eggs were measured using vernier calipers. Each egg was uniquely numbered with carbon ink and partially buried in perlite incubation medium (85 ml deionized water plus 150 g perlite), which had been previously placed in plastic Tucker brand modular storage boxes (32 x 19 x 10 cm). Individual eggs were not in contact, and clutches were incubated separately. To retard moisture loss I placed a layer of aluminum foil under the box lid and determined the weight of the box and contents. Once each week the boxes were opened to inspect the eggs for viability (Ewert, 1985) and were rehydrated by adding water until they regained their original weight. Incubation time was defined as the time to date of pipping (Gutzke et al., 1984). Once the first egg of each clutch pipped, a bottomless waxed paper cup was placed over each egg so that hatchlings could be matched to their eggs (Janzen, 1993). Hatchling wet mass (to 0.01 g) was determined with an electronic balance, and hatchling carapacial length and width (to 1 mm) were measured with vernier calipers. Hatchling measurements were made within 24 hours of hatching. Ambient temperature was not controlled, but did not exceeded 34°C nor fall below 24°C, with an average diurnal variation of 7°C. Statistical analyses were performed using the SAS System computer programs (SAS Institute, 1988).

Results. — Of the 32 turtles (31 road-killed and 1 survivor) with oviducal eggs, 23 contained no unbroken eggs. The remaining nine individuals contained between 2 and 21 unbroken eggs. Two individuals with intact carapaces had a mean of 17.5 unbroken eggs and no broken eggs. The other seven individuals with smashed carapaces contained an average of 4.7 unbroken eggs. The difference in number of unbroken eggs is due in part to broken eggs near many of the turtles. I also observed American crows (*Corvus brachyrhynchos*) and fish crows (*C. ossifragus*) removing eggs from the opened carapaces of some turtles. Previously Shealy (1976, for *C. ossifragus*) and Burger (1977, for *C. brachyrhynchos*) reported crow predation on the eggs of the Alabama map turtle (*Graptemys pulchra*) and *Malaclemys terrapin* respectively.

Eggs from the two relatively intact turtles had higher hatch rates (30 of 35 eggs hatched = 85.7%) than eggs from turtles with opened carapaces (13 of 32 eggs hatched = 40.6%); Fisher's exact test, $x^2 = 14.8$, $P < 0.0001$. The difference is probably due to the fact that the relatively intact turtles had not yet died. One of these survived and was released. The other died of head injuries shortly after discovery. All turtles with opened carapaces were clinically dead at discovery as evidenced by a lack of coordinated movements when mechanically stimulated.

Of the seven turtles with open carapaces, two, with estimated death times of at least 3 hours, contained a total of five eggs. Only one of these eggs (20%) hatched; the other four failed to develop. The other five turtles, with estimated death times of less than one hour, contained 27 eggs. Of these, 12 (44.4%) hatched, and the remaining eggs failed to develop. However, hatch rates for the two groups are not statistically different (Fisher's exact test, $x^2 = 1.05$, $P = 0.625$), but the sample is very small.

No quantitative or qualitative differences among eggs ($n = 67$) or hatchlings ($n = 43$) existed. The mean initial egg wet mass (10.11 g, range 8.20–11.69, SD 0.76), mean egg width (22 mm, range 20–24, SD 1.17), mean egg length (35 mm, range 33–38, SD 1.48), mean hatchling wet mass (7.29 g, range 6.34–8.48, SD 0.55), mean carapacial width (29 mm, range 26–31, SD 1.19), and mean carapacial length (30 mm, range 27–33, SD 1.22), along with a mean incubation period of 62.1 days (range 60–68 days, SD 1.43) are well within the range for eggs and hatchlings of the subspecies as previously reported by Cagle (1950).

Discussion. — This study documents that a significant percentage (40.6% in the current study) of oviducal eggs removed from road-killed female turtles may hatch. Even though best results were obtained for turtles that did not have the carapace broken open, some eggs from females that had been dead for as long as three hours hatched.

At certain stages in their development, turtle eggs are susceptible to damage by jarring and rough handling (Limpus et al., 1979, but see Feldman, 1983, and Ewert, 1985, for contrary findings). However, they can be remarkably resilient as well. In one instance, where I witnessed the female being struck, four of ten eggs were ejected and bounced down the pavement for 4 to 6 m. Each of these four eggs remained intact, and one of the four hatched.

While *Trachemys scripta elegans* is not an endangered or threatened species, the methodologies for collecting and incubating the eggs are simple and could be applied in programs where endangered or threatened species are concerned (R.C. Wood, *pers. comm.*). Such hatchlings could contribute significantly to conservation programs for endangered chelonians.

Because deaths due to vehicular accidents can be sufficient to reduce populations of endangered species, such as *Gopherus polyphemus* (reviewed by Diemer, 1986) and *G. agassizii* (reviewed by Ruby et al., 1994), subsequent release of hatchlings from salvaged eggs might help mitigate the negative impact of roadways on endangered species of turtles. However, hatching a few eggs offers only minimal compensation as compared to strategies for keeping the adult females alive in the first place. Strategies such as highway barriers (Ruby et al., 1994), warning signs, or speed-reduction devices may be of equal or greater importance in preserving endangered chelonians.

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