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Update on Permanent Residency, Persistence, and Longevity in a 35-Year Study of a Population of Three-Toed Box Turtles in Missouri

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In 1965, a study of a population of three-toed box turtles *(Terrapene carolina triunguis)* (Fig. 1) was initiated on a 22.2 ha area in Cole County, Missouri. For the next 25 years, 1743 individuals were collected, marked, and released at the point of capture (Schwartz and Schwartz, 1974, 1991; Kiester et al., 1982; Schwartz et al., 1984). Surveys through 1999 have now provided additional information on permanent residency, persistence, and longevity.

Permanent Residency. — Thirty-one turtles were collected over periods spanning 32 through 35 years; the number of captures for these individuals was 7 to 53 (mean 29.5). They included 17 males and 14 females with three age-classes (see below) represented. Based on the minimum rectangle method, all lived within a home range of 2.1 to 12.5 ha (mean 7.3).

Figure 1. *Terrapene carolina triunguis* (Turtle no. 514, male) was collected a total of 50 times over 35 years. This photograph was taken in 1978 when he was 20 years old. At his last collection in 1999 (age 41), he was still in excellent condition. Photo by Charles W. Schwartz.

It is apparent from these data that some turtles have a home area where they are permanent residents for up to 35 years, although wandering outside the area may not be documented. However, not all turtles are permanent residents in this study area because some are known to have moved through the environment as transients (Kiester et al., 1982; Schwartz et al., 1984). The ratio of permanent residents to transients in this study area is approximately 3:1 (Schwartz and Schwartz, 1991).

Persistence. — In 1989, 22 individuals of the original 1965 population of 366 were collected alive on the study area (Schwartz and Schwartz, 1991). Recent surveys found 13 turtles alive 35 years after marking, 9 alive 34 years after marking, and 7 alive 32 years after marking. Two additional turtles (Nos. 165 and 55, both females) were found freshly dead in their 34th and 35th years, respectively. Thus, 31 turtles lived 32–35 years after marking. This persistence is comparable to that of the subspecies *T. c. carolina*, for which Williams and Parker (1987) reported turtles in Indiana living at least 25 years after marking, and Stickel (1978) reported turtles in Maryland alive 30 years after marking. The most recent report of this latter turtle population (Hall et al., 1999) showed 7 turtles alive 50 years, 5 alive 40 years, and 6 alive 30 years after marking.

Longevity. — As a means of estimating a three-toed box turtle's age, three age-classes were established (Schwartz et al., 1984). These were based on a combination of characters (number and condition of scute rings, coloration, and total length of carapace): Age Class 1 (juveniles), actively growing, (from hatching through 9 years old); Age Class 2 (young adults), growing slowly or recently stopped growing (duration probably 23 years, from 10 through a projected 32 years old); and Age Class 3 (old adults) no longer growing (>33 years old). With additional data, the duration of these classes can be revised slightly, although the class-defining characteristics remain the same. The length of Age Class 1 is still 9 years.

Turtles at the beginning of Age Class 2 are easily aged because 10 scute rings, presumed to be annual, are present and can be counted accurately. But it is sometimes difficult to know exactly when a turtle leaves Age Class 2 and becomes Age Class 3 because the transition is gradual (due to wear of the shell and fading of the color), and growth and aging may be variable even within a single population.

During this 35-year study, five turtles moved from Age Class 1 through Age Class 2 into Age Class 3 but, because of some gaps in surveys at the beginning or ending of the years they spent in Age Class 2, the precise time in this age class cannot always be known. Turtles Nos. 168 and 594, both males, spent 21 known years out of a possible 22 and 30 years, respectively, in Age Class 2; No. 2006, a female, spent 26 known years out of a possible 28 years; No. 248, a female, and No. 514, a male, each spent 29 known years out of a possible 30. An additional 14 turtles spent from 21 through 28 known years in Age Class 2. These data suggest that the duration of Age Class 2 is between 21 and 29 years, and thus turtles in Age Class 2 are from 10 through a probable 30–38 years old.

The duration of Age Class 3 is known to be as long as 35 years because 8 turtles, originally Age Class 3 when marked in 1965, were captured throughout the entire 35-year study period. Eleven other turtles were captured in Age Class 3 for 21 through 31 years.

Using the duration of the above age-classes, the oldest turtles were a minimum of 65 years old at their last collection in 1999 and could be as much as 73 years of age. This longevity in *T. c. triunguis* is comparable to that of *T. c. carolina* in which subspecies some individuals are known to have survived >70 years (Hall et al., 1999).

Recent Threats. — This turtle population was relatively undisturbed for many years before the present study began and it has continued to be a healthy, natural one. However, drastic changes are occurring in the habitat. In 1998 the northern half of the study area, along with adjacent lands, was annexed into the city limits of Jefferson City, Missouri, and a housing development was started on it immediately; in 1999, the property along the western border was staked for development. This present study is providing a baseline for monitoring the potential detrimental aspects of these disturbances.

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A Translocation Strategy for Confiscated Pancake Tortoises

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Re-establishing or founding new populations of threatened or endangered species has become a popular method of conservation for a wide range of species. Translocations have been used in recent years as a conservation technique for multiple species of reptiles (Dodd and Seigel, 1991). Despite the popularity of translocations, their validity as a conservation technique continues to be questioned by a number of authors (Berry, 1986; Kleiman, 1989; Dodd and Seigel, 1991). Although translocation programs are often highly visible in the media, their methodologies and decision-making protocols are rarely published and reviewed in the scientific literature. A widespread lack of follow-up research has made it extremely difficult to gauge the success of past efforts (Dodd and Seigel, 1991; Burke, 1991).

Despite such concerns, translocation can be both successful and ecologically beneficial if performed under a specific suite of circumstances. Knowledge of ecological and social factors important to the continued survival of a population is essential before any animals are moved to a new habitat. Vital preliminary information includes knowledge of the reasons for the decline of the species in other areas, understanding of the biological and habitat constraints for the species, consideration of population and demographic factors in the released population, presence of con-