

TERRAPENE CAROLINA (Eastern Box Turtle). WINTER MORTALITY. Risk for box turtle death during hibernation is not well determined, but it is an important metric for population survival because this species rebounds very slowly from losses (Hall et al. 1999. *Biol. Conserv.* 88:165–172).

Those who have commented on box turtle winterkill indicate that few turtles generally die during most winters (Ernst et al. 1994. *Turtles of the United States and Canada*. Smithsonian Institution Press, Washington, DC. 578 pp.; Dodd 2001. *North American Box Turtles, A Natural History*. University of Oklahoma Press, Norman, Oklahoma. 231 pp.; Cook 2004. *Appl. Herpetol.* 1:197–228), a view which agrees with 22 years in our 23-year chronicle.

In our study (e.g., Seibert and Belzer 2013. *Rept. Amphib. Conserv. Nat. Hist.* 20:53–74) we have been monitoring (since 1993), via radiotelemetry, a population composed of displaced adult, and headstarted *Terrapene carolina* in NW Pennsylvania, USA. Previous papers have detailed aspects of health in these turtles, our study habitat, location, and our methods. Here we report a mortality event that occurred in the record-breaking cold winter of 2013–2014.

Terrapene carolina often hibernates in places with little groundcover (Madden 1975 Unpubl. PhD dissertation, City University of New York, New York. 217 pp.). Unlike box turtles in more southern climes (Ernst et al., *op. cit.*), individuals in NW Pennsylvania consistently remain underground and do not change hibernacula during the winter. Our turtles use many different types of substrate (sedge fields, leaf-filled depressions, hardpan, stony subsoil, root-ridden soil, old tree-root pits, etc.) for hibernating, some of which limit the depth of cover that the turtles are able to achieve, but with no noticeable detriment to their winter survival.

Allard (1935. *Sci. Mthly.* 41:325–338) reported a high rate of death (3 of about 30 turtles) in a population near Washington, DC during the winter of 1932–1933. A 10% mortality rate would constitute a major population event. Allard ascribed disease or poor condition among his turtles as a primary contributor to the die-off. For the 20 years that preceded 2013 in our population, seven of those winters produced low mortality (2% of the population during five of the winters; 1% during two winters); 13 of the winters induced no deaths. Then, in the winter of 2013–2014, southern extensions of the polar vortex brought record-breaking

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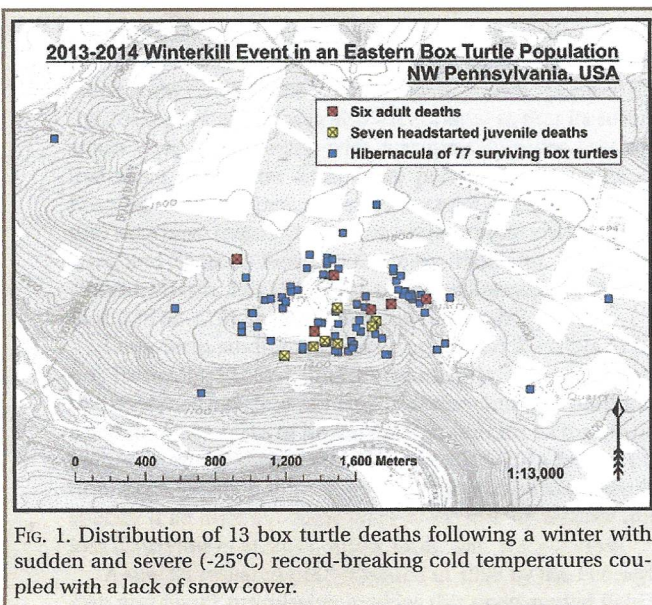


FIG. 1. Distribution of 13 box turtle deaths following a winter with sudden and severe (-25°C) record-breaking cold temperatures coupled with a lack of snow cover.