

Winter aggregations of adult red salamanders (*Pseudotriton ruber*)

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Information on the winter ecology of amphibians is important for understanding their biology, management and conservation, particularly in temperate climates where amphibians may spend several months overwintering (Irwin, 2005). However, few data are available on winter ecology of many amphibians, especially salamanders (Irwin, 2005; Lannoo, 2005). *Pseudotriton ruber* are medium-sized, semi-aquatic salamanders occurring generally from New York State to Louisiana and westward to Indiana in the eastern United States (Petranka, 1998; Hunsinger, 2005). Typically, adult *P. ruber* move from terrestrial to aquatic habitats (e.g., streams, springs) during late fall, and presumably overwinter at these sites (Bishop, 1941; Bruce, 1978; Petranka, 1998). While abundant in these aquatic habitats during the fall and subsequent spring, *P. ruber* have been noted to be difficult to locate during winter (Bruce, 1978; Pfingston, 1989; Hunsinger, 2005) and typically disappear from the surface of streams and springs, leading to the suggestion they may occupy inaccessible, subterranean retreats within streams and springs during the winter months (Pfingston, 1989; Hunsinger, 2005).

During winter 2016-2017, two instances of adult *P. ruber* congregated underneath a single rock within two separate springs were observed in the South Branch Roaring Creek watershed, Northumberland County, Pennsylvania, USA (40.831°N, 76.502°W, WGS 84 grid). On 27 December 2016 at 14:00 h (United States Eastern Standard Time) at an air temperature of 4 °C, eight adult *P. ruber* were congregated underneath a small (~20 x 15 cm diameter) rock within an unnamed spring. On 16 January 2017 at 13:45 h (United States Eastern Standard Time) at an air temperature of 0 °C, 22 adult *P. ruber* were found congregated underneath a medium-sized (~40 x 30 cm in diameter) rock within an unnamed spring (Fig. 1). During each observation, the salamanders were active and began dispersing from their aggregation immediately upon removal of cover (Fig. 1). In each case, the rocks were carefully returned to their original position and the salamanders gently coaxed back underneath the retreats.

Few reports have appeared in the literature regarding aggregations of adult *P. ruber*. Niemiller et al. (2006) found 14 adult *P. ruber* collectively underneath several rocks within a cave stream whilst Walker (1931, in Pfingston, 1989:272) found a concentration of 22 adult *P. ruber* within "a few square meters" in a spring in Ohio during March. During the present field work further rocks and other cover



Figure 1. Aggregation of adult *P. ruber* underneath a single, uplifted stone within a spring in eastern Pennsylvania during January 2017

(e.g., woody debris) at each spring were gently lifted but no more adult *P. ruber* were found. However, adult and larval salamanders of *Desmognathus fuscus* and *Eurycea bislineata* were found underneath other cover objects within each spring. Thus, it is unclear why a number of adult *P. ruber* aggregated underneath a single cover rock when other (presumably) suitable cover was present within each spring. Niemiller et al. (2006) found nest attending *P. ruber* in their cave aggregation; suggesting these individuals aggregated for reproduction. However, no nests were associated with the aggregating *P. ruber* in Pennsylvania. Additionally, because breeding in *P. ruber* occurs outside of the coldest winter months (i.e., breeding season of this species varies geographically but is thought to occur outside of the cold winter months, Petranka, 1998), this aggregation appears to be unrelated to mating. Climate records for Northumberland Co., Pennsylvania show that temperatures during winter 2016-2017, including the months of December and January during which the present observations took place, were warmer on average than previous years (<https://www.usclimatedata.com/climate/elysburg/pennsylvania>). Thus, it is possible that above-average temperatures might have stimulated mating later in the season. Walker (1931, in Pfingston, 1989) suggested that the aggregation of *P. ruber* he observed was related to hibernation. Because the observations reported occurred during winter and

presumably outside of the known breeding season for *P. ruber*, it seems more likely that these aggregations were due to overwintering, although mating might also have been involved. Perhaps some unknown physical factor made these particular rocks more suitable for overwintering than other cover available within each spring. These observations of adult *P. ruber* aggregating underneath rocks at the surface of springs, while limited, contribute an important observation regarding the winter ecology of this species.

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