Introduction


Eastern Newts have one of the most variable and multi-faceted life cycles of all amphibians, with three possible developmental pathways. Aquatic larvae may metamorphose to a terrestrial juvenile stage (i.e., the eft) that later transforms again into an adult morphology. The eft stage is skipped in many populations so that larvae transform directly into adults. Paedomorphosis is also common, in which animals maintain the larval morphology as sexually mature gilled adults. There is considerable subspecific and geographic variation in the potential to follow each of the three pathways, likely reflecting regional ecology (Takahashi and Parris, 2008) while certainly affecting terrestrial habitat use.

The Peninsula Newt (*Notophthalmus viridescens piaropicola*) is the southernmost form of the four presently recognized subspecies and a Florida endemic whose geographic range extends as far as southern mainland Florida (Conant and Collins, 1998). The eft stage is thought to be skipped normally so that larvae transform into adults that remain aquatic. Paedomorphic condition is suggested to be relatively common (Schwartz and Duellman, 1952; Duellman and Schwartz, 1958; Mecham, 1967). Moreover, most accounts indicate aquatic habitat as most important (Duellman and Schwartz, 1958; Mecham, 1967; Bartlett and Bartlett, 1999), and in southern Florida this species is strongly associated with permanent sources of water (WEM, personal observation).

There is little documentation of terrestrial activity in the Peninsula Newt, although individuals reportedly were found “crossing roadways on rainy nights” (Bartlett and Bartlett, 1999) and “occasionally emerging to walk on floating vegetation” in aquatic habitats (Jacksonville Zoo...
2011). Extensive fieldwork has revealed no terrestrial movements by this species on wet roads by day or night in extreme southern (WEM, personal observation) and west-central (P.R. Delis, personal communication) Florida. Thus, although terrestrial activity in Peninsula Newts has been mentioned, the rarity of these accounts suggests the behavior is genuinely uncommon. Herein, we use drift fence data to quantify terrestrial habitat use by this species in southwest Florida, USA, and report changes in capture frequency over a 16-year period.

**Methods**

As part of a local effort to monitor changes in herpetofauna composition and abundance in southwest Florida, we established drift fence arrays at nine sites on a large reserve of protected land in Collier County (Corkscrew Regional Ecosystem Watershed, CREW). The site is comprised of about 243 km$^2$, much of the watershed leading to the Corkscrew Swamp Sanctuary. The mission of CREW is to preserve and manage the water resources and natural heritage of this important watershed. CREW contains diverse habitats common and typical of the region: cypress domes, sawgrass marshes, pine-palmelo flatwoods, oak hammocks, and popash sloughs.

Drift fences made of buried silt fencing were placed in a cross configuration (each arm 7.6 m long) in varying habitat types (mesic flatwoods, n=3; oak hammocks, n=3; wet prairie, n=1; and depression marshes, n=2). We set homemade funnel traps of stapled aluminum screen at the end of each fence line. Each trap was shaded with palm fronds, and a damp cloth was placed inside to further inhibit desiccation. Traps were deployed for seven-day periods and checked daily in both wet and dry seasons. To test for changes in herpetofaunal populations and communities, we performed two rounds of sampling, first in the 1990s (1995-97) and again more than a decade later (2010-11). We report full details of methodology elsewhere (JRC et al., unpublished manuscript).

**Results and Discussion**

On 29 June 2011, a small Peninsula Newt displaying adult morphology (29.5 mm SVL, 0.36 g) was caught at an array placed near the edge of a drying sawgrass marsh wetland (Figure 1). This period of 2011 was extremely dry in southwest Florida. Rainfall in the 12 months leading up to this capture was 172 mm below average (1250 vs. 1422 mm). The cumulative total for the first half of 2011 was 79 mm below average (480 vs. 559 mm). The water table, as measured at a nearby well (~1.5 km from site of capture), was at its lowest over the six-year period for which data have been collected (April 2007-April 2013). All of the more shallow wetlands in the immediate area had dried down earlier that year (JRC, personal observations).

During a wetter period in the fall of 1996, two other Peninsula Newts were caught in terrestrial traps at a nearby CREW site (North Flint Pen Strand, Lee County) on 27 September and 8 November. In this sampling period at Flint Pen, many newts (N=51) were caught in traps that were under water (usually > 150 mm) at additional drift fence arrays within 1.5 km. Standing water was probably near these terrestrial traps at the time of capture. Elevation was similar, and the other arrays where newts were common had underwater traps on those days. Only these three out of 113 total newt captures occurred on land (2.7%), and the upland arrays never had newts.

These terrestrial captures are notable because Peninsula Newts have never been reported on land in the Everglades and southwestern flatwood ecoregions of southern Florida despite intense herpetological sampling in the modern era (WEM, personal observation; though we note a terrestrial capture in Dade County communicated to us during manuscript preparation by R.D. Bartlett). Duellman and Schwartz (1958) reported examination of a specimen collected in Monroe County (southeast of our study site) in 1932 and concluded that it was an eft. However, no additional efts have been reported since, and these combined observations suggest that both the eft stage and terrestrial habitat use by adults is extremely rare, if not absent, in the region.

![Figure 1. A severely dry and emaciated Peninsula Newt captured by a terrestrial drift fence trap in June 2011 at Corkscrew Regional Ecosystem Watershed, Collier County, Florida, USA. Photo credit: J.R. Cassani.](image-url)
Our data corroborate the rarity of terrestrial habitat use by Peninsula Newts in southern Florida and raises the question of why individuals occasionally venture onto land. The newt we trapped in 2011 was clearly stressed, displaying extreme emaciation and poor body condition. It may have been forced into unusual terrestrial behavior by drought, searching for suitable aquatic habitat or food. The two terrestrial captures in 1996 were likely lingering toward the edge of a gradually drying wetland, similar to the individual taken under moist cover near water at the Rodman Reservoir in Alachua County (R.D. Bartlett, personal communication).

Peninsula Newt captures at the same drift fence sites using similar methods declined from 60 in 1995-97 (1.05/trap-day) to just 1 in 2010-11 (0.02/trap-day). This finding could be a result of drought, as traps and fences were in standing water more often during the 1990s sampling (JB, personal observations). If newts avoid terrestrial movements, lower water levels may have caused a similar population to go undetected because animals were restricted to underground refugia near the last areas of moisture in the lowest microhabitats. However, a local population decline for this species remains a possibility, as is suggested for many North American amphibians (Adams et al., 2013). Peninsula Newts are dependent on relatively shallow, yet semi-permanent wetlands such as those found in hydric pine flatwoods, a habitat type that has been severely impacted by altered hydrology as a result of continued land use changes and increasing development in the growing region of southwest Florida (SFWMD, 2008; Ceilley and Bortone, 2000).

Unlike its northern relatives, the Peninsula Newt appears much less inclined to use terrestrial habitat at any life history stage. Such ecological information is critical for management plans aiming to conserve this wetland species. In the face of climate change induced periods of severe drought, a nearly exclusive reliance on aquatic systems coupled with poor dispersal over land could place this endemic species at a dangerous disadvantage in a profoundly changing aquascape. We hope our observations highlight the dearth of information about this important animal and stimulate interest, concern, and support for south Florida’s only newt.

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References