



# Life-history characteristics of a population of Ring-necked Snakes (Colubridae: *Diadophis*) occupying anthropogenic habitat.

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## Abstract

Anthropogenic activity can alter the environment in ways that benefit some species. For herpetofauna, such alteration can occur in the form of trash heaps, log piles, rip-rap or other objects that provide retreat or hibernation sites. During emergence and the early portion of the activity season, in 2010 - 2012, we sampled a population of Ring-necked Snakes (*Diadophis punctatus*) inhabiting a 1200-m levee sited between a river and a reservoir. Constructed using rip-rap boulders, the levee provides abundant cover objects, under which we caught all subjects. We encountered individuals representing all life-history stages; the density at our study site was among the highest reported for this species. Inter-annual recapture rates ranged between 0 and 5%. Subject mass was strongly correlated with snout-vent length; among adults, males tended to be longer and heavier than females. We contend that the rip-rap habitat along the levee provides multiple benefits for these fossorial snakes in the form of microhabitats that satisfy thermoregulatory, dietary, and hibernation requirements. Features available within anthropogenic habitat might not only be tolerated by Ring-necked Snakes, but also allow this species to attain higher population densities than would occur in natural settings.

## Introduction

- Although typically detrimental, habitat alteration can provide features that support larger population sizes for some organisms (6).
- Semi-fossorial snakes can change their subsurface depth to maximize thermal benefits without increasing predation risk (4).
- The small body size of several semi-fossorial snake species has limited the understanding of their biology as well as their needs for conservation (5).

## Purpose

Our study concerns a large population of Ring-necked Snakes (*Diadophis punctatus*) that occurs along a levee constructed to separate a reservoir from a river channel. We estimate the individual density as well as report several morphometric patterns present within the population.

## Methods

- We caught snakes during visual encounter surveys (VES [3]), mostly during the Spring months. Search efforts targeted snakes under rocks (Fig. 1).
- We sexed all snakes with cloacal probes, recorded standard morphometrics (1), and uniquely marked all snakes with a medical cautery unit (8).
- We used unpaired t-tests to compare parameters between snake genders.

Fig. 1 – Ring-necked Snake encountered under typical-sized rip-rap boulder on the levee.



## Study Site

- The 1280-m levee separating the Embarras River from the Charleston Side-channel Reservoir was constructed in 1982 to isolate a drinking water supply and reduce sedimentation within the river.
- The levee consists of clay berms covered by mixed layers of gravel, rip-rap boulders, and soil (Fig's. 2,3). Depending on the position along the levee, surface layers are 60-150 cm in depth. The boulders are quarried limestone, and most range in size from 20-35 cm (largest cross-sectional dimension).
- Gradual succession has been managed along the entire levee, with surface vegetation dominated by vines (*Toxicodendron*, *Vitis*, *Lonicera*), grasses, and stunted trees (*Populus*, *Morus*, *Robinia*).

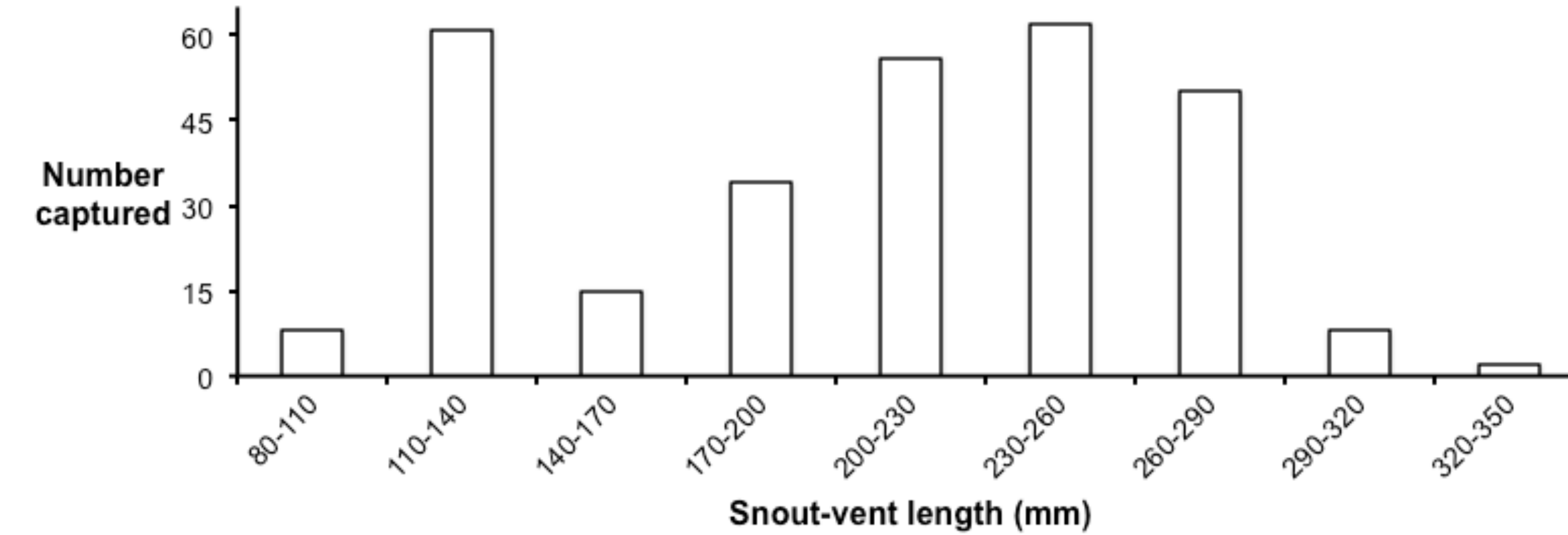


Figure 4. Size frequency distribution of *Diadophis punctatus* observed in rip-rap habitat (total n = 298).

## Results

- We observed 129 snakes per ha. The number of snakes encountered per VES ranged from 1 to 45 individuals (mean  $\pm$  1 SE =  $14.0 \pm 2.9$  snakes).
- Snakes occurred with greater frequency on the east side of the levee (98.7% of all captures), but were never associated with the jetties projecting eastward towards the river.
- The recapture rate for *Diadophis punctatus* for the study duration was 8.4%, and ranged as high as 10% within years. Some patches along the levee appeared to be preferred microhabitats (consistently yielding snakes, although rarely the same individuals).
- Across all life-history stages, male snakes were longer and heavier than females (Table 1), although both genders exhibited similar growth trajectories (Fig. 5). Relatively fewer individuals in the 140-175 mm range of SVL suggests a period of accelerated growth (Fig. 4).

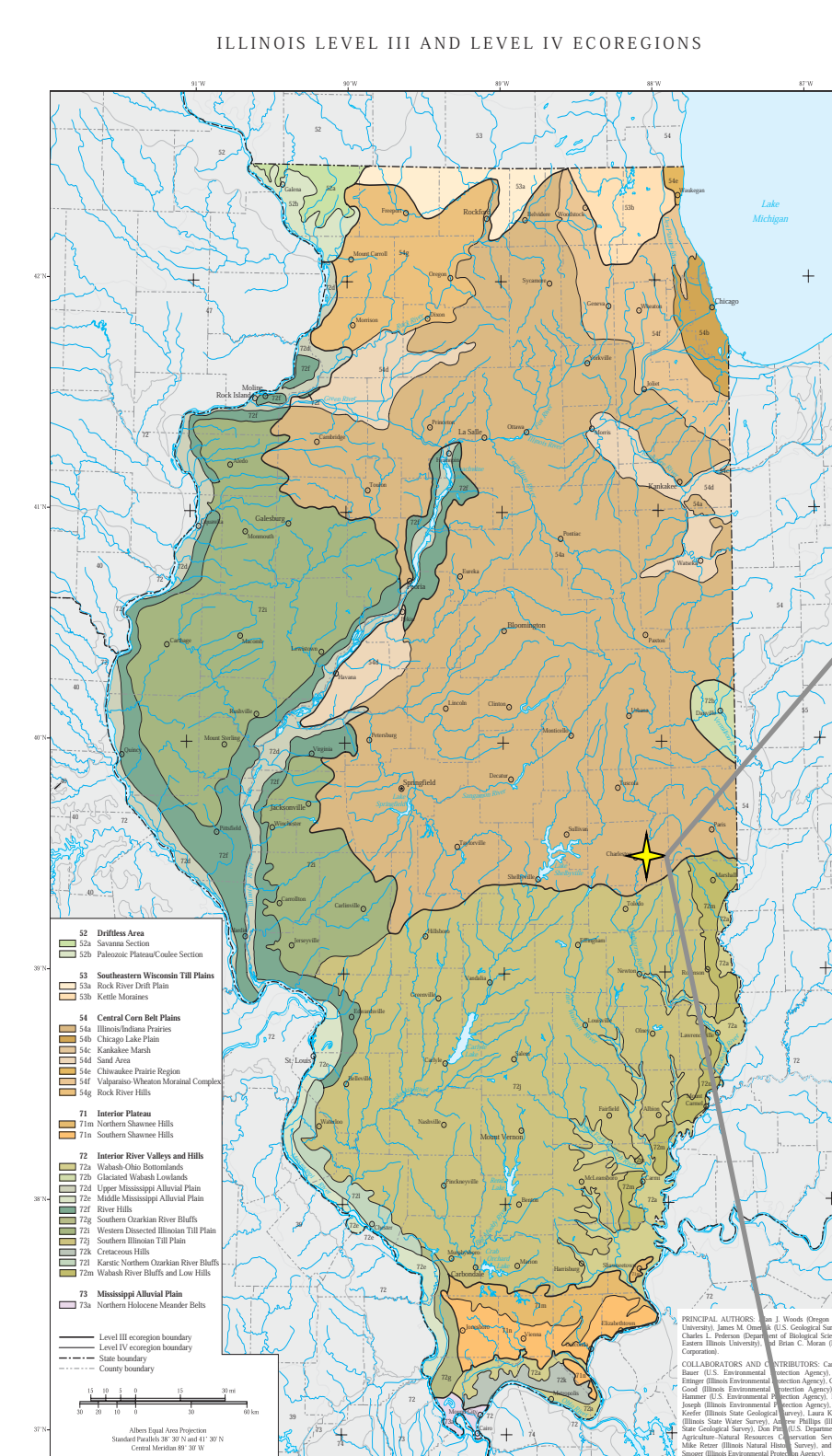


Fig. 2 – Study site (2.31 ha): locality within Illinois (above); aerial view of levee separating the reservoir from the river (right); and, ground-level view from the south end of the levee (far right).

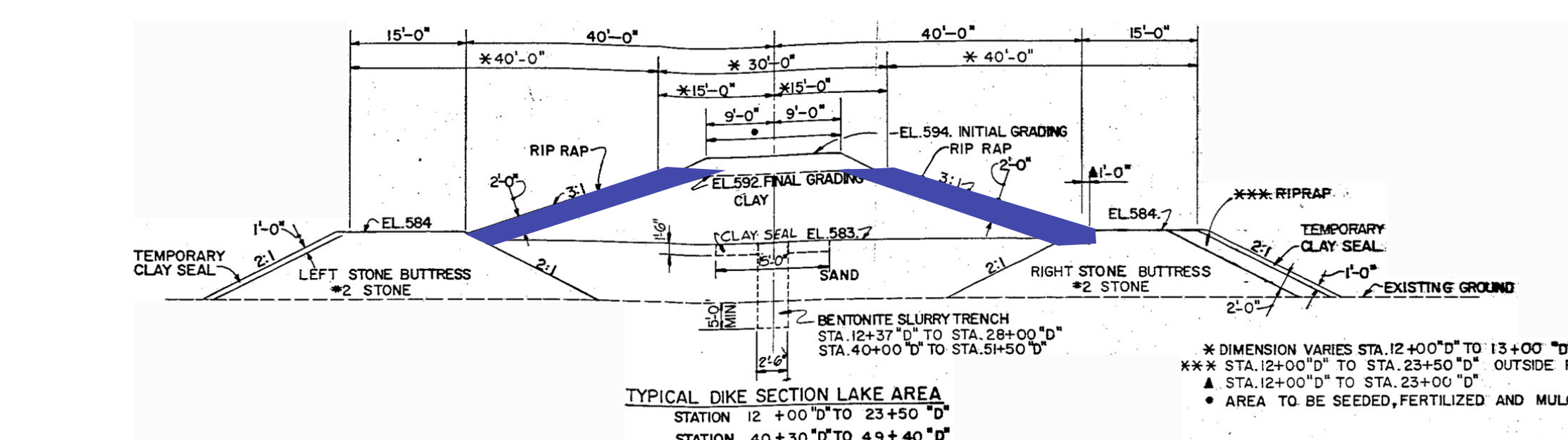


Fig. 3 – Architectural elevation view of levee (cross-section), showing rip-rap layers (purple) where snakes were found.



Table 1. Morphometric parameters for *Diadophis punctatus* observed at the Lake Charleston levee. Values are reported as means  $\pm$  1 standard error, sample sizes are given in parentheses, and p-values are given for unpaired t-test comparisons of differences between genders.

Parameter	Gender		P
	Female	Male	
snout-vent length (mm)	196.4 $\pm$ 5.7 (119)	212.6 $\pm$ 4.0 (175)	0.017
tail length (mm)	48.5 $\pm$ 1.6 (114)	61.8 $\pm$ 1.3 (174)	< 0.001
tail : total length ratio	19.8 $\pm$ 0.2 (114)	22.4 $\pm$ 0.1 (173)	< 0.001
mass (g)	4.2 $\pm$ 0.3 (119)	4.9 $\pm$ 0.2 (174)	0.03
mass per mm SVL	0.019 $\pm$ 0.001 (119)	0.022 $\pm$ 0.001 (174)	0.003

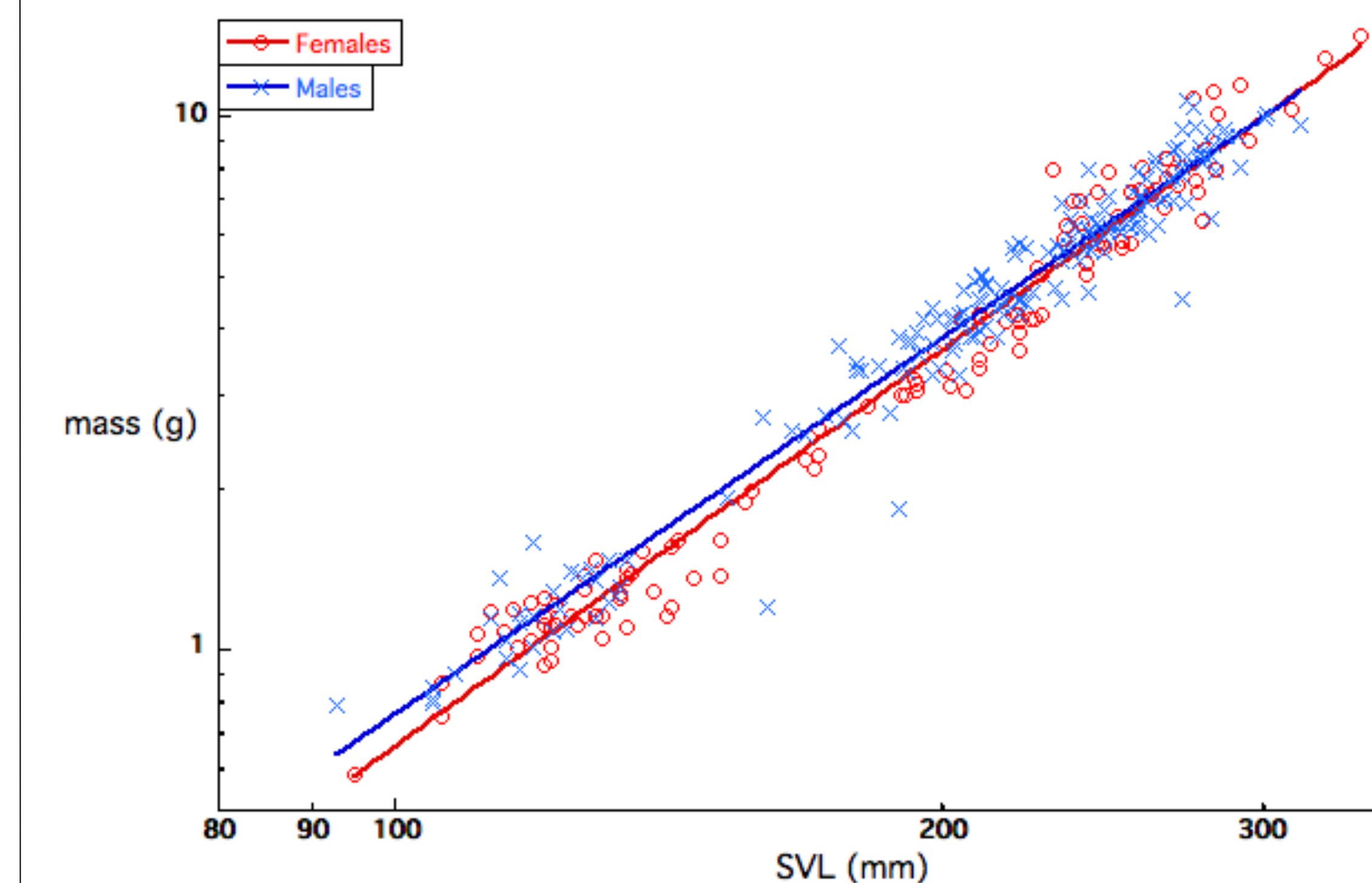


Figure 5. Mass (g) as a function of snout-vent length (SVL; mm) for *Diadophis punctatus*. Both variables are plotted on log-scales; the coefficients of determination ( $r^2$ ) for females (n = 119) and males (n = 174) are 0.95 and 0.93, respectively.

## Discussion

- The levee habitat at Lake Charleston is atypical for that previously described for Ring-necked Snakes (2,7), yet it supports an unusually high density (*cf.* 2).
- Although seven other snake species also associate with the levee habitat for overwintering (*pers. obs.*), most disperse off the levee during the activity season.
- Contrary to previous studies (7), male snakes were longer and heavier than females. However, sexual maturity appears to be reached at similar body sizes.
- We suggest that Ring-necked Snakes effectively use this habitat by moving vertically between rip-rap layers in search of prey and optimal thermal conditions.
- Appropriately-timed search efforts can yield large sample sizes for understudied snake species, even in anthropogenically-altered habitat.

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