

Yearly body size distribution in the terrestrial snail *Succinea costaricana* (Stylommatophora: Succineidae)

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ABSTRACT. The study of neotropical snails has gained importance in recent years because some species, like *Succinea costaricana*, have become quarantenary or agricultural pests. We studied the yearly body size distribution of this species in an ornamental plant farm at Guápiles, Limón, Costa Rica; *S. costaricana* originally inhabited the tropical rain forest that was cleared to establish agricultural space in the XIX century. Fixed-time collection was done every other month in randomly selected plants and soil sections. Body size distribution (measured in the shells) indicates a capacity to reproduce year-round with a peak when pluviosity decreases in December. At this time of year the population is dominated by snails under 4 mm in shell length (longest individual: 12.06 mm). However, the yearly rainfall pattern does not correlate with shell length, width or width/length ratio: rainfall alone is not the most important factor affecting population dynamics. Eggs of *S. costaricana* are covered only with a mucilaginous material that might easily be infected or predated. The reproductive peak in the less humid part of the year may be an advantage if levels of predation or infection are lower.

RESUMEN. Estudiamos la distribución anual del tamaño corporal del caracol terrestre *Succinea costaricana*. Tomamos muestras cada dos meses en un cultivo de plantas ornamentales que cubre lo que antes fue bosque lluvioso tropical en Limón, Costa Rica. La población se reproduce todo el año, pero hay un aumento cuando disminuyen las lluvias en diciembre, tal vez como respuesta a una disminución en la presencia de parásitos y depredadores. El patrón de lluvia no se correlaciona con longitud, ancho o cociente longitud/ancho en la concha.

KEY WORDS. Tropical, land snail, demography, size reproduction, seasonally.

The study of neotropical terrestrial gastropods, traditionally limited to technically oriented observations by parasitologists, has gained some importance, partially because some are considered agricultural or quarantenary pests of new products exported to industrialized countries (Villalobos *et al.* 1995, Monge-Nájera 1997). Whenever a terrestrial gastropod species has received attention because of its role in agriculture or in the transmission of parasites considered important by humans, our ignorance of their ecology behavior and evolution has become evident (Monge-Nájera 1997), and *Succinea costaricana* (Stylommatophora: Succineidae) is an example of this problem.

For two centuries, most knowledge on the genus *Succinea* Draparnaud 1801 (Succineidae) was based only on North American and European species. However, recent reports dealt with the ecology of tropical species; these include Patterson (1989) in Tahiti, Ramírez (1994) in Peru, and Villalobos *et al.* (1995) in Costa Rica. *S. costaricana* von Martens 1898 is a neotropical species -currently considered a quarantenary pest- for which the seasonal abundance pattern and basic behavioral and reproductive traits were reported a few years ago (Villalobos *et al.* 1995). This paper reports how body size distribution varies during a year in a Costa Rican population and considers how this variation reflects demographic changes.

MATERIALS AND METHODS

The study site is an ornamental plant farm located at La Roxana de Guápiles, Limón Province, Costa Rica (altitude 106 m, yearly mean temperatures: 24.5 °C, 4 440 mm rainfall and 87 % relative humidity, Costa Rican Meteorological Institute database). The area is part of the biotic unit "tropical wet without dry months" (Herrera & Gómez 1993). Soil pH is 4.6 and the mean calcium concentration is 122 ppt (A & L Southern Agricultural laboratories, Florida, U.S.A.). The main crops of e farm are *Dracaena marginata* and *D. deremensis* (Dracaenaceae). Visits were made to the field every two months from March 1992 through May 993. Fixed time collections of 5 mm per sampling nit per observer, for a total of 4 observers, a method that has been successful when sampling land snail richness in tropical rain forests (Emberton *et al.* 1996), were done in plants and the soil their bases. For details see Villalobos *et al.* (1995).

RESULTS

The mean shell length of the population varies throughout the year (Kruskal-Wallis, $p<0.001$) but large and small (less than 4 mm long) individuals re present all the time (Fig. 1A). Highest length values were found in May and September (Fig. 1A). The longest shell, 12.06 mm, was close to the maximum from a laboratory population (13.5 mm, Villalobos *et al.* 1995).

Mean population shell width also varies and reaches highest values were found in May and September (Kruskal-Wallis, $p<0.001$) but elongated and globose shells occur throughout the year (Fig. 1A). Width is correlated with length (Spearman efficient = 0.95, $p<0.01$).

Width/length ratios differed among months (Fig. 1C; Kruskal-Wallis, $p<0.01$): shells were wider in the second half of the year (July-January).

For the eight sampling dates, rainfall pattern not correlate with mean length (Fig. 1A and 2) (Spearman coefficient = 0.19, $p>0.05$) mean width (Fig. 1B and 2) (Spearman coefficient = 0.17, $p>0.05$) or width/length ratio (Fig. 1C and 2) (Spearman coefficient -0.31, $p>0.05$).

DISCUSSION

The maximum shell length of *Succinea costaricana* is intermediate between the lengths of the tropical species *S. wallisi* (11 mm, Patterson 1989) and of temperate species such as *S. vaginaccontorta* (12.4 mm, dry habitats, USA, Franzen 1971) and *S. putris* (18.5 mm, damp habitats, Europe, Rigby 1965). This is in agreement with the idea that larger snails colonize extreme microhabitats (Willig *et al.* 1998). Maximum shell width (9.65 mm) is wider than in other species from a variety of habitats that range from 7.4 to 8.8 mm (Patterson 1989, Franzen 1971).

The ratio values agree with a relative abundance of "globose" species in other rainforests (De Winter & Gittenberger 1998). Possible reasons for the yearly cycle in shell shape include several physical (substrate, temperature, humidity) and biological (vegetation competition and density) factors known to affect other snails (Tattersfield 1981, Coppo & Glowacki 1982).

The occurrence of all size classes throughout the year indicates continuous reproduction, an interpretation supported by laboratory data (Villalobos *et al.* 1995) and studies in other species of the genus (Evans 1968, Godan 1983). There is, however, a weak seasonality (Herrera & Gómez 1993): rainfall decreases during the last months of one year and the beginning of the next (Fig. 2). A reproductive peak is observed at the beginning of this rainfall decrease (Fig. 1A), opposite to other tropical and temperate snails from more seasonal habitats that have reproductive diapause when rainfall decreases (Barrientos 1998, Franzen 1971). We hypothesize that lower rain levels reduce mortality by pathogens (specially fungi) because the eggs of *S. costaricana* are covered only with a mucilaginous material that possibly provides little protection (Villalobos *et al.* 1995).

The lack of stronger associations between shell morphometry and climate suggest that biological factors affect *S. costaricana* more than its seasonal habitat relatives. Field experiments are required to identify these factors and we suggest that future workers assess the role of predators and parasites: in this climate, they are present year-round and may force snails to respond with continuous reproduction.

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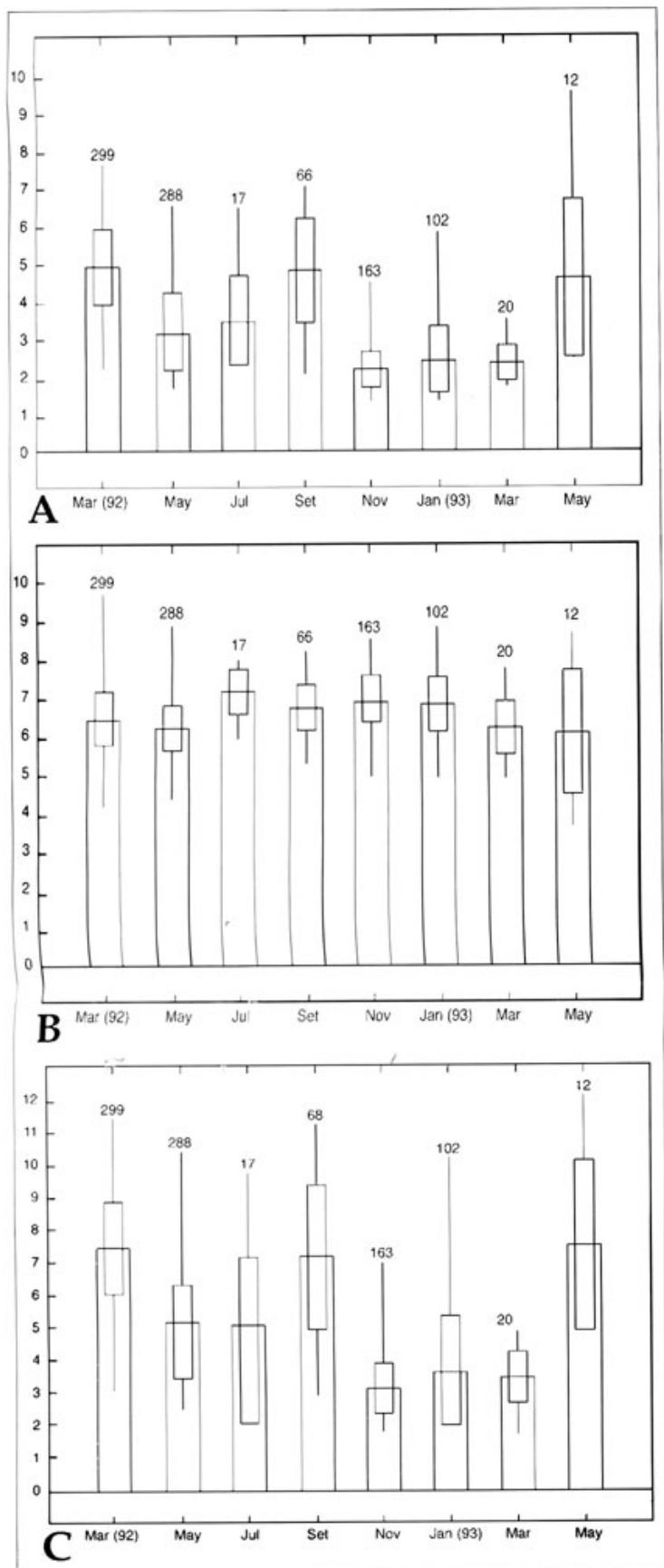


Figure 1. Mean, standard deviation and range of shell length (A), width (B) and width/length ratio C) in a population of *Succinea costaricana*, Limón, Costa Rica.

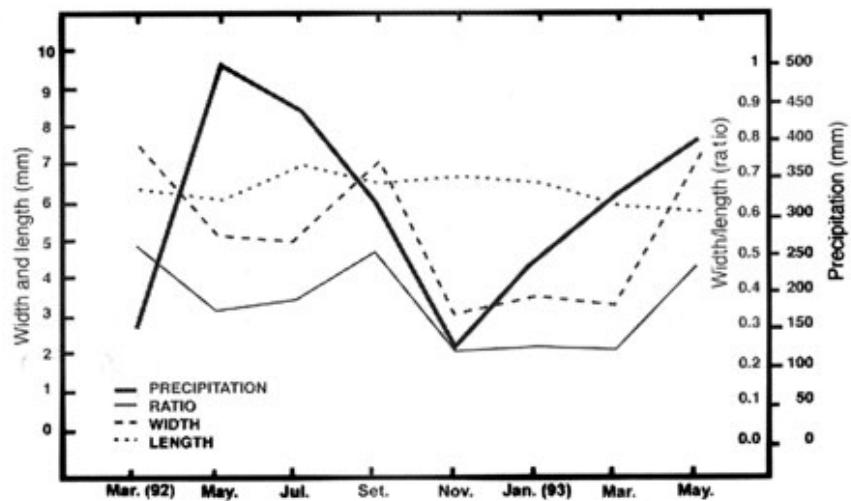


Figure 2. Mean precipitation and mean shell length, width and width/length ratio in a population of *Succinea costaricana*, Limón, Costa Rica.

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