Early maturity and breeding in *Arianta arbustorum* (L.) (Pulmonata: Helicidae)

Bruno Baur
Zoological Museum, University of Zürich-Irchel, Winterthurerstr. 190, CH — 8057 Zürich, Switzerland

During field studies on the land snail *Arianta arbustorum* (L.) in the eastern Swiss Alps we repeatedly observed mating snails of which one snail was subadult while its partner was fully grown with a thickened lip. In four instances a record was kept (Table 1). In one case the subadult snail had a bigger shell size than its adult partner, in the other cases the subadults were smaller. The mating snails from Weissbad and the subadult snail from Savognin were brought to the laboratory and kept isolated in transparent polythene boxes in natural daylight and at a temperature of 19 — 22°C. The bottom of the boxes was covered with 2 cm soil and the snails were fed on lettuce, carrots and oatmeal.

The subadult snail from Savognin laid 3 clutches of 12, 20 and 14 eggs, the subadult snail from Weissbad 2 clutches of 26 and 39 eggs (Table 2). Compared with its adult mating partner, the subadult snail from Weissbad produced fewer and smaller eggs. On the other hand, the hatching rate of the subadult's eggs was higher. Within 20 days after mating the subadult snail from Weissbad had grown to adult size and acquired a lip (adult shell diameter 17.8 mm), while the subadult snail from Savognin completed its shell growth 9 days after the first oviposition (adult shell diameter 16.5 mm).

These observations do not prove that the subadult snails transmitted sperm to their partners. The adult partner might have kept sperm from previous matings since it is known that snails store sperm from several matings for longer than one year[1,2,3]. On the other hand it is known that spermatogenesis precedes oogenesis in stylommatophorans[4].

The present observations show that *A. arbustorum* is capable of reproducing while still subadult. Formerly, helicids were considered to be mature only when fully grown and with a thickened lip at the aperture of the shell[1, 2, 5]. More recently, precocious breeding was also seen in *Monacha cantiana* (Montagu)[6], *Theba pisana* (O.F. Müller)[7], *Helix aspersa* O.F. Müller[7] and *Helix pomatia* Linné[8] as well as in vitrinids[9] and zonitids[10].

While all cases listed in Table 1 are from mountain areas, subadult mating in *A. arbustorum* was also occasionally noted at low altitude (H. Burla, pers. comm.). Though it is rarely observed, the frequency of precocious breeding might increase with the altitude of the habitat, where living conditions become harsh. The copulating subadult snail from Savognin was in one of 23 observed mating pairs of adult snails in an area of about 500 m^2 (C. Raboud, pers. comm.).

A. arbustorum takes one to three years from hatching to adulthood in a population near Zürich at 600 m (Baur, unpubl.), while at high altitude and high latitude full growth takes longer[11, 12, 13]. In the Alps adult size of *A. arbustorum* tends to decrease with the altitude of the site[14, 15]. Since according to life history theory prolonged maturation cuts down fecundity, smaller-sized snails, and snails capable of subadult reproduction, may be selected.

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Table 1. Size of mating *A. arbustorum* compared to the size of adult snails from the same populations.

Date	Locality	Altitude (m above sea-level)	Shell diameter (mm) Mating snails subadult	adult	Adult snails from same locality Mean	Range	Sample size
17 April 82	Steinegg, 47°20'N; 9°27'E	840	14.7	15.6	15.5	13.1-17.6	80
17 June 83	Amden, 47°10'N; 9°11'E	1440	16.8	19.3	18.7	17.0-20.3	54
13 May 84	Weissbad, 47°19'N; 9°26'E	800	17.0	20.4	19.1	17.2-20.5	36
29 July 84	Savognin, 46°36'N; 9°40'E	2480	15.7	15.5	16.5	14.8-18.2	100

Table 2. Time from mating till oviposition, number of clutches and eggs, mean egg diameter and breeding success of subadult *A. arbustorum*, compared with one of their mating partners.*) no measurements.

Origin	Stage	Oviposition (days after mating)	Number of eggs	Egg diameter Mean ± S.D. (mm)	Hatching rate (%)
Weissbad	subadult	22	26	2.8 ± 0.1	100
		33	39	2.8 ± 0.1	82
Weissbad	adult	12	34	3.2 ± 0.1	74
		21	57	3.2 ± 0.1	46
		36	28	3.4 ± 0.1	79
		54	45	*)	44
		89	40	*)	25
Savognin	subadult	8	12	2.6 ± 0.1	50
		22	20	2.6 ± 0.1	70
		29	14	2.8 ± 0.1	79

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Genetic heterogeneity within and among morphological types of the parthenogenetic snail *Potamopyrgus jenkinsi* (Smith, 1889)

D. W. Foltz*, H. Ochman†, J. S. Jones§, and R. K. Selander¶

Department of Zoology, Louisiana State University, Baton Rouge, LA

†*Department of Biochemistry, University of California, Berkeley, CA*

§*Department of Genetics and Biometry, University College, London,* NW1 2HE, *England*

¶*Department of Biology, University of Rochester, Rochester, NY*

Cytological and electrophoretic studies have revealed that many species of apomictic parthenogenetic animals are complexes of genetically-distinct clones. In most cases, the distributions of clones broadly overlap, although exceptions to this pattern are known[1]. Recent studies on morphological variation[2] and ecological distribution[3,4] in several parthenogenetic species support the hypothesis that successful clones possess "general purpose" genotypes, which have high fitness in a variety of habitats[5].

The freshwater prosobranch snail *Potamopyrgus*