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LIFE CYCLE AND POPULATION DYNAMICS OF *ALINDA BIPLICATA* (MONTAGU, 1803) (GASTROPODA: PULMONATA: CLAUSILIIDAE)

ELŻBIETA KUŹNIK-KOWALSKA

Department of Systematics and Zoogeography, Institute of Zoology, Wrocław University, Sienkiewicza 21, 50-335 Wrocław, Poland

ABSTRACT: Based on monthly quantitative sampling it has been found that *Alinda biplicata* (Mont.) reproduces in June, July and August; juveniles grow at a rate of ca. 1 whorl/month and reach maturity in the third/fourth year of life. Adults live more than one year, the total life span being at least 4 years.

KEY WORDS: Clausiliidae, *Alinda biplicata*, life cycle

INTRODUCTION

Very little research has been done on population dynamics and life cycles of clausiliids. Fragmentary data on a few species are contained in LIKHAREV (1962 and literature cited therein). The only attempt at reconstructing life cycle based on field observations was PIECHOCKI's (1982) study on *Vestia elata* (Rossmässler, 1836). During my studies on the comparability of two methods of quantitative sampling (KUŹNIK 1997), I have accumulated extensive material that could serve as a basis for reconstructing life cycles of some of the common species. The most abundant of them was *Alinda biplicata* (Montagu, 1803); this paper is a description of its life cycle as inferred from regularly taken quantitative samples.

STUDY AREA

The nature reserve Muszkowicki Las Bukowy (Fig. 1) is situated at the foothills of the Sudetes (SW Poland), ca. 1 km from the village Muszkowice. It is a fragment of a forest complex, 16.43 ha in surface area. The reserve is located on a slope of a gorge exposed to NE. The upper, southern border of the reserve adjoins cultivated fields. The lower, northern border runs along the bottom of the valley of a small stream Złotnik. The upper and lower parts of the slope differ in their microclimate (MACKO 1954). The area is varied topographically; differences in altitude reach 30–40 m; it rises from north to south. The southern and northern parts of the reserve are covered with loess-like deposits. The soil and litter are calcium-rich; in the central-eastern part of the reserve travertines occur. The vegetation is also varied: a beech forest grows in the upper part of the slope, closer to the stream it is replaced by an oak-hornbeam forest, ash-alder forest and fragments of alder swamp forest.

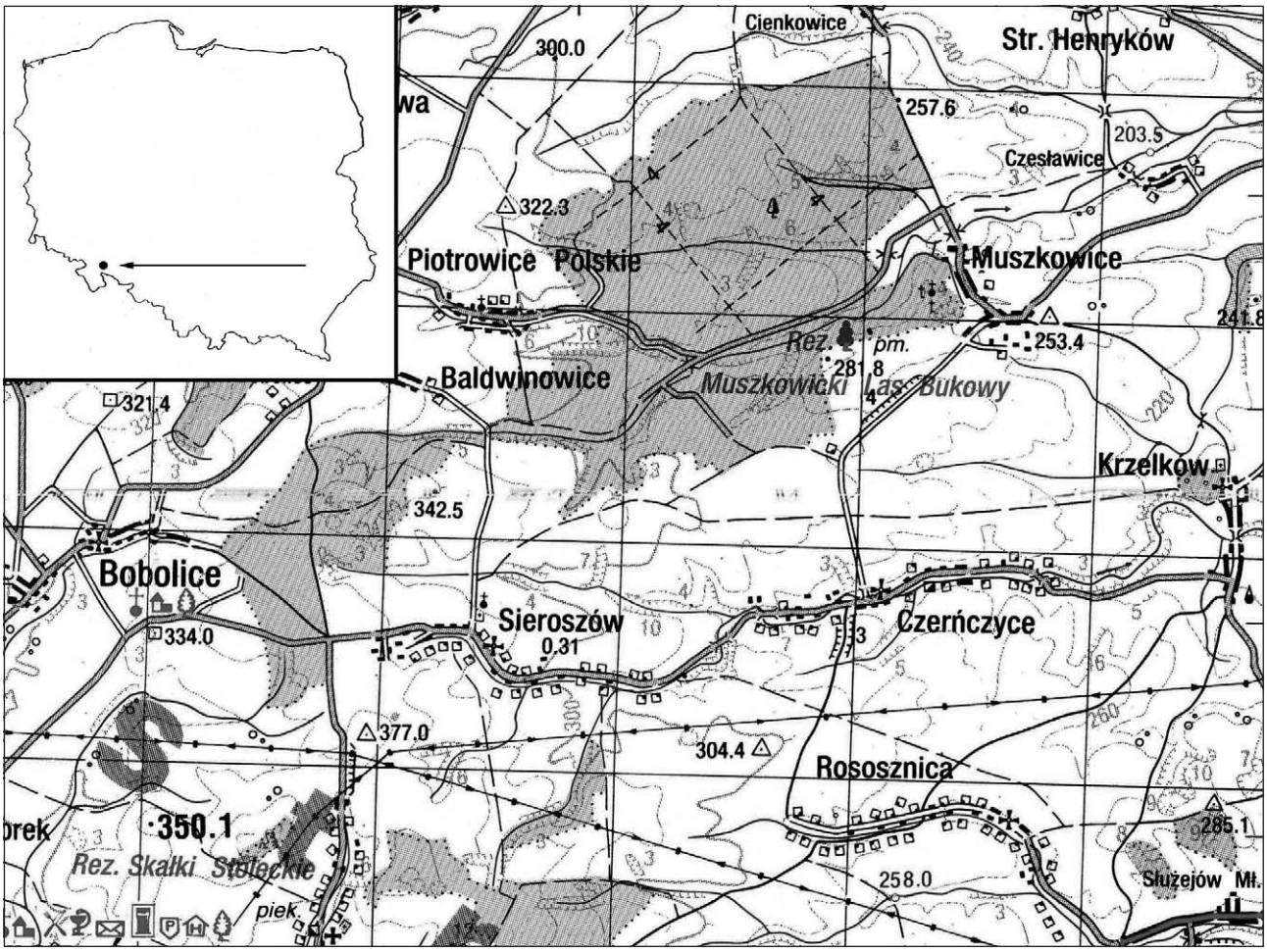


Fig. 1. A map of the studied area

MATERIAL AND METHODS

Samples were taken from October 1993 till October 1994, from a patch of beech, ash-tree, alder and hornbeam. Each month four surface samples were taken of a total area of 1 m^2, according to the modified OEKLAND's (1930, KUŹNIK 1997) method. Each sample was sorted three times: immediately after bringing it to the laboratory, and then twice after drying and sieving the material through sieves of 1 x 1 and 0.5 x 0.5 cm mesh. Only living individuals were taken into account.

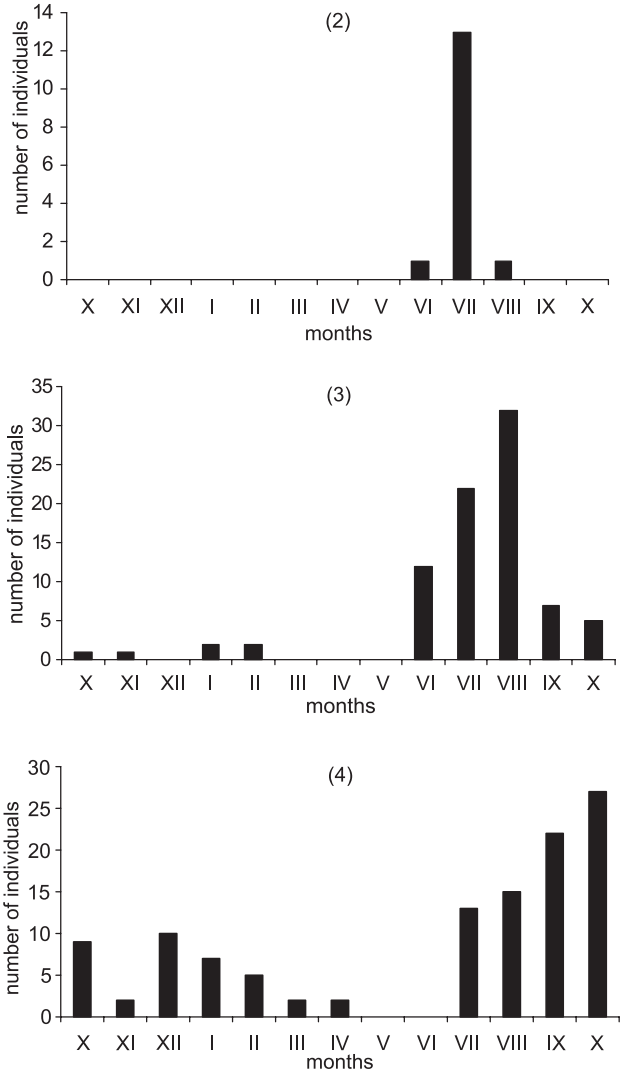
Like other clausiliids, *A. biplicata* becomes sexually mature when it completes building lip and apertural barriers (LIKHAREV 1962). Immature individuals obtained from the samples were divided in age classes according to the number of whorls. The number of whorls among the adult individuals of the studied population ranges from 11.2 to 12.6 and these were treated jointly as one class. The snails start building their apertural barriers when their shells have somewhat more than 10 whorls, and such individuals were regarded as subadults. The number of whorls in newly hatched juveniles is 1.2–2 and thus the first class was regarded as neonates. All the other age classes were regarded as juveniles. The age classes were as follows: class I (neonates) – 1.2–2.1 whorls, II – 2.2–3.1, III – 3.2–4.2, IV – 4.2–5.1, V – 5.2–6.1, VI – 6.2–7.1, VII – 7.2–8.1, VIII – 8.2–9.1, IX – 9.2–10.1, X (subadults) –10.2–11.1, XI (adults) – 11.2–12.6.

RESULTS AND DISCUSSION

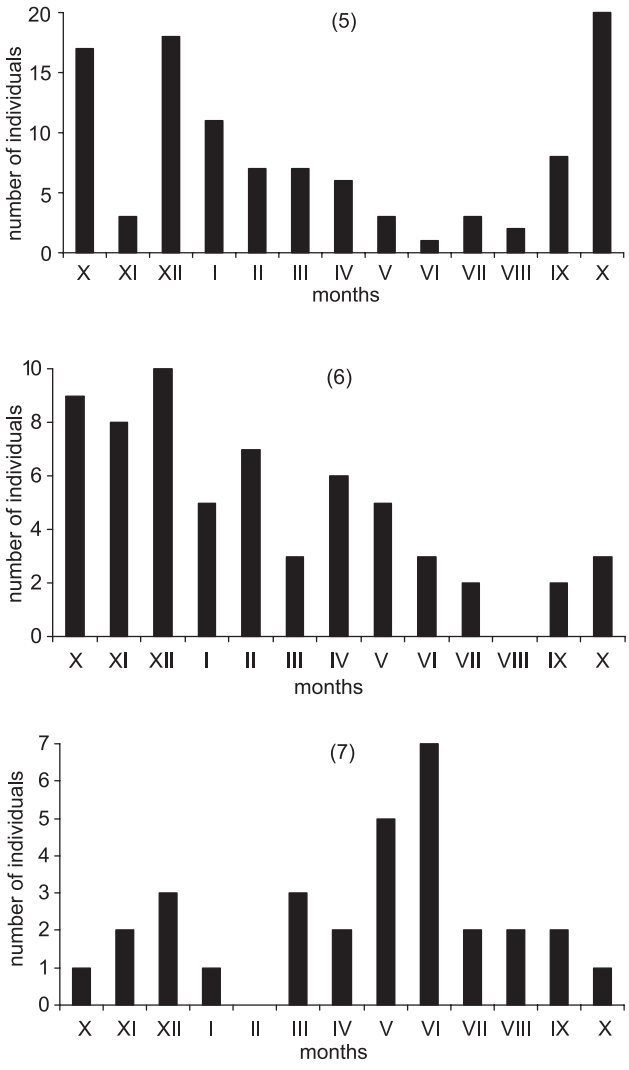
The abundance of particular age classes in consecutive months is presented in figures 2–12.

The neonates (class I) start to appear in June, with a maximum in July; then their abundance drops dras-

tically in August (Fig. 2). It can be thus inferred that the snails hatch from June to July. Their disappearance in August/September cannot be caused by a high mortality, since class II, which appears in June and July, becomes the most abundant in August (Fig. 3). Some members of this age class persist through autumn and winter months which may be a result of a slow growth in some sporadic cases, or of some few adult individuals laying their eggs outside the reproductive peak. Class III appears first in July, reaching its maximum in September/October (Fig. 4) and juveniles of this size winter over. Class IV is abundant in October, November and December (Fig. 5). Most probably, like class III, it includes individuals hatched in June. With the preceding and following classes (III and V), they form the bulk of wintering juveniles. From May to August class IV is poorly represented; juveniles hatched in the spring and summer have still not attained such a large size. Class V, probably comprising individuals that were the earliest to hatch and/or the quickest to grow, is the most abundant in October, November and December (Fig. 6). Individuals of class VI are few in the fall and winter and numerous from March till June (Fig. 7). They are probably juveniles which have reached 6 whorls in the fall and resume their growth in the spring. Class VII is present from March till October, with the maximum from March to July (Fig. 8). Like members of class VI, they are juveniles the in second season of growth. The temporal distribution of class VIII is uneven, with maxima in June, July and November (Fig. 9). June/July class VIII juveniles are probably those that reached ca. 8 whorls the previous fall; November juveniles may be those that wintered over as members of



Figs. 2–4. The abundance of the neonate class I (2) as well as juvenile classes II (3) and III (4) in consecutive months of studies

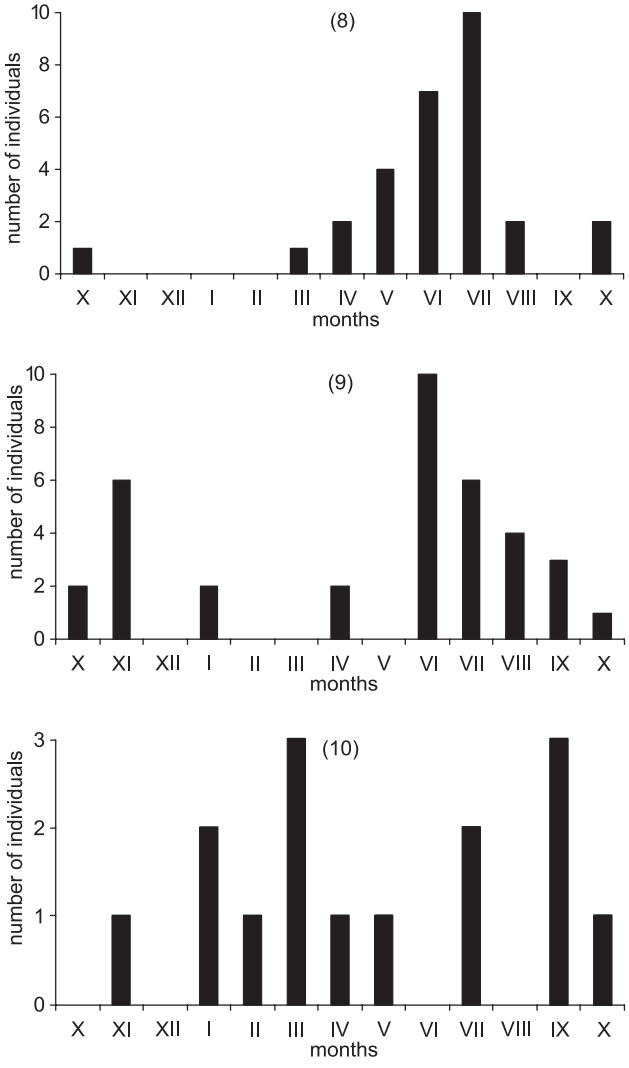


Figs. 5–7. The abundance of the juvenile classes IV (5), V (6) and VI (7) in consecutive months of studies

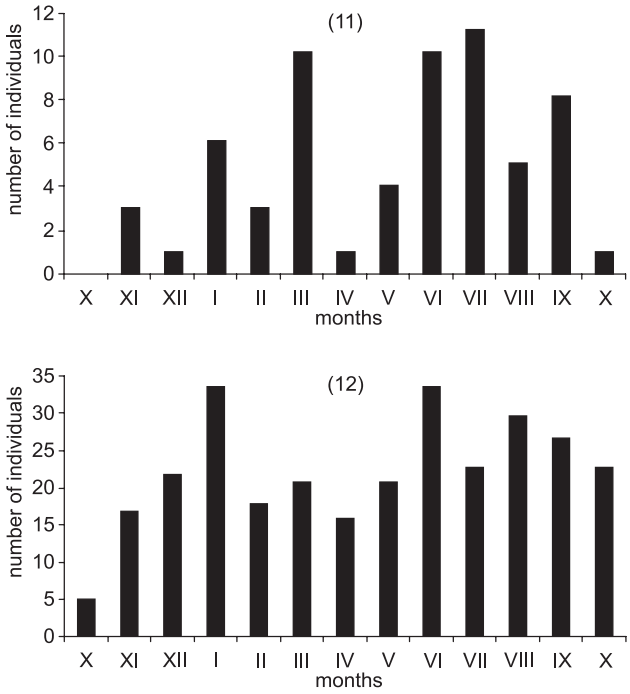
classes V or VI. Class IX is never abundant but persists throughout the year (Fig. 10) which may reflect a slower and/or uneven growth at that stage, or simply a random event. The latter interpretation is supported by the fact that the subadult class (X) reaches its maximum abundance in March, June and July (Fig. 11) and comprises individuals in the third season of growth, that wintered over as members of class IX (March) or VII and VIII (June/July). Adult (class XI) individuals are present and rather evenly distributed throughout the year (Fig. 12).

Figure 13 illustrates proportion of neonates, juveniles, subadults and adults in consecutive months.

The above data indicate the following life cycle of *A. biplicata*. The reproductive period (egg-laying and hatching) falls on June, July and August, with a maximum in July. The shift in abundance maxima of consecutive age classes by ca. 1 month indicates that the average growth rate is ca. 1 whorl/month. The earliest hatched juveniles may reach 5 or even 6 whorls till the fall; those that hatched later reach only 3-4 whorls. The snails wintering after their first season of growth range thus from 3 to 6 whorls. In the second season the juveniles grow up to 8 and sometimes even 10 whorls, and in the fall they are still juvenile. Individual growth differences seem to increase from class VI (6.2–7.1 whorls) upwards. The snails reach sexual



Figs. 8–10. The abundance of the juvenile classes VII (8), VIII (9) and IX (10) in consecutive months of studies



Figs. 11–12. The abundance of the subadult class X (11) and adult class XI (12) in consecutive months of studies

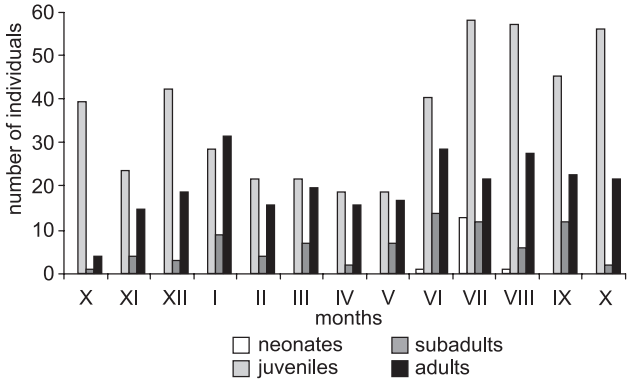


Fig. 13. Proportion of neonates, juveniles, subadults and adults in consecutive months of studies

maturity in their third season; those that reached 10 whorls in the preceding year may start reproducing in the third season, probably however most winter over for the third time before reproducing and they lay eggs in June-August of the fourth year.

The abundance varies between the age classes (Table 1). The differences between the juvenile age classes may indicate either differences in their mortality or in the degree of difficulty in sorting them out of the sample. However, there is a drastic difference between all the juvenile classes on one hand and the adults on the other. This suggests that adult individuals of *A. biplicata* live longer than one year, and probably two-three years, and the individual life span is no less than four years.

Table 1. Total abundance of consecutive age classes of *A. biplicata* in 13 months

Age class		Abundance
I	1.2–2.1	15
II	2.2–3.1	82
III	3.2–4.1	113
IV	4.2–5.1	103
V	5.2–6.1	63
VI	6.2–7.1	31
VII	7.2–8.1	29
VIII	8.2–9.1	35
IX	9.2–10.1	15
X	10.2–11.1	63
XI	11.2–12.6	291

REFERENCES

KUŹNIK E. 1997. Comparison of two methods of quantitative sampling applied in studies on land malacocenoses (Gastropoda: Pulmonata). Malak. Abh. 18: 263–270.

LIKHAREV I. M. 1962. Klauziliidy (Clausiliidae). Fauna SSSR, N.S., 83, Molljuski III, 4. Nauka, Moskwa-Leningrad.

MACKO S. 1954. Las Bukowy w Muszkowicach na Dolnym Śląsku i jego warunki ekologiczne. Acta Soc. Bot. Pol. 23: 519–543.

OEKLAND F. 1930. Quantitative Untersuchungen der Landschneckenfauna Norvegens. I. Zeitschr. Morph. Ökol. Tiere 16: 748–804.

PIECHOCKI A. 1982. Life cycle and breeding biology of *Vestia elata* (Rossm.) (Gastropoda, Clausiliidae). Malacologia 22: 219–223.

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