POLSKA AKADEMIA NAUK
INSTYTUT ZOOLOGII

ANNALES ZOOLOGICI

Tom 33 Warszawa, 25 XI 1975 Nr 2

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Life cycles in some *Vitrinidae* (*Mollusca*, *Gastropoda*) from Poland

[7 Text-figures and 2 Tables]

Life cycles of *Vitrinidae* were observed and disputed long since. A number of reports comes from the end of the XIXth century. Summarizing the observations of earlier authors as well as his own ones HESSE (1923) concluded, that the *Vitrinidae* live one year. LOHMANDER (1938) published the collections of Ch. H. LINDROTH from Iceland. Mature *Vitrina pellucida islandica* LOHM. were noted there from June till November with maximum density in August. Juveniles occurred from June till August with maximum in July. Semiadults were observed in July and in August.

A similar summary of samples of *Vitrina pellucida* MÜLLER from the Alps was published by FORCART (1955). He found the results from the North and from the Alps to be similar, and hence presumed the life cycles to be similar, too. The life cycle of lowland populations he regarded as different, because living animals can be found there only from late autumn till early spring. FORCART did not give any final conclusions expressis verbis, but it can be understood that he regarded a one-year cycle as typical for lowlands and some other, perhaps a two-year or perhaps an entirely irregular cycle as typical for mountain and northern populations. According to Dr. WALDÉN (personal communication) in the northern regions of Sweden *V. pellucida* is observed all year round. A summary of *V. pellucida* samples from the region of Kłodzko, Poland, giving the per cent of young, semi-adult and mature animals was made by Dr. RIEDEL (1958, not published). During summer and autumn the most numerous groups were successively the young, semi-adult and mature animals, which suggested a one-year cycle with the hatching period in spring.

These and some other similar papers prove at least, that the vitrinid life cycle changes considerably according to the geographical position and climate. All the above conclusions, however, were based on materials sampled at random, coming from different localities, stations, years, months etc. Moreover, conclusions were based on the classification into "mature", "semi-mature" and "young", but this meant usually not more than arbitrary assignment of a given animal to a given size group.

For museum collections one takes usually big, well-grown specimens. Even if not on purpose, little ones are often omitted, being less conspicuous. Hence the proportion of big and small specimens in museum samples is much distorted as compared with nature. On the other hand, as was shown in a previous paper (Umiński 1975), in *Vitrinidae* size and maturity have astonishingly little to do with each other.

Such being the circumstances I thought it worth while to look after several stations rich enough in vitrinids to enable regular, periodic sampling and a detailed study of their life cycle.

TERRITORY

The Tatra Mts. were chosen as the study area because of the relative abundance of vitrinids there. Next, in high mountains one could expect to find comparable stations differing much in elevation and hence in climate. The valley Dolina Kościeliska was chosen for being easily accessible and rich in varied habitats. A good station had to be spacious enough and to have a *Vitrinidae* population rich enough to permit monthly sampling without running the risk of habitat deterioration or of destruction of the studied population. The occurrence of vitrinids there should be rather stable, which is almost against their nature, as many of the cited authors testify. Last but not least, the selected stations should widely differ in elevation. After two years' observation of about 30 stations the following three were chosen for intensive study in 1963–1965.

1. Lodowe Zródło. Elevation 980 m[1]. Situated on the bottom of the valley Dolina Kościeliska, about 2200 m from the mouth of the valley, it is surrounded by high limestone cliffs, which shelter it against the wind and exert their usual thermic influence. The Lodowe Źródło (literally Ice Spring) is a spring, forming a basin, several meters in diameter. Out of this basin start a few streams, which flow for some fifty meters independently and then fall into the main stream of the valley. This way something like a delta is formed, composed of several little islets. The terrain is level and flat, entirely covered with a relatively thick layer of soil. Because of constant infiltration the soil is rather moist all year round. Single spruce trees 3–13 m high grow here. The herb growth is composed of *Petasites albus* (L.), *Myosotis palustris* Nathorst, *Alchemilla Walasii* Pawl., *Chaerophyllum hirsutum* L., *Geum* sp. Below the herbs grow *Cratoneurum decipiens* (De Not.) and *Brachythecium rivulare* Br. Samples were taken along the shore of the main basin.

2. Hala Pyszna. Elevation 1240 m. This name applies to the grassy bottom of a vast circus, occupying the uppermost part of Dolina Kościeliska valley and formed by the slopes of four big ridges viz. Ornak, Baniste, Błyszcz and Kamienista. Here accumulates the cold air flowing down all these north-facing slopes. Hence I presume, that the climatic difference between this station and the preceding one is much bigger than it would result from the bare difference in elevation. The station is located at the lowest point of this circus, on the edge of spruce forest covering the lower part of the valley. It is a clearing about 100 m in diameter, surrounded by old spruce stand, the forest belt separating it from grassland is sparse and only 20 m wide. The terrain is almost level and flat, entirely covered with a thick layer of soil, overgrown with raspberry *Rubus idaeus* L. and nettle *Urtica dioica* L. The soil is covered with litter consisting almost exclusively of raspberry and nettle debris with some spruce needles. In the middle of this clearing lie the ruins of a shelter-house of the then Polish Tatra Society (PTT), burnt down during the II World War. Around the ruins there is some rotting wood. Samples were taken around the ruins.

3. Siwe Sady. Elevation 1420 m. It is a little circus, overhanging the big circus of Hala Pyszna. The station is situated in the bed of a stream, which is draining this circus. The terrain around the stream bed is flat, inclined at an angle of 24°, covered with soil, over-

[1] In what follows the stations will be referred to by their elevation only.

grown with mountain pine *Pinus mughus* Scop. and with bilberry *Vaccinium myrtillus* L. The walls and bottom of the stream consist of big rocks and rubble with only patches of soil here and there. *Epilobium alpestre* (Jack.) Krock. is common. The stream is usually just trickling. It was never observed to cover the whole bottom of its bed. Samples were taken among herbs on patches of soil in the stream-bed.

METHODS

As far as terrain permitted, material was taken quantitatively from measured surface area (square-frame method). Because of high fluctuations in density the number and size of sample areas had often to be changed on the spot. When density was low, the number of squares was raised to get enough material. In case of very high density the number and size of sample areas was reduced to make the sampling practicable. At the station at 980 m elevation, because of extremely high densities recorded there, the sample consisted of 3 rectangular frames, of $^1/_{32}$ m^2 each. At 1240 m sample consisted of 10–15 squares of $^1/_{16}$ m^2. At 1420 m, where terrain prevented the use of square-frame, material was sampled per unit of time, to obtain even a rough estimate of density. In the years 1963–1965 material was sampled monthly from July till October. Additional samples were taken in November 1963 and in May 1965.

Shell diameter was measured te the nearest 0.1 mm using an ocular micrometer. Where information on reproductive maturity was needed, the animals were dissected, their reproductive organs examined and stage of maturity determined according to the 5-stage scale (Umiński 1975). Eggs were not determined to the species level. It is assumed that changes in population density and/or composition, caused by the sampling itself, are negligible.

MATERIAL

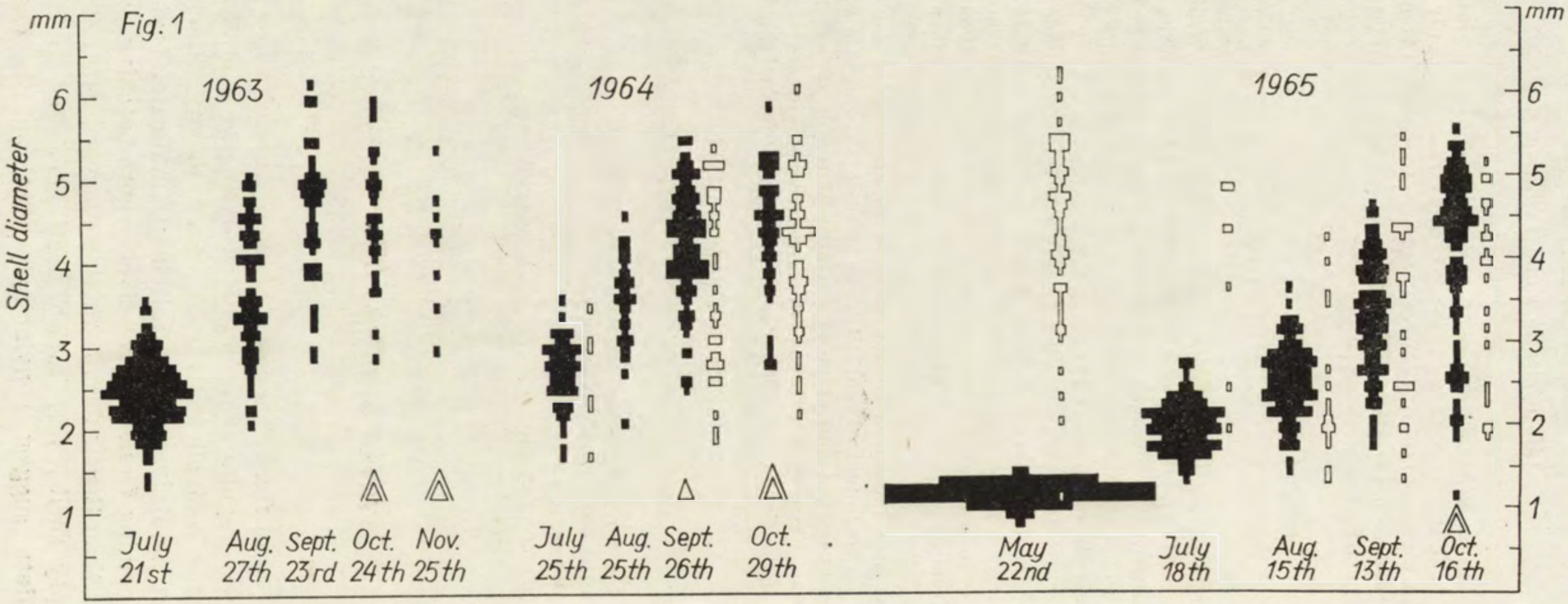
Material collected for the present study consisted of:
Vitrina pellucida (Müller) – 1954 specimens,
Semilimax kotulai (Westerlund) – 606 specimens,
Eucobresia nivalis (Dumont et Mortillet) – 220 specimens.

RESULTS

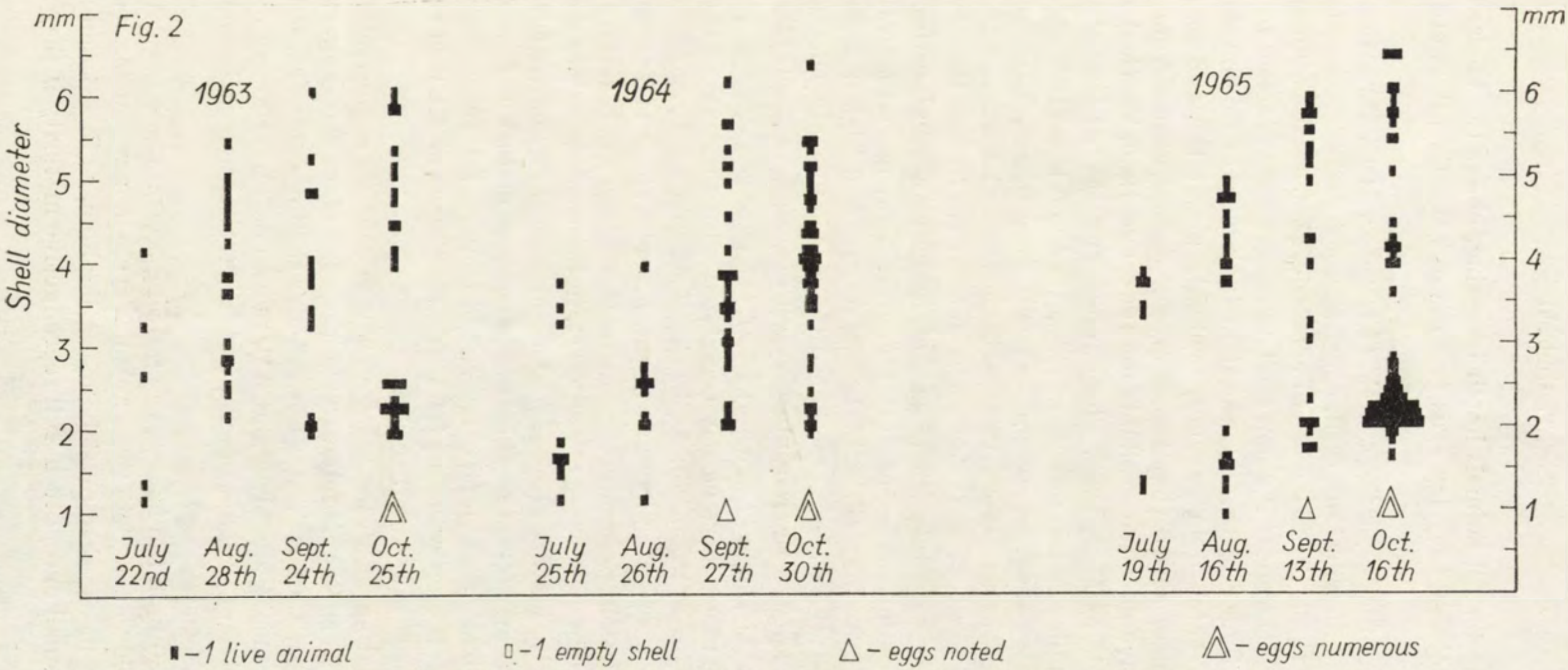
Vitrina pellucida (O. F. Müller)

Station at 980 m

As can be seen in fig. 1, the situation here appears to be fairly clear. Size distribution is very regular and symmetrical. In the sample of May, 1965 it is obvious, that not a single individual (of a total of 213) could be hatched in autumn. Even the July samples, all clearly indicate, that they represent one generation, coming from one, relatively short hatching period. Eggs were noted not earlier than September. Sampling on April 24th, 1962 revealed vast numbers of empty shells, vast numbers of eggs and not a single living animal. These data suggest convincingly that we are dealing here with



mm
Fig. 1
Shell diameter
1963
1964
1965
6
5
4
3
2
1
July 21st
Aug. 27th
Sept. 23rd
Oct. 24th
Nov. 25th
July 25th
Aug. 25th
Sept. 26th
Oct. 29th
May 22nd
July 18th
Aug. 15th
Sept. 13th
Oct. 16th
mm



Figs. 1, 2. *Vitrina pellucida*. Seasonal size distribution. Fig. 1. Station at 980 m (Lodowe Źródło). Fig. 2. Station at 1240 m (Hala Pyszna).

a one-year life cycle. All animals hatch in spring, about the beginning of May. In September–October they lay eggs and die out shortly afterwards. Only the eggs hibernate.

Somewhat conflicting is the sample of October, 1965, because of a tremendous range of size distribution. Still, eggs were not found sooner than in October. Therefore I think it reasonable to conclude, that all the animals (even the one of 1.9 mm and the one of 2.0 mm shell diameter) were hatched in spring, but lagged behind in their growth. Only the stray individual of 1.2 mm shell diameter must have been hatched in autumn, probably about the end of September.

Some evidence, supporting the one-year theory comes from the empty shells. Quantitative data are available for 1964 and 1965. Particularly interesting is the sample of May, 1965. The number and size distribution of empty shells make it similar to the sample of Oct., 1964 and sharply contrasting with the sample of July, 1965, where empty shells were scarce. This indicates that snow cover preserves the shells very well throughout winter, but during the snow-free season most *V. pellucida* shells deteriorate in less than two months. Hence the number of empty shells may be taken as a rough estimate of mortality in the preceding period of over 1 month. Now, mortality estimated this way is very low from May till July, low in August and high in September and October. Moreover, there is no detectable difference in mortality between animals of different size. Late in the autumn they all die, big and small alike.

The last, and perhaps decisive piece of evidence are data on reproductive maturity. This is much more closely correlated with the time of the year than with the animal's size. For example, in the size range of 3.1 mm–3.6 mm shell diameter in July there were animals in the juvenile stage III, in August — in mature stage I and in September — in mature stage II. Smaller individuals, of 2.8–2.9 mm are in July early juvenile III, in September — late mature I and in October are fully mature II, ready to deposit eggs. In Sept., 1964 specimens were noted, which at 2.6 mm shell diameter (!) were mature I. I think it probable, that even animals that small can reach in October full reproductive maturity. In August, on the other hand, fairly big specimens of 4.1 mm represent no more than the stage mature I.

If the population of *V. pellucida* at 980 m consists exclusively of animals which hatched this spring, it follows that they are all of the same age. E. g. in the sample of Oct., 1964 specimens of 2.8 mm shell diameter as well as those of 5.9 mm are all most probably about 6 $^1/_2$ month old. In other words, maturity would be a function of age, not of size, which is a situation rather common and more or less obvious.

Station at 980 m is the lowest, the growing season there is relatively long. *V. pellucida* is able to complete the whole life cycle in one growing season. Some sort of regulating mechanism must be operating here, as in autumn all the animals, even very small ones, attain full reproductive maturity if they only reach some minimum size, probably about 2.7 mm. Strays, differing in timing from the bulk of the population, must be eliminated, as they are extremely rare.

To sum up, at 980 m all individuals of *V. pellucida* hatch in spring, about the beginning of May, in summer they grow and mature, in October lay eggs and shortly after they die out. Only the eggs hibernate. The whole population here is one generation of animals about equal in age.

Station at 1240 m

Size distribution here (fig. 2) is markedly different from that at 980 m. In majority of samples the same typical pattern can be observed. Size range is much wider, difference between the biggest and the smallest animals is much greater. Then, there is a gap in the middle, animals of medium size are lacking. Even if the material here is not as rich as that from 980 m, this pattern is surely not a mere coincidence. First of all, the pattern is particularly clear in July, when the population at 980 m still forms one tight cluster of symmetrical size distribution. Next, the July size range in 1963, 1964 and 1965 was wider by 0.8 mm, 0.7 mm and 1.4 mm (36 %, 37 % and 85 %) respectively. It is hard to believe, that the population, living 260 m higher, could grow and differentiate so much more, being hatched in spring.

Reproductive maturity displays here some interesting regularities. In the size range 3.4–3.9 mm the July animals are juvenile III, the August ones – mature I and the September ones – mature II. This is the same sequence, which at 980 m was presented by animals of the range 3.1–3.6 mm. It means, that animals, living at 1240 m reach a given level of maturity being bigger, their maturation is delayed, as compared with growth. This was found true for many pairs of animals, equal in size and sampled at the same time at both stations. Specimens from 1240 m had invariably the reproductive system smaller and less developed than their counterparts from 980 m. A most profound difference was found in October specimens of 2.8–2.9 mm. While at 980 m such individuals were fully mature II, here they were not more than juveniles II b.

All this makes sense if we accept the theory of a two-year life cycle and the resulting age distribution of this population. Let us compare, for example, the two samples of July 1964. At 980 m specimens of 1.7 mm as well as those of 3.6 mm in shell diameter were all at the age about $3^1/_2$ month. At 1240 m animals of 1.7 mm were hatched this spring and aged about 3 months, while those of 3.6 mm were one-year-olds, aged not less than 14 months. Here also maturity depends mainly upon age, but, there being twice as much time for maturation, this process runs at a slower pace. Most obviously, this calls for some regulating mechanism, too.

The thesis, that at 1240 m *V. pellucida* hatch only in spring and early summer needs confirmation. A strong evidence to this effect comes from the fact that eggs were found in September and in considerable numbers not earlier than in October. Now in these two months individuals of 1.5 mm or less were never noted. The smallest specimen ever seen had a shell diameter of 0.9 mm. Hence the 1.5 animals of July or August had to live long enough to increase their shell diameter by at least 0.6 mm (66 % linear!), i.e. not less than 2 months.

To sum up, at 1240 m *V. pellucida* hatch in spring and early summer (May–June). During their first year of life they grow to 1.8–2.9 mm in shell diameter, attaining the stage juvenile II. In the next year they grow to 3.5–6.5 mm, reach full reproductive maturity in autumn, lay eggs in September–October and die out shortly afterwards. It is the eggs and the half-grown juveniles that hibernate. At any time of the year the population consists of two groups – smaller this-year animals and bigger one-year-olds. If their size ranges touch each other, as happens sometimes, there still remains the difference in reproductive maturity to separate both groups. They are not successive generations, but something like two distinct subpopulations, their respective life- and breeding-cycles shifted in phase by one year. It seems possible, that gene-flow between these two subpopulations can be considerably restrained.

Station at 1420 m

Material of *V. pellucida* taken here is not rich enough (only 3 specimens in 1963!) to justify any final conclusions. Size distribution (fig. 3) reminds of the two-year-cycle pattern, seen at 1240 m. Difference in shell diameter between the biggest and the smallest specimen in one sample is always surprising, it may reach even as much as 4.8 mm. Most often there is a group of big animals and a group of small ones, with a gap in between. Still, it is not possible to exclude a three-year cycle or lack of any regular life cycle. At these altitudes *V. pellucida* may live „as the weather permits", the life span, growth rate and

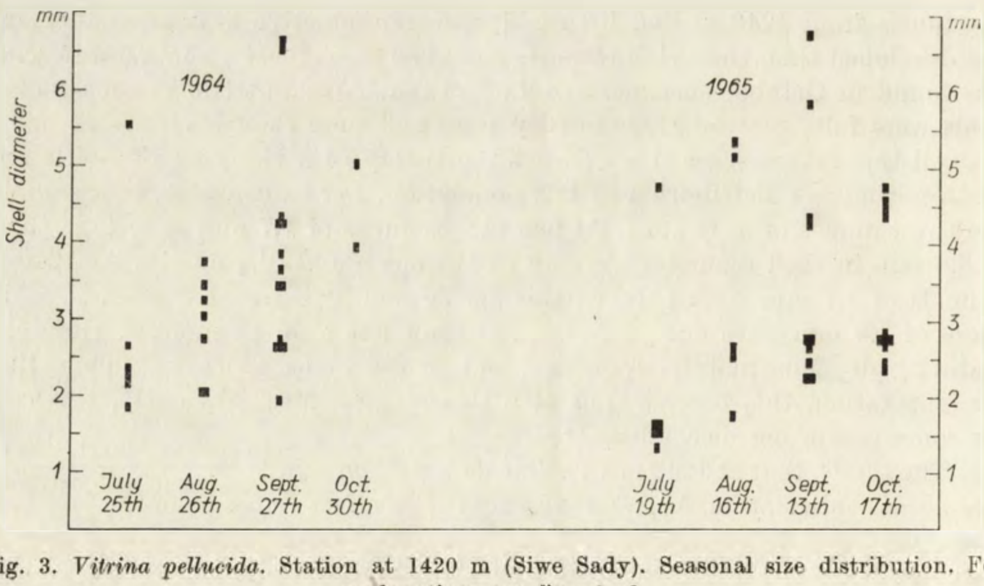


Fig. 3. *Vitrina pellucida*. Station at 1420 m (Siwe Sady). Seasonal size distribution. For explanations see figs. 1, 2.

maturation rate determined by the number of days with suitable weather conditions rather, than by calendar months or years.

*

* *

At the two stations of higher elevation, presumably with a two-year life cycle, very big individuals are more common than at the lower station with a one-year cycle. As the biggest animals appear in September and in October, per cent of specimens of 5.5 mm or over was calculated in these samples (Table I). Anticipating what is to follow, data on *Semilimax kotulai* are given here, too. These were calculated from August and September samples, in which the biggest individuals were observed.

Table I. Per cent of big individuals. Years 1963–1965.
Vitrina pellucida – September and October samples.
Semilimax kotulai – August and September samples.

Station	*V. pellucida* shell diameter ≥ 5.5 mm	*S. kotulai* shell diameter ≥ 5.0 mm
980 m	3.1 %	3.8 %
1240 m	13.5 %	17.2 %
1420 m	12.0 %	12.7 %

It seems to be another manifestation of the rather well-known phenomenon, that many invertebrate populations living under low-temperature conditions are longer-lived and attain bigger dimensions than populations of the same species, with live in warmer climate.

Semilimax kotulai (WESTERLUND)

Station at 980 m

The pattern of size distribution (fig. 4) is somewhat confusing and its interpretation difficult. This is partially due to the paucity of several samples, caused by summer drought periods. Nevertheless in all July samples the population appears well clustered, the size range is narrow, and all the animals, even as big as 3.5 mm in shell diameter, are juveniles. Conclusion, that they all hatched this year in spring and are of the same age, seems safe enough. Sample of May 1965, with a cluster of individuals of 1.2–1.7 mm confirms this view. But in this very sample one specimen of 5.0 mm was found, proving that, although there is no marked group of one-year-olds, at least some fully grown individuals can survive winter.

Further considerations have to be based mainly on the 1965 material as it is the only one, relatively numerous. Samples of August, September and

October 1965 show a very wide size range (1.7–4.8 mm) and, though the mean was growing all the time, the lower size limit remained stable at 1.7–1.9 mm. It looks as if there was a background of individuals, evenly spaced throughout the whole size range, and against it a cluster of animals of similar size, which form a swelling in the diagram. Now, while the "background" remains fairly stable from August till October, the "cluster" is moving up the scale, being in August about 2.4 mm, in September about 3.4 mm and in October about 4.0 mm.

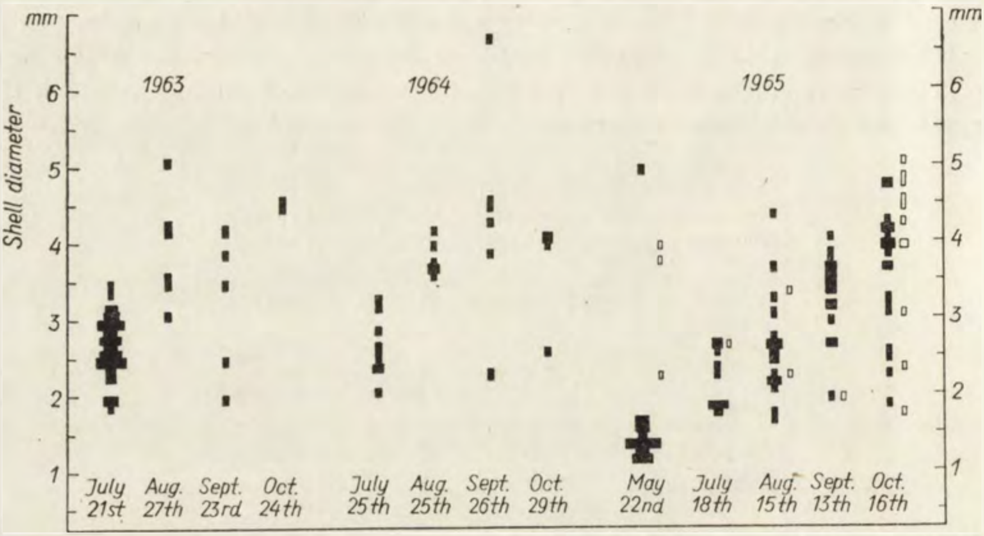


Fig. 4. *Semilimax kotulai.* Station at 980 m (Lodowe Źródło). Seasonal size distribution. For explanations see figs. 1, 2.

Though less regular in size distribution, the 1965 material reminds to some extent of that of *Vitrina pellucida* from the same year and station, and it must similarly represent a population homogeneous in age, consisting of one generation. Material from the August, September and October samples of 1963 and 1964 does not permit any conclusions, but it surely does not contradict those drawn from the 1965 material.

The size distribution of empty shells in 1965 samples is also similar to that of *Vitrina pellucida*. In May the shells of *S. kotulai* are less numerous, but this is no surprise since they are even thinner, more delicate and fragile, than those of *V. pellucida*. Shells found in May are much bigger than those of living animals, obviously remnants of individuals, which died last autumn. In July, August and September there are few empty shells, and these few fall within the size range of the living population. In October many shells are found, and their size distribution is exactly the same as that of live animals. Hence mortality in spring and summer must be low. It is very high in late autumn and about the same in all size categories.

As regards reproductive maturity — small animals up to 2.0 mm are always juvenile I, no matter what time of the year may be (Table II). Similarly in the size range 2.1–3.0 mm at any time are found exclusively juvenile II animals. In specimens over 3.0 mm a sequence is noted, resembling that in *V. pellucida*. Individuals of 3.1–3.2 mm are in August juvenile III, in September mature I and in October mature II. Thus the difference in reproductive maturity between specimens of 2.6 mm and those of 3.2 mm in August is just one stage while in October it amounts to three stages. Up to some size limit maturity depends upon size. Above that limit, which must be about 3.1 mm, maturity depends upon age. In autumn all animals which attained at least this minimum size, reach full reproductive maturity.

Table II. *Semilimax kotulai*. Station at 980 m. Reproductive maturity in relation to size and to season.

	Shell diameter, mm			
	< 2.0	2.1–3.0	3.1–3.2	3.7
May	juv. I	–	–	–
July	juv.I	juv. II	juv. II–juv. III	–
August	juv. I	juv. II	juv. III	juv. III/mature I
September	juv. I	juv. II	mature I	mature II
October	juv. I	juv. II	mature II	mature II

Just as with *V. pellucida*, there is some trouble with the very small animal of 1.9 mm, sampled in October 1965. The eggs appeared here only in October, so it should follow that even this individual hatched in spring, but was enormously delayed in growth. On the other hand, as in May no animals over 1.7 mm were found (with one exception already mentioned), such stunted individuals must die in autumn.

Possibly the climatic conditions of the station at 980 m are close to the limit, under which *S. kotulai* is no longer able to make its full life cycle in one growing season. Hence some irregularities like the hibernation of fully grown animals or the unproductive death of small animals, which did not manage to grow and mature enough till autumn. To a smaller degree such irregularities were seen in *V. pellucida*, too.

Station at 1240 m

Size distribution (fig. 5) implies a two-year cycle. In any sample there is a group of small animals, presumably hatched this spring and a group of big ones, presumably one-year-olds. Individuals of intermediate size either are lacking entirely or are scarce. In July the size range is more than twice wider than at 980 m. Reasoning as for *V. pellucida* in p. 7 I think that these results are not due to chance, but give a true picture of the population of *S. kotulai*.

The only aberrant results were obtained in August 1964 and 1965, when it was not possible to delimit the two groups by size alone. The size ranges of both groups were so wide, that their extremes touched each other. But anyway all the questionable specimens can be assigned to their proper groups by the stage of reproductive maturity. When this is done (dashed line in fig. 5) it comes out that the size range of one-year-olds is much wider than that of young animals. This is more or less to be expected and parallelling the situation at 980 m where in May the size range is narrow and in October it is wide.

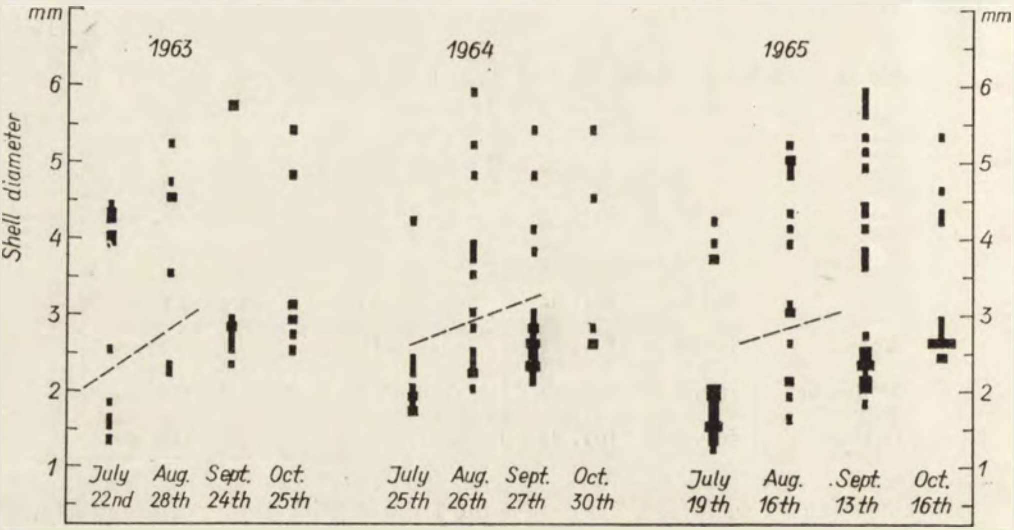


Fig. 5. *Semilimax kotulai*. Station at 1240 m (Hala Pyszna). Seasonal size distribution. For explanations see figs. 1, 2. Dashed line separates young animals from one-year-olds.

Maturation runs a course analogous to that in *V. pellucida*. Young this-year animals grow, but their maturation goes on slowly. About 2.1 mm in shell diameter they turn from juvenile I to juvenile II. Then they keep growing but do not advance any more in maturity. In September and October they may be as big as 3.2 mm and still juvenile II, while at 980 m animals of that size are fully mature (stage mature II). The hibernating population consists presumably of juveniles II of the size range 2.3–3.2 mm. Such was the composition of a sample taken on April 23rd, 1962 from under the still persisting snow cover (not depicted). In spring the rate of maturation in one-year-olds is fairly rapid. Therefore in July and August animals are found which are much more advanced in maturity than could be judged from their size. E.g. in 1963 the 2.6 mm specimen of July was juvenile III, though by 0.6 mm smaller than the two 3.2 mm animals of October, which were only juvenile II. Such small but advanced in maturity animals are of course one-year-olds which hibernated being very small, possibly just over the minimum size of 2.1 mm.

Station at 1420 m

Though the material here is anything but rich, its fairly regular size distribution clearly implies a two-year life cycle. The gap between young animals and one-year-olds is always quite wide. The only sample of August 1964, where there is no such gap, can be easily divided according to reproductive maturity. The specimen of 2.9 mm was a late juvenile II and the 3.2 mm one — an early mature I. Such remarkable difference in maturity, compared with only a slight

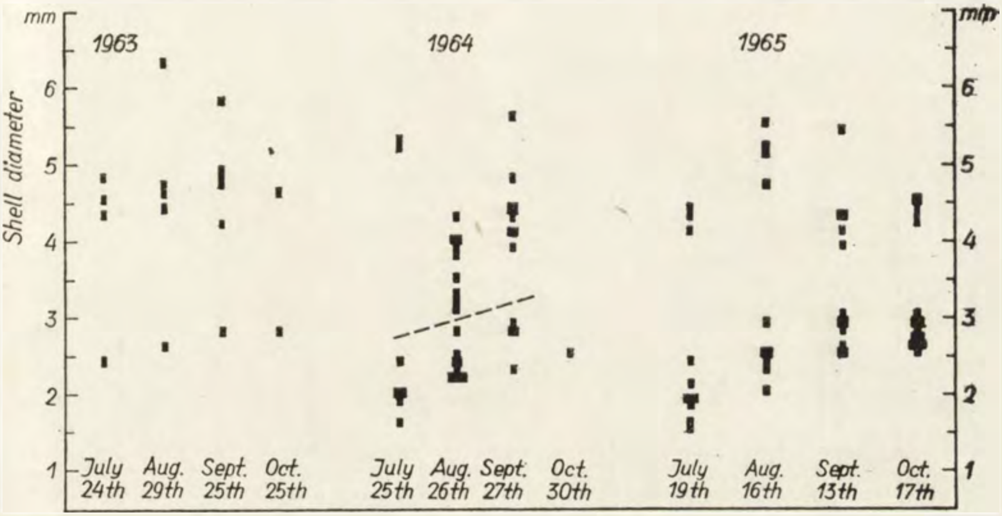


Fig. 6. *Semilimax kotulai.* Station at 1420 m (Siwe Sady). Seasonal size distribution. For explanations see figs. 1, 2. Dashed line separates young animals from one-year-olds.

difference in dimensions proves convincingly that the first animal (as well as all smaller ones) hatched this spring, while the second one (and all bigger ones) was a one-year-old. In the first year the animals grow to about 3.1 mm and mature to juvenile stage II. In the second year they grow to their maximum size and reach full maturity. Biggest specimens were found in August and September. As such animals were no longer there in October, they probably deposited eggs and died earlier.

Size distribution, typical of a two-year life cycle was noted also in several samples from a few other stations. Especially good were two stations, not far from that at 1240 m. At 1110 m elevation excellent samples were taken in October and November 1961. At 1370 m equally instructive material was sampled in October and November 1961, in August 1962 as well as in August, September and October 1963.

In populations with a two-year life cycle very big individuals are more common than in populations with a one-year cycle, as was mentioned in p. 9 and in table I.

Eucobresia nivalis (Dumont et Mortillet)

This species is rare in the study area and its occurrence is highly irregular. At the station at 980 m barely 10 specimens were taken in three years. I could not secure even one full series of samples. The few samples, big enough to show any size distribution are shown in fig. 7. The size distribution pattern is quite typical of the two-year cycle. Some data on reproductive maturity con-

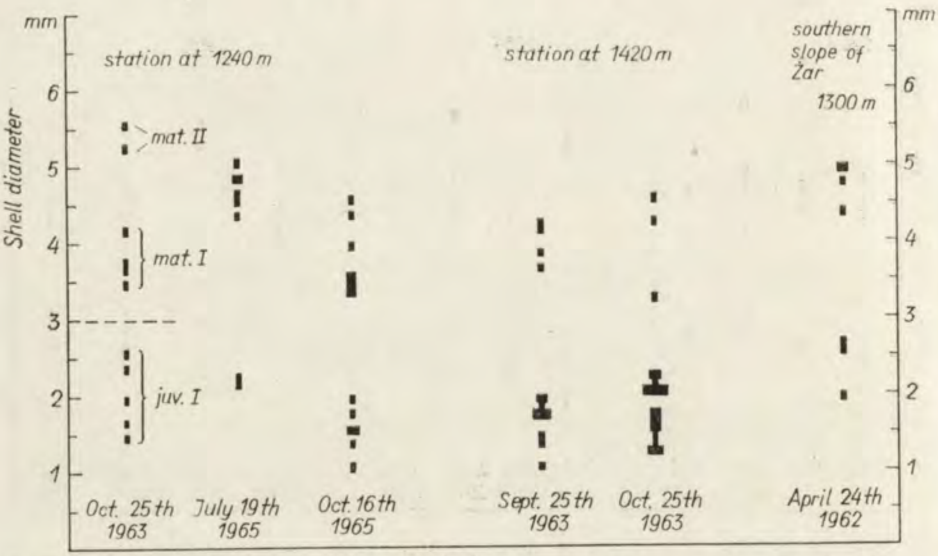


Fig. 7. *Eucobresia nivalis*. Seasonal size distribution. Selected examples. Dashed line separates young animals from one-year-olds.

firm the two-year-cycle theory. In 1963 at 1240 m two specimens of 2.4 mm and 2.2 mm, sampled in August were both at the stage juvenile II. Individuals of 2.4 mm taken there in September and in October were only juvenile I. Judging from analogous sequences, found in the other two species, the August animals must have been small one-year-olds, while those of September and October were well-grown this-year young ones.

It should be stressed, however, that conclusions drawn solely from size distribution of samples can be misleading. The sample from about 1300 m elevation, taken on the south-facing slope of the ridge Żar in nearby Tomanowa valley (fig. 7) is a perfect example of a two-year-cycle pattern. But it was taken on April 24th, 1962 and henceforth both groups obviously did hibernate. Thus the smaller animals were one-year-olds and the big ones most probably two-year-olds.

It is possible, that at 1240 m and at 1420 m *E. nivalis* has a two-year life cycle. But a three-year cycle is possible, too. Presumably at elevations close to the timber-line *E. nivalis* lives „as the weather permits" as was supposed for *V. pellucida* at the uppermost station, and the two-year or three-year cycles observed are just chance results of weather conditions in this particular year and the year before.

SUMMARY

At the lower station of 980 m elevation *Vitrina pellucida* and *Semilimax kotulai* live a one-year life cycle. The animals hatch in spring (April–May), grow and mature in summer. In autumn all animals which passed a minimum size limit (2.8 mm and 3.2 mm respectively) attain full reproductive maturity, in September–October they deposit eggs and die out shortly after. Individuals below the minimum size do not mature and die out in autumn. Exceptions from this course of events are extremely rare in *V. pellucida* and very rare in *S. kotulai*.

At the two higher stations, at 1240 m and at 1420 m both species have a two-year life cycle. In the first year they hatch in May–June. During summer they grow, but the rate of maturation is slow. In autumn they represent the stage juvenile II, and the size range is 1.8–2.9 mm in *V. pellucida* and 2.3–3.2 mm in *S. kotulai*. In the second year they grow on and the maturation rate is much higher. In late summer and autumn all are fully mature, deposit eggs and die out.

The population there consists of two groups, their respective life cycles out of phase by one year. Individuals of both groups can be found at any time. In winter it is the eggs of one group and half-grown, juvenile II animals of the other group.

In populations of *V. pellucida* and of *S. kotulai* with a two-year life cycle per cent of very big specimens ($\geqslant 5.5$ mm and $\geqslant 5.0$ mm respectively) is about four times higher than in populations with a one-year cycle.

Eucobresia nivalis at 1240 m and 1420 m may have a two-year cycle but it is probably rather irregular, changing very much according to weather conditions.

Acknowledgements. Appropriate permissions to enter the stricts reservation Hala Pyszna and to collect material there, granted by the Tatra National Park authorities, are hereby gratefully acknowledged.

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STRESZCZENIE

[Tytuł: Cykle życiowe niektórych krajowych *Vitrinidae* (*Mollusca*, *Gastropoda*)]

Na stanowisku przy Lodowym Źródle (980 m n. p. m.) w Tatrach *Vitrina pellucida* i *Semilimax kotulai* mają jednoroczny cykl życiowy. Wylęgają się z jaj na wiosnę, pod koniec kwietnia, przez lato rosną i dojrzewają. Jesienią wszystkie zwierzęta, które przekroczyły pewną minimalną wielkość progową (odpowiednio 2,8 mm i 3,2 mm średnicy muszli) osiągają pełną dojrzałość rozrodczą, w październiku składają jaja i wkrótce giną. Okazy poniżej wielkości minimalnej giną, nie osiągnąwszy dojrzałości. Wyjątki od tych reguł są nadzwyczaj rzadkie u *V. pellucida* i bardzo rzadkie u *S. kotulai*.

Na stanowiskach na Hali Pysznej (1240 m n. p. m.) i na stoku Siwych Sadów (1420 m n. p. m.) w Tatrach obydwa gatunki mają dwuletni cykl życiowy. W pierwszym roku życia wylęgają się pod koniec maja, w ciągu lata rosną, ale tempo dojrzewania jest niskie. Do jesieni osiągają stadium młodociane II i rozmiary: *V. pellucida* 1,8–2,9 mm średnicy muszli, *S. kotulai* 2,3–3,2 mm. W drugim roku rosną dalej a tempo dojrzewania jest wyższe. Jesienią wszystkie są w pełni dojrzałe (stadium dojrzałe II), we wrześniu–październiku składają jaja i giną. Populacja składa się z dwu grup, których cykle życiowe są względem siebie przesunięte w fazie o jeden rok. O każdej porze roku można znaleźć przedstawicieli obydwu grup. Zimują jaja jednej grupy i na wpół wyrośnięte okazy drugiej grupy.

W populacjach *V. pellucida* i *S. kotulai* o dwuletnim cyklu życiowym odsetek okazów bardzo dużych (odpowiednio $\geqslant 5,5$ mm i $\geqslant 5,0$ mm) jest mniej więcej czterokrotnie wyższy, niż w populacjach o jednorocznym cyklu życiowym.

Eucobresia nivalis na obydwu wyżej położonych stanowiskach ma przypuszczalnie dwuletni cykl życiowy, który jednak ulega znacznym wahaniom i zakłóceniom, zapewne pod wpływem warunków klimatycznych w danym roku i sezonie.

РЕЗЮМЕ

[Заглавие: Циклы некоторых польских *Vitrinidae* (*Mollusca*, *Gastropoda*)]

В местонахождении лежащем около Ледового зрудла (980 м н. у. м.) в польских Татрах *Vitrina pellucida* и *Semilimax kotulai* имеют однолетний цикл. Вылупливание из яиц наступает весной, в конце апреля. На протяжении лета животные растут и созревают. Все особи, которые превысили осенью определенную минимальную пороговую величину (диаметр раковины соответственно 2,8 мм и 3,2 мм) достигают полной половой зрелости, в октябре откладывают яйца и вскорости после этого погибают. Остальные меньшие особи погибают не достигнув половой зрелости. Исключения из этих правил у *V. pellucida* встречаются чрезвычайно редко, а у *S. kotulai* очень редко.

В местонахождениях на Хали Пышной (1240 м н. у. м.) и на склоне Сивых Садов (1420 м н. у. м.) в польских Татрах оба вида имеют двухлетний цикл. На первом году они вылупливаются в конце мая и на протяжении лета растут, но скорость созревания малая. К осени животные достигают ювенальной стадии II и величины диаметра раковины: у *V. pellucida* 1,8–2,9 мм, у *S. kotulai* 2,3–3,2 мм. На втором году происходит дальнейший рост, а скорость созревания увеличивается. К осени все созревают (стадия половозрелая II – см. UMIŃSKI 1975), в сентябре – октябре откладывают яйца и погибают. Таким образом популяции состоят из двух групп, циклы которых отличаются на один год. В каждое время года можна встретить представителей обоих групп. Зимуют яйца одной группы и молодые особи второй группы.

В популяциях *V. pellucida* и *S. kotulai* с двухлетним циклом процент крупных особей (соответственно $\geqslant$5,5 мм и $\geqslant$5,0 мм) почти в четыре раза выше, чем в популяциях с однолетним циклом.

Eucobresia nivalis имеет, по всей вероятности, на обоих выше лежащих местонахождениях двухлетний цикл. Однако он подвержен значительным колебаниям и нарушениям, обуславливаемым, по-видимому, климатическими условиями в данном году и сезоне.

Redaktor pracy – Prof. dr A. Riedel

Państwowe Wydawnictwo Naukowe – Warszawa 1975
Nakład 990+90 egz. Ark. wyd. 1,25 druk 1 1/8. Papier druk. sat. kl. III, 80 g, B1. Cena zł 10,–
Nr zam. 2179/75 – Wrocławska Drukarnia Naukowa