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RESEARCH ON THE ECOLOGY OF *DREISSENSIA POLYMORPHA*
PALL. IN THE SZCZECIN LAGOON (ZALEW SZCZECIŃSKI)*

This paper presents results so far obtained by research on the biology and dynamics of a population of *Dreissensia polymorpha* Pall. in the Szczecin Lagoon. Density of individuals of this species of molluscs was found to be very great on the sides of sand-banks. The part played by *D. polymorpha* in the process of covering the bottom of the lagoon was defined and partially estimated.

Dreissensia polymorpha Pall. is a species originating from the basins of the Black and Caspian Seas. It reached our waters during the last century and has continued to spread since. Among the bodies of water in which it has spread is the Szczecin Lagoon, where the living conditions are particularly favourable to it, since enormous colonies of this species have developed which frequently number as many as 114,000 live specimens per 1 sq.m. of the bottom. *D. polymorpha* forms 87.7% of the whole biomass of the bottom fauna of the lagoon, which is clear evidence of the part played by this species in the biological production of this body of water. *D. polymorpha* is undoubtedly the most numerous and most intensively acting filtrative organism of the bottom fauna of the lagoon. It must, therefore, be assumed that *Dreissensia* is one of the elements in the lagoon hastening the process of sedimentation of both organic and inorganic seston. As a result of this activity the process of covering the bottom, and in this way rendering the lagoon shallower through the coagulation of the seston and accumulation of the shells of dead animals, undoubtedly increased

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in rapidity with the appearance of *D. polymorpha*. Systematic examination of the population of this lamellibranch was undertaken in order to explain what effect the colonies of the species have on the changes taking place in the water and the part played by this species in the biocenosis of the lagoon.

The first stage of this work consisted in determination of the distribution within the Polish part of the Szczecin Lagoon of the larger compact populations of *D. polymorpha*. The areas occupied by such compact populations totalled about 46 sq.km., that is, scarcely 10% of the bottom. The biomass of zoobenthos of this area forms, however, about 66.5% of the biomass of zoobenthos of the whole Polish part of the Szczecin Lagoon.

The second part of the work, which is still being continued, consists in the investigation of distribution according to numbers, weight and age composition of the populations of *D. polymorpha*. These observations, combined with the knowledge we have of the hydrological and biological conditions in the Szczecin Lagoon, are aimed at establishing the following connections:

- 1) the ecological causes of the localisation of beds of *D. polymorpha* on the sides of sandbanks,
- 2) the structure of the bed,
- 3) the dynamics of the population changes in the bed (increase, growth of individuals, mortality),
- 4) the participation of *D. polymorpha* in the process of accretion of the bottom of the lagoon.

DISTRIBUTION AND STRUCTURE OF THE BEDS

The compact populations of *D. polymorpha*, the density of which is at least 3,000 live lamellibranchs per 1 sq.m., were accepted as beds. In addition to these populations this species also occurs in smaller groups or singly, but these small groups were not included in the observations. The beds, as stated above, occur in a strictly limited area, on the slopes of sandbanks encircling the lagoon along its shores. The breadth of the beds and also partly the number of the individuals depends chiefly on the steepness of the sides of the sandbank. In general it may be said that the beds are situated within limits of depth from 2 to 4.5–5 m. This corresponds to the zone of transition from gentle to steep slope of the sides of the sandbank. The greatest density of individuals in the bed was found in places where the margin of the sandbank exhibits the most intensive process of accretion. In this case *Dreissensia* both hastens this process and its individuals gather in places where the process of natural sedimentation of suspended matter is most intensive and where as a result there are optimum food conditions for them. The intensive process of sedimentation of suspended matter on the sides of the sandbanks is conditioned by the specific distribution of currents in the lagoon.

The total area of the beds of *D. polymorpha* in the Polish part of the lagoon was defined by means of measurements made of about 46 sq.km. Approximately 60,000 tons of this mollusc live in this area, that is, total mass together with shells. In addition the biomass of individuals not grouped in compact beds was estimated at about 7,000 tons, making the biomass of these lamellibranchs about 67,000 tons in the Polish part of the lagoon.

The size of individuals occurring in the bed varies and depends on localisation. In general, small specimens predominated in the region of the upper part of the sandbank's sides (depth 2–3 m.) on a hard sandy bed. In those parts of the side at a greater depth, partly covered with mud, larger individuals were in the majority. The upper edges of the beds where density is not great are covered by separate colonies consisting almost entirely of small specimens. The parts of the bed at a greater depth are compact and composed of many layers. The bottom layers consist of well-grown individuals, the younger specimens composing the outer, upper layer. It was found that the larger specimens lead a settled way of life only, since they are closely bound together by byssus, while the small lamellibranchs, up to 10 mm. in length, are capable of migrating.

AGE AND GROWTH

The pelagian larvae of *D. polymorpha* undergo transformation and transition to the settled way of life during the period from July to September of each year. Young specimens are about 1 mm. in length by the middle of September. When transferred at this stage to an aquarium they attained the length of 4 to 6 mm. after 10 months. It must be assumed that under natural conditions growth is slightly more rapid in the first year of life and a length of 7 to 10 mm. is attained, since individuals of this size predominate in the populations.

The curve of frequency of classes of length (Fig. 1) exhibits 3 to 4 peaks, the peaks in the larger classes being less distinct. The first two distinct

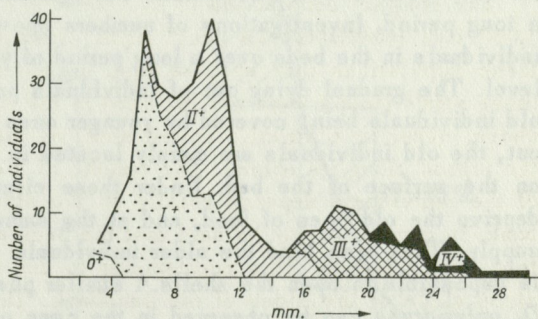


Fig. 1. Composition of a population of *Dreissensia polymorpha* Pall. — abundance of individuals of different length and age

peaks in the curve of frequency show that the mean length of one-year old specimens is 7–10 mm., 2-year old, 10–14 mm., 3-year old, 17–22 mm. The fourth peak, far less distinct, is formed by individuals from 26–27 mm. in length.

Growth rings were found on the shells (Fig. 2). Observations and measurements showed that these rings make it possible, in the majority of specimens, to determine age by means of a method similar to that applied when determining the age of fish by their scales. Measurements showed that the longest axis of the growth ring coincides with the average measurements of the shells of individuals of corresponding age. After examining 2,500 specimens it was found that the population of *D. polymorpha* in the Szczecin Lagoon consists of five generations, including in this the youngest generation.

The average composition in percentages of the population is as follows: one-year old individuals – 42%, two-year old – 36.8%, three-year old – 15.3%, four-year old – 5.4%, five-year old – 0.5%.

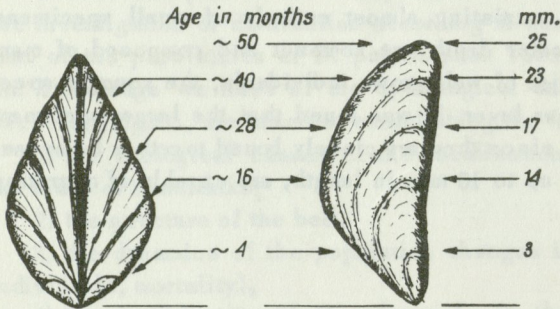


Fig. 2. Growth rings in the shell of *Dreissensia polymorpha* Pall.

The composition of the population and length of life of the individuals show that about 42% of the whole population dies every year. Mortality varies within each generation and increases with the age of the generation. For example, 88% of the one-year old specimens attain the age of 2 years, 41% of the two-year olds – 3 years, 35% of

the three-year olds, 4 years, and only 9% of the four-year olds – 5 years. These data are based on the assumption that the initial number of generations is similar each year. These calculations can therefore only be used as an average of a long period. Investigations of numbers show that the averages of density of individuals in the beds over a long period of years are maintained at a constant level. The gradual dying out of individuals presumably consists chiefly in the old individuals being covered by younger ones as they grow. As already pointed out, the old individuals are mainly located in the bottom layer, the young ones on the surface of the bed. Under these circumstances the young individuals deprive the old ones of food, and at the same time reduce the latter's oxygen supply. They also bind the older individuals with byssus to an extent when it is impossible to open the shells. A similar phenomenon to the "suffocation" by *D. polymorpha* can be observed in the case of overgrown *Unio* and *Anodonta*. Silting up of the old specimens lying at lower levels is more intensive. Part of these molluscs, particularly the young ones, are eaten by roach and eels, but it would seem that this factor is of no particular significance in the mortality process of *D. polymorpha* in the Szczecin Lagoon.

PARTICIPATION OF *DREISSENSIA POLYMORPHA* IN THE ACCRETION
OF THE BOTTOM OF SZCZECIN LAGOON

The enormous abundance of organisms filtering the water in the Szczecin Lagoon, binding and transforming the suspended matter, undoubtedly tends to hasten sedimentation, and in the same way, accretion of the bottom. The activities of *D. polymorpha* lead in this case to:

- a) coagulation of inorganic suspended particles, secreted together with mucus,
- b) accretion of the shells of the dead lamellibranchs and products of dissolution of the bodies of dead individuals,
- c) mechanical retention of suspended matter in the porous structure of the bed.

It has not so far been possible to determine the rate of filtration and coagulation of suspended matter by the populations of *D. polymorpha*. It would, however, seem that the activities of these lamellibranchs is of great significance in the process of covering the bottom of the lagoon. It will be possible to obtain more exact data after establishing by means of experiment the rate and degree of filtration of water by *D. polymorpha*. A knowledge of the mortality rate of individuals made it possible to estimate the number of shells deposited yearly on the bottom of the lagoon. As mentioned above, the biomass of *D. polymorpha* in the Polish part of the Szczecin Lagoon is about 67,000 tons. It was established that *D. polymorpha*, together with its shell, contains 58% water, that is, the dry mass of these molluscs in the lagoon is approximately 39,000 tons. The shell forms on an average 61% of the dry mass of this species. As shown (Fig. 3), 41% of the individuals in the population die every year, but since there are mainly large specimens they

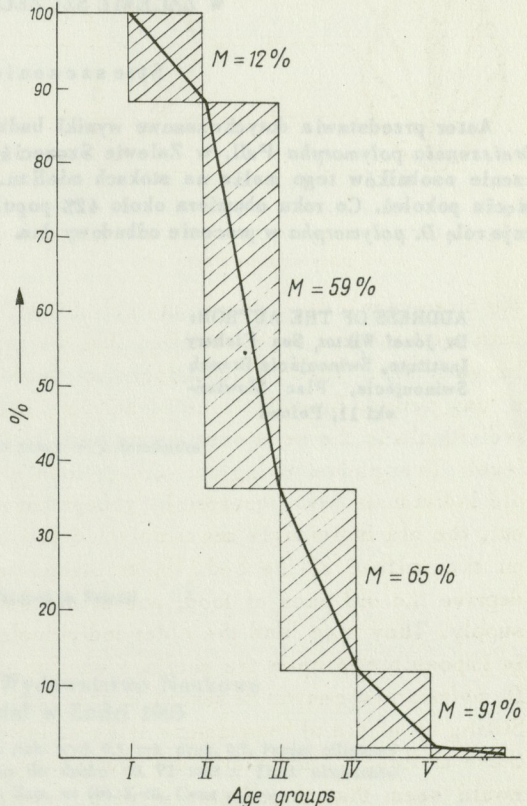


Fig. 3. Composition in percentages of the population of *Dreissensia polymorpha* Pall. in relation to a generation aged one year (100%) as a function of mortality (M) of each generation

form about 64% of the mass of the whole population. It may therefore be taken that a mass (dry) of about 25,000 tons dies every year, and the deposited shells form a mass of over 15,000 tons. It must, however, be emphasised that the calcareous parts of the shells partly dissolve in course of time.

Mechanical retention of suspended particles is also of importance to the process of accretion of the bottom. Calculations show that each 1 000 individuals located in 1 sq.m. of the bottom enlarge the area retaining sediments by a further 1.5 sq.m. Under such circumstances the process of retention of deposits originating from sedimentation is accelerated, since the deposits which would normally be washed away by waves are retained in the pores between the shells

BADANIA NAD EKOLOGIĄ *DREISSENSIA POLYMORPHA* PALL. W ZALEWIE SZCZECIŃSKIM

Streszczenie

Autor przedstawia dotychczasowe wyniki badań nad biologią i dynamiką populacji *Dreissensia polymorpha* Pall. w Zalewie Szczecińskim. Stwierdza bardzo duże zagęszczenie osobników tego małża na stokach mielizn. Populacja składa się z czterech — pięciu pokoleń. Co roku obumiera około 42% populacji. Autor określa i częściowo szacuje rolę *D. polymorpha* w procesie odbudowy dna.

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