POLSKA AKADEMIA NAUK
INSTYTUT ZOOLOGII

ANNALES ZOOLOGICI

Andrzej PIECHOCKI

The *Sphaeriidae* of Poland
(*Bivalvia, Eulamellibranchia*)

Tom 42 Nr 12

PAŃSTWOWE WYDAWNICTWO NAUKOWE
WARSZAWA – WROCŁAW
1989

Adres Redakcji:

Instytut Zoologii Polskiej Akademii Nauk
ul. Wilcza 64, 00-950 Warszawa, skr. 1007

ISBN 83-01-09006-5
ISSN 0003-4541

PAŃSTWOWE WYDAWNICTWO NAUKOWE — ODDZIAŁ WE WROCŁAWIU

Nakład 755 + 90 egz. Ark. wyd. 5,75; ark. druk. 4.5. Pap. druk. sat. kl. III, 80 g, 70 × 100. Oddano do składania w maju 1988 r. Podpisano do druku w kwietniu 1989 r. Druk ukończono w maju 1989 r. Zam. nr 3386/88. Cena 250 zł

Wrocławska Drukarnia Naukowa — Wrocław, Lelewela 4

POLSKA AKADEMIA NAUK
INSTYTUT ZOOLOGII

ANNALES ZOOLOGICI

Tom 42 Warszawa, 31 V 1989 Nr 12

Andrzej PIECHOCKI

The *Sphaeriidae* of Poland (*Bivalvia, Eulamellibranchia*)

[With 94 text-figures]

Abstract. The bivalve family *Sphaeriidae* of Poland is revised. The paper contains descriptions and drawings of all 21 species of the recent fauna of Poland (3 species of the genus *Sphaerium* SCOP., 1 of *Musculium* LINK and 17 of *Pisidium* PFEIFF.). Description of particular species includes the data concerning shell morphology and its variability, ecology and distribution. A key to Polish species of *Sphaeriidae* is also given.

I. INTRODUCTION

The bivalves of the family *Sphaeriidae* are among most common freshwater invertebrates in Poland. They inhabit all kinds of running and stagnant waters. The wide distribution of the sphaeriids in Poland, as well as in other areas, results from their extreme capability of adapting to a variety of habitat conditions, their dispersal abilities and their peculiar reproductive biology. It is assumed that a major role in dispersal of these minute clams, and especially the genus *Pisidium* C. PFEIFFER, is played by insects and aquatic birds. Clinging to their legs and feathers, the sphaeriids can cover long distances (KUIPER 1983). Even single individuals of these hermaphroditic animals can give origin to a distinct and often isolated population.

Until recently the *Sphaeriidae* remained one of the least known freshwater invertebrate groups in Poland. Only recently several publications appeared which have considerably increased the knowledge of the *Sphaeriidae* of our country. Among them papers by BERGER (1958, 1959, 1960, 1961, 1962), BERGER and DZIĘCZKOWSKI (1977), DYDUCH-FALNIOWSKA (1982, 1983 a, b), JAECKEL (1962), KASPRZAK (1975, 1982, 1986), PIECHOCKI (1969, 1972, 1981, 1985, 1986), and TETENS and ZEISSLER (1964) should be mentioned. The papers have been based on determinations verified by specialists in the sphaeriid bivalves. Of pre-war pub-

lications the papers by BOETTGER (1926 a and b), FELIKSIAK (1938), GEYER (1919), JANKOWSKI (1933), POLIŃSKI (1917) and SCHUMANN (1905) are worth notice.. The authors just named were either specialists in the sphaeriids or used a help of other malacologists. Fairly numerous data on the *Sphaeriidae* can be found in many other – both old and more recent – faunistic or hydrobiological papers. Determinations presented there, however, often raise serious doubts which is caused by the great variability of the sphaeriids and by the well known lack of "sharp" diagnostic characters. It should be remembered that in the case of many species of *Pisidium* unambiguous determination became possible only after a series of papers by a Dutch outstanding malacologist J.G.J. KUIPER had been published (1942–1983).

Despite the perceptible advance, the *Sphaeriidae* still remain the least known group of freshwater molluscs in Poland. Due to the papers of the above mentioned authors the minute bivalves of Pomeranian Lake District, Mazurian Lake District, Wielkopolsko-Kujawska Lowland, Białowieża Forest, Małopolska Upland and Świętokrzyskie Mts. have been comparatively well studied. However the *Sphaeriidae* of Podlasie, Lubelska Upland, Roztocze, Upper Silesia, Nowotarska Basin and all montane regions of the Southern Poland are the least known, while those of Lower Silesia, Trzebnickie Hills, Krakowsko-Wieluńska Upland and Baltic Coast have been only fragmentarily studied.

Within last years the bivalves of the family *Sphaeriidae* were the subject of numerous studies of Soviet authors, e.g. PIROGOV (1972), PIROGOV and STAROBOGATOV (1974), STAROBOGATOV (1977), TIMM (1974, 1975, 1976) and STADNIČENKO (1981, 1982, 1983, 1984). The Soviet malacologists use a different, much more restricted species concept which results in generic, subgeneric and specific taxa recognized at present in U.S.S.R. being much more numerous than those recorded from Western Europe. Thus in 1981 the Soviet authors recognized 7 genera, 12 subgenera and 70 species of the *Sphaeriidae*, whereas as few as 20 species of *Pisidium*, 2 species of *Musculium* and 4 of *Sphaerium* were known from Europe (KUIPER 1981). According to the estimates of SCARLATO (1981, after KUIPER 1983), 200–500 species of minute sphaeriids can occur in USSR, while KUIPER (ibidem) estimated the actual number of the world *Pisidium* as not exceeding 100, and of *Sphaerium* – 50. In her recent monograph of Ukrainian freshwater bivalves, STADNIČENKO (1984) mentions as many as 74 species of *Sphaeriidae* s. lato, 7 of them being representatives of the genus *Musculium* LINK, 3 of *Amesoda* RAF., 2 of *Cyclas* BRUG., 3 of *Sphaerium* SCOP., 2 of *Pisidium* C. PFEIFF., 50 of *Euglesa* LEACH and 7 of *Neopisidium* ODHN. It follows from this list that STADNIČENKO, like other Soviet authors, uses a sphaeriid classification quite different from that hitherto accepted. This applies also to the family level, the family *Cycladidae* (not *Sphaeriidae*!) being divided into four subfamilies: *Musculiinae, Cycladinae, Pisidiinae* and *Euglesinae*. Numerous subgenera are usually distinguished within the genera, and such subgenera correspond in their shell variability ranges to traditionally recognized species. As observed by KUIPER (1983), the contemporary views of the Soviet authors on the

classification of the *Sphaeriidae* are largely comparable with the principles of the 19th c. "Nouvelle École" represented e.g. by BOURGUIGNAT.

As a result of the completely different classification of the *Sphaeriidae* and of the different species concept two distinct systems have come into existence: the traditional system and the system used by the Soviet malacologists. This creates great difficulties in the studies on the *Sphaeriidae*, and makes it impossible to compare the results and use the literature data.

In the light of the above considerations, the objective of my studies on the *Sphaeriidae* was not only to increase and order the faunistic data, but also to attempt to relate them to the classification proposed by Soviet malacologists.

II. TAXONOMIC CHARACTERS IN THE *SPHAERIIDAE*

When identifying species, mainly the shell characters are analysed, the outline, convexity, shape of the umbones, situation of ligament, surface sculpture, gloss, the structure of the hinge-plate and hinge-teeth being taken into account (Figs 1–7). The identification is difficult and requires great experience. A material including extensive series of individuals collected from various habitats gives a chance for correct determination. Such extensive samples enable an estimation of the individual and specific variability ranges. Comparative materials determined by specialists are of great help. A high percentage of species can be identified basing on the shell outline, considered along with its gloss and its surface sculpture that are main taxonomic characters.

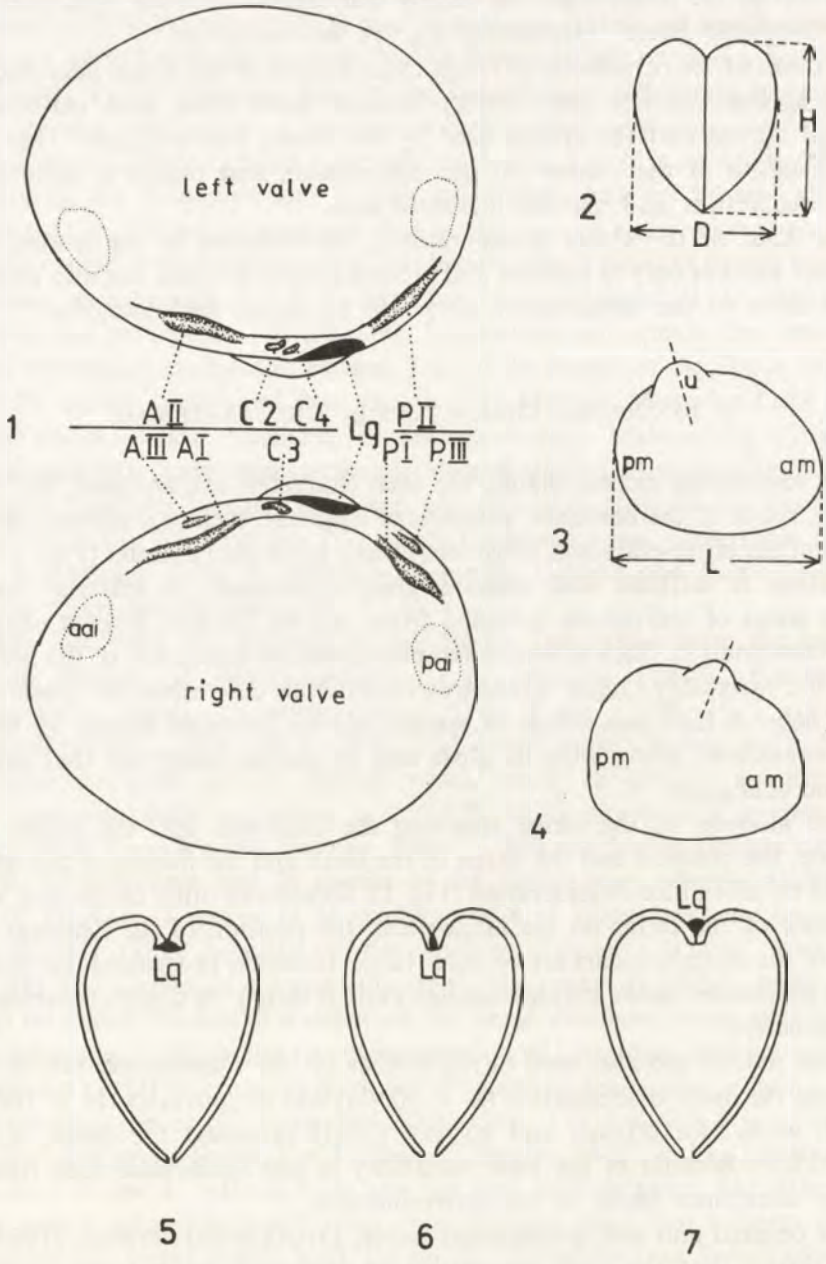
In the analysis of the hinge structure the thickness and the shape of the hinge-plate, the position and the shape of the teeth and the outline of the ligament pit should be taken into consideration (Fig. 1). Sometimes other characters, such as the presence of the callus on the hinge-plate, the position of the ligament or the position of the adductor scars are of importance. It should be stressed that the hinge structure sometimes shows a wide variability and it should be always combined with other characters.

Various indices are also used in the studies on the *Sphaeriidae*. MEIER-BROOK (1963) used the index of elongation (L × 100/H) and of convexity (H × 100/D) of the shell, while HOLOPAINEN and KUIPER (1982) proposed the index of height (H × 100/L)[1]. Because of the wide variability of the *Sphaeriidae* such numerical data may sometimes result in mis-determinations.

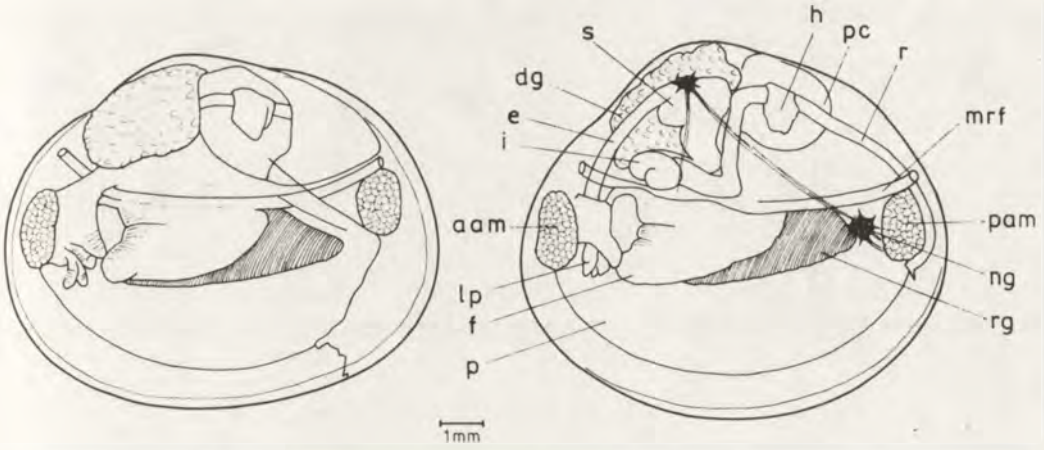
In her original and well documented paper, DYDUCH-FALNIOWSKA (1983a) has recently shown that the shell microstructure examined using scanning electron microscope can be of a high diagnostic value in the determination of the *Sphaeriidae*.

---

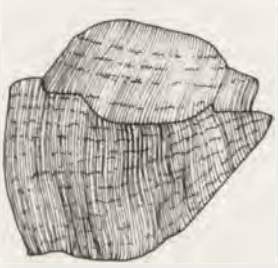
[1] Lettering: L – shell length, H – shell height, D – shell thickness (convexity).



Figs. 1–7. Terminology of sphaeriid shells. 1 – Dentition: A I, A II, A III, anterior lateral teeth; C_2, C_3, C_4, cardinal teeth; P I, P II, P III, posterior lateral teeth; lg, ligament and ligament-pit; aai, anterior adductor impression; pai, posterior adductor impression. 2 – Height (H) and thickness (D) of the shell. 3 – Length (L) of the shell; beak or umbo (u) inclined backward; am, anterior or front margin of the shell; pm, posterior margin. 4 – Beak inclined forward. 5 – Ligament and ligament-pit introwerted. 6 – Ligament enclosed. 7 – Ligament extraverted. (After KUIPER).



8 9

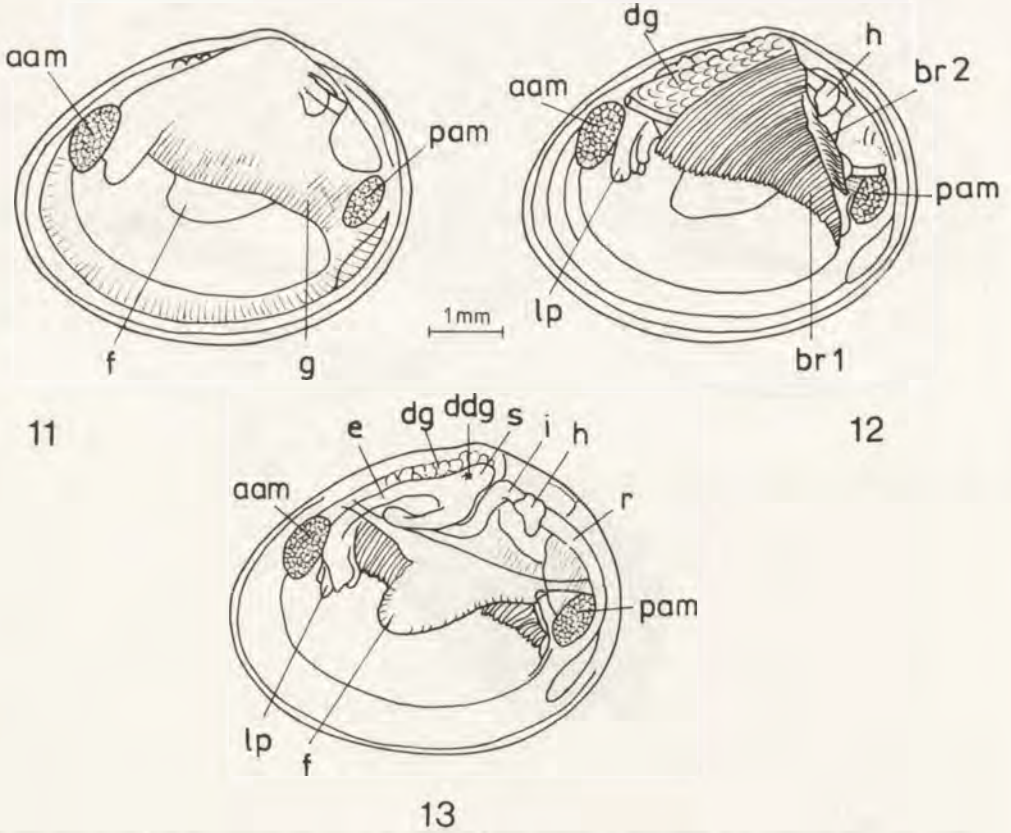


10

Figs 8–10. Morphology and anatomy of *Sphaerium corneum*. 8 – After removal of left valve and the left half of mantle lobe. 9 – Animal with soft parts partly removed to show some internal organs; aam, anterior adductor muscle; dg, digestive gland; e, esophagus; f, foot; h, heart; i, intestine; lp, labial palps; mrf, muscle retractor of foot; ng, nervous ganglion; p, pallium (mantle); pam, posterior adductor muscle; pc, pericardium; r, rectum; rg, right gill; s, stomach. 10 – Isolated gills. (After CASTAGNOLO, FRANCHINI and GIUSTI).

The inaccessibility of the equipment and the difficulties involved in the preparation of the material prevent, unfortunately, any wider use of the scanning electron microscopy in the malacologists routine work.

Soft parts of the animal play also a significant role in the identification and classification of the *Sphaeriidae* (Figs 8–13). The following characters are usually taken into consideration: the structure of the siphons or the siphonal openings, the structure of the gills and of the kidneys (ODHNER 1929, ZEISSLER 1971). The characters just listed play, however, their main role in generic and subgeneric divisions, though recently the attempts at a use of anatomical characters for species identification are becoming more and more numerous. The papers by GLÖER, MEIER-BROOK and OSTERMANN (1978) and by HOLOPAINEN and KUIPER (1982) provide a good example of this approach.



Figs 11–13. Morphology and anatomy of *Pisidium amnicum*. 11 – After removal of left valvae; aam, anterior adductor muscle; f, foot; g, gill; pam, posterior adductor muscle. 12 – Left mantle lobe removed to show gills; br 1, inner gill; br 2, outer gill; dg, digestive gland; h, heart; lp, labial palps. 13 – Animal with soft parts partly removed to show some internal organs; ddg, duct of digestive gland; e, esophagus; i, intestine; r, rectum; s, stomach. (After CASTAGNOLO, FRANCHINI and GIUSTI).

III. MATERIAL AND METHODS

Both the literature data and sphaeriid materials, either my own or deposited in zoological museums have been used in this study.

In the case of the literature data, only publications containing determinations which raise no doubts have been used.

Samples were taken using a hand net of 0.5 × 0.5 mesh size. The bottom sediment was then washed on a screen of the same mesh. The bivalves were initially preserved in 75% ethyl alcohol, and subsequently determined and stored as dry. In laboratory work a stereomicroscope, production Carl Zeiss (Jena) was used, the magnifications being 16–100 ×. Drawings were prepared using a drawing apparatus of the same production.

The material comprising about 60 000 specimens is preserved in the Department of Invertebrate Zoology and Hydrobiology, University of Łódź. Materials of the *Sphaeriidae* of the folloving collections

have been also used in the studies: Museum of the Institute of Zoology, Polish Academy of Sciences, Warsaw (in the text abbreviated as IZ PAN); Museum of Natural History, Wrocław University (MZW); Zoologisches Museum der Humboldt-Universität, Berlin (ZMB); Senckenberg Museum, Frankfurt a. Main (SMF). I have determined also the materials collected by Dr. I. MIGAŁOWA in the Biebrza River.

I owe my sincerest thanks to Dr. R. JANSSEN (Frankfurt a. Main), Prof. Dr. R. KILIAS (Berlin), Prof. Dr. A. RIEDEL (Warsaw) and Prof. Dr. A. WIKTOR (Wrocław) for the loan of materials. My special thanks are due to Mrs. Ewa ZAJĄCZKOWSKA-MATUSIAK, M. Sc. for the original drawings of the Polish *Sphaeriidae* and Mrs. Maria GOLAŃSKA, M. Sc. for the preparation of the UTM maps. I wish to express my heart-felt thanks to Dr. B. POKRYSZKO, Museum of Natural History of the Wrocław University, for preparing the English translation.

The present study was supported by the grant of the Institute of Zoology, Polish Academy of Sciences, as a part of MR-II-3 Project.

IV. KEY TO POLISH SPECIES OF *SPHAERIIDAE*[1]

1. Shell large or medium-sized (length 7.0–25.0), umbones situated in its mid part . . . . . 2.
—. Shell small (length 1.5–11.0), umbones displaced posterad . . . . . 6.
2. Shell distinctly thin-walled, whitish, on its umbones cap-like embryonic shells (Fig. 25). . . . . *Musculium lacustre* (p. 265).
—. Shell more thick-walled, yellowish, olive or brown, usually without embryonic shell on umbones[2] . . . . . 3.
3. Shell extremely thick-walled and strong, covered with very distinct ribs; length not exceeding 12.5 (Fig. 17). . . . . *Sphaerium solidum* (p. 260).
—. Shell not especially thick-walled, its surface smooth or striated . . . . . 4.
4. Length 18.0–25.0, thickness (convexity) 10.0–14.0, shell oval and comparatively flat (especially in young individuals) (Figs 20–22). . . . . *Sphaerium rivicola* (p. 263).
—. Length 8.0–16.0, thickness 6.0–10.0 . . . . . 5.
5. Shell spherical and tumid (Fig. 14.). . . . . *Sphaerium corneum* (p. 258).
—. Shell trapezoidal in outline, its angles more or less distinctly marked (Fig. 16). . . . . *Sphaerium corneum* f. *scaldianum* (p. 259).
6. Length 7.0–11.0, shell irregularly ribbed, young individuals flat (Fig. 30). . . . . *Pisidium amnicum* (p. 268).
—. Length 1.5–6.5, shell smooth, striated or ribbed, young individuals usually distinctly convex . . . . . 7.
7. Umbonal appendiculae present . . . . . 8.
—. Umbonal appendiculae absent . . . . . 10.

---

[1] All species recorded from Poland as well as two distinct forms: *S. corneum* f. *scaldianum* and *P. casertanum* f. *ponderosum* have been included in the key.

All dimensions are given in mm and refer to the size attained by adult individuals.

Taxonomic characters and details of shells see Figs 1–7.

[2] Embryonic shells can be sometimes found in forms of *S. corneum* (p. 260).

8. Shell minute (length 1.5–2.2) and tumid, with a collar-like ridge parellel to the lines of growth (Fig. 88).
. . . . . *Pisidium moitessierianum* (p. 307).
–. Shell larger (length 3.3–5.5) and comparatively less convex, umbonal appendiculae obliquely situated to the lines of growth . . . . . 9.
9. Shell triangular in outline, thick-walled, umbonal appendiculae relatively small and sometimes blunted; shell surface slightly ribbed; hinge-plate very robust and strongly bent (Figs 38–40).
. . . . . *Pisidium supinum* (p. 273).
–. Shell asymmetrically oval, its walls not very thick, umbonal appendiculae strongly marked, sharp, situated on narrow umbones which are displaced posterad; shell surface striated; hinge plate thick though only slightly bent (Figs 34–36).
. . . . . *Pisidium henslowanum* (p. 270).
10. Shell ribbed or covered with thick striae . . . . . 11.
–. Shell delicately striated or smooth . . . . . 14.
11. Shell very minute (length 1.7–2.3), asymmetrically oval, with distinctly marked angle between the upper and the anterior margin; covered with regularly spaced, delicate ribs; hinge-plate constricted in its mid part; lateral teeth, especially A I and P I, strongly developed (Figs 92 and 93).
. . . . . *Pisidium tenuilineatum* (p. 310).
–. Shell larger (length 2.5–4.6), its shape and sculpture different . . . . . 12.
12. Shell extremely thick-walled, its length usually 2.5–3.0, oval or tapezoidal, strongly shiny and irregularly ribbed; umbones narrow and sharp, bounded by 3–5 incised grooves; hinge-plate very thick and strong; cardinal teeth rather fine (Figs 57–59).
. . . . . *Pisidium crassum* (p. 286).
–. Shell walls thinner, shell generally larger, though not so massive as in the preceding species . . . . . 13.
13. Shell very strongly and regularly ribbed (!), its outline broadly oval with truncated hind part; teeth C_2 and C_4 parallel (C_4 distinct longer) (Figs 75–77).
. . . . . *Pisidium pulchellum* (p. 297).
–. Shell strongly and irregularly striated (sometimes ribbed), its outline circular-oval or tapezoidal (angles marked !); umbones narrow and raised above the short upper margin; C_2 bent, C_4 straight and situated above C_2 (touching it); P I and P III can converge in front (Figs 79–81).
. . . . . *Pisidium lilljeborgii* (p. 300).
14. Shell very strongly shiny[1] . . . . . 15.
–. Shell mat or its gleam extinguished by striae . . . . . 17.
15. Shell rhomboidal, minute, strongly convex, its umbones broad; upper and lower margin almost parallel (Figs 42 and 43)
. . . . . *Pisidium milium* (p. 276).
–. Shell of different shape . . . . . 16.
16. Shell minute, roundish and tumid, its umbones strongly protruding and

[1] The gleam can be masked by a sediment covering shells; empty shells show a markedly weaker gleam.

displaced posterad; hinge-plate very short; at the junction of P I and P III a thickening (pseudocallus) (Figs 60–62).
. . . . . *Pisidium obtusale* (p. 288).

–. Shell medium-sized, trapezoidal, its angles rounded; umbones broad, bounded by 3–5 concentric grooves (Fig. 54).
. . . . . *Pisidium nitidum* (p. 284).

17. Umbones narrow and strongly protruding . . . . . 18.

–. Umbones comparatively broad and weakly protruding . . . . . 20.

18. Shell extremely thick-walled, its outline triangular; hinge-plate very thick, ligament pit wide (Figs 66 and 67).
. . . . . *Pisidium casertanum* f. *ponderosum* (p. 291).

–. Shell walls thinner, shape different . . . . . 19.

19. Shell asymmetrically oval, its umbones distinctly displaced posterad and inclined posterad (!); C_2 and C_4 parallel (Figs 50–52).
. . . . . *Pisidium subtruncatum* (p. 281).

–. Shell oval, umbones strongly protruding, situated in its mid part (!) (Fig. 71).
. . . . . *Pisidium hibernicum* (p. 295).

20. Shell flat, delicate and fragile; hinge-plate weak, long and narrow. Length 2.2–3.25, thickness 1.2–1.8 . . . . . 21.

–. Shell more or less convex, comparatively thick-walled; hinge-plate distinctly marked. Length 3.0–6.5, thickness 1.6–4.0 . . . . . 22.

21. Shell oval (its shape resembling small individuals of *S. corneum*), usually somewhat shiny; ligament pit long and comparatively very wide (Figs 46–48). Two pairs of gills.
. . . . . *Pisidium pseudosphaerium* (p. 278).

–. Shell outline somewhat rhomboidal, its surface silky; ligament pit very narrow and long; lateral teeth, especially A III and P III often rudimentary (Figs 86 and 87). Hind pair of gills reduced.
. . . . . *Pisidium conventus* (p. 305).

22. Shell usually large (length up to 6.5), oval, its umbones somewhat displaced posterad, thick-walled, irregularly striated, with marked growth ridges; C_3 hook-like (Figs 64 and 65).
. . . . . *Pisidium casertanum* (p. 291).

–. Shell smaller (length up to 4.0), regularly oval, umbones situated in its mid part. On the right valve a distinct callus (!) between P III and ligamentum (Figs 83 and 84).
. . . . . *Pisidium personatum* (p. 303).

V. SYSTEMATIC PART

In the present paper the concept of the family *Sphaeriidae* in the broad sense is adopted. This family is represented in the Polish fauna by the genera: *Sphaerium* SCOPOLI, *Musculium* LINK and *Pisidium* C. PFEIFFER. The system is compatible with the classification of the sphaeriids proposed by ZEISSLER (1971). Other classification systems have been recently reviewed by DYDUCH-FALNIOWSKA (1983 a). The characteristics of the family *Sphaeriidae* and its genera presented below have been based mostly on the papers of EHRMANN (1933), ZEISSLER (1971) and ELLIS (1978).

Familia: *Sphaeriidae*

Small or medium-sized animals (about 2.0–30.0 mm in length) having mostly thin-walled shells which can be perforated by numerous pores. Hinge-plate provided with cardinal and lateral teeth. Mantle margins and siphons devoid of papillae; foot very long, capable of extremely strong extension. Outer (posterior) gills smaller than the inner (anterior) ones. Kidneys paired, in the shape of coiled tubes. Hermaphroditic. Young develop in special brood-pouches within the gills. Distributed over all continents except Antarctic.

Sphaerium Scopoli, 1777

Shells relatively large (usually more than 10.0 mm long), roundish or oval, with nearly symmetrically situated umbones (posterior shell part slightly larger). Hinge-plate comparatively narrow, cardinal teeth fine, lateral teeth lamellate. Ligament poorly visible from the outside. The animal has two siphons united at their base, of which the lower (inhalant) is larger than the upper (exhalant). Both pairs of gills well developed, the outer twice shorter than the inner ones (Fig. 10). Newly hatched young are extremely flat and comparatively long ($^1/_4$–$^1/_3$ parent length).

In the Polish fauna the genus is represented by three species.

Sphaerium corneum (Linnaeus, 1758)

Synonyms: *Tellina cornea* Linnaeus, 1758; *Cyclas cornea* Draparnaud, 1801.

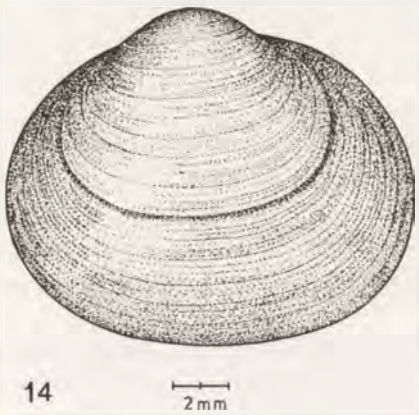
Shell spherical, tumid, with broad and not very prominent umbones situated approximately in its mid part. No distinctly marked angles in the shell outline (Fig. 14).

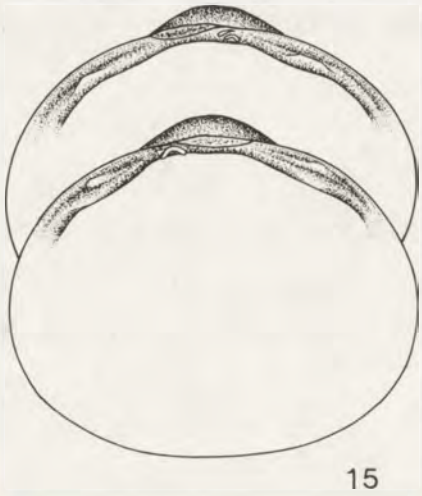
Shell thick-walled, its surface delicately and irregularly striated; among the striae sometimes are visible the stronger lines of periodical break in growth. Periostracum colour variable: from yellow to dark brown. Lower (younger) part of the shell lighter that the upper. Ligament sunken, poorly visible between the umbones. Shells of young individuals flat, with scarcely marked umbones.

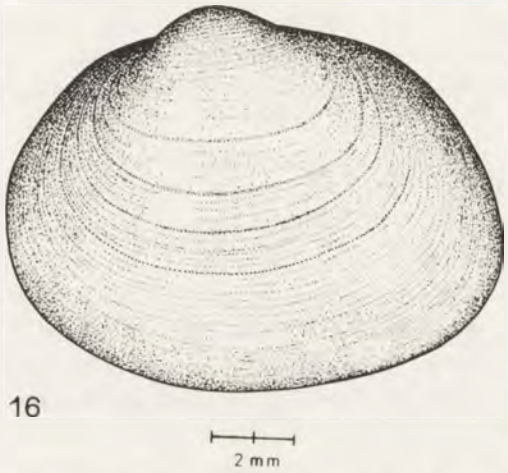
Hinge-plate comparatively thin, cardinal and lateral teeth fine. C_3 bent and constricted in its mid portion; C_2 and C_4 variable, C_2 being most often bent, C_4 situated parallelly to its posterior arm. Among lateral teeth A II and P II distinctly larger than the paired teeth (A I, A III, P I, P III). Ligament pit short and relatively wide (Fig. 15).

Dimensions: length 8.0–16.0, height 7.0–11.5, thickness 6.0–9.5.

S. corneum is the most variable member of the genus *Sphaerium*. The variability consists e.g. in significant size differences, varied shell outline, various extent of the development of the hinge-plate and hinge teeth as well as in differences in the shell







Figs 14–16. *Sphaerium corneum* and *S. corneum* f. *scaldianum*. 14 – *S. corneum*, shell in lateral view; 15 – *S. corneum* interior of left and right valve; 16 – *S. corneum* f. *scaldianum*, shell in lateral view.

wall thickness and its colouration. Because the species is very common one can found in almost any river, lake or pond a specific population of *S. corneum*, conchologically different from populations of neighbouring water bodies. Basing on the form of shell it can be often concluded about the ecological conditions of a reservoir (oxygen, pH, bottom sediment, eutrophication).

Because of the wide shell variability several forms of the species have been distinguished of which the following are most often mentioned:

S. corneum f. *scaldianum* (NORM.). This is the most distinct form often regarded even as a separate species. Shell trapezoidal in outline, comparatively feebly convex,

with prominent and narrow umbones somewhat displaced anterad. Anterior portion of the shell rounded, posterior with distinct angles between the upper and the posterior, as well as between the posterior and the lower margin (Fig. 16). Shell comparatively thick-walled and strong. According to DYDUCH-FALNIOWSKA (1988) the form is characteristic of well oxygenated waters which do not stimulate a strong development of gills (small convexity of shells). *S. corneum* f. *scaldianum* inhabits running waters, most often large rivers. In Poland the form has been recorded from the rivers: Warta (near Gorzów), Odra, Stobrawa, and streams near Kluczbork and Kobylno (GOLDFUSS 1883, MERKEL 1894, GEYER 1927), the river Vistula near Warsaw and Płock and the Czarna Hańcza River above the lake Wigry (leg. S. FELIKSIAK, coll. IZ PAN).

S. corneum f. *nucleus* STUDER. Shell spherical, comparatively small (dimensions: 8 × 7 × 6), thin-walled, in its shape resembling a cherry stone. It inhabits swamp pools and peat-bogs.

S. corneum f. *firmum* CLESSIN. Shell thick-walled, strongly convex, its umbones distinctly prominent. Old river beds.

S. corneum f. *mamillatum* WESTERLUND. On the umbones distinct embryonic shells are set. Various kinds of water bodies.

S. corneum f. *lacustris* DRAPARNAUD. Shell thin-walled and flat. Small reservoirs and ditches.

The above forms may differ only slightly from the typical form and are united with it (and with each other) by the series of intermediate specimens.

S. corneum is an extremely eurytopic species. In Poland it lives in all types of fresh waters: large and small rivers, channels, drainage ditches, lakes, ponds, old river beds and pits remaining after peat excavation, and in brackish waters. It shows a high resistance to water pollution and eutrophication and in strongly eutrophicated waters it is sometimes the only mollusc species. In such reservoirs *S. corneum* may reach extremely high densities – up to thousand and more specimens per square meter. For example, in highly polluted parts of the river Wel above the town of Lidzbark Welski the bottom in some places is covered with such a thick layer of the clams that thousands of individuals can be taken with one haul of a hand-net.

According to the so called saprobic system *S. corneum* is regarded as an indicator organism of the α-mesosaprobic zone (TUROBOYSKI 1979).

S. corneum is a Holarctic species. In whole Poland, except mountainous areas, it is very common and numerous. Its vertical distribution does not exceed 450 m a.s.l. (HAZAY 1885).

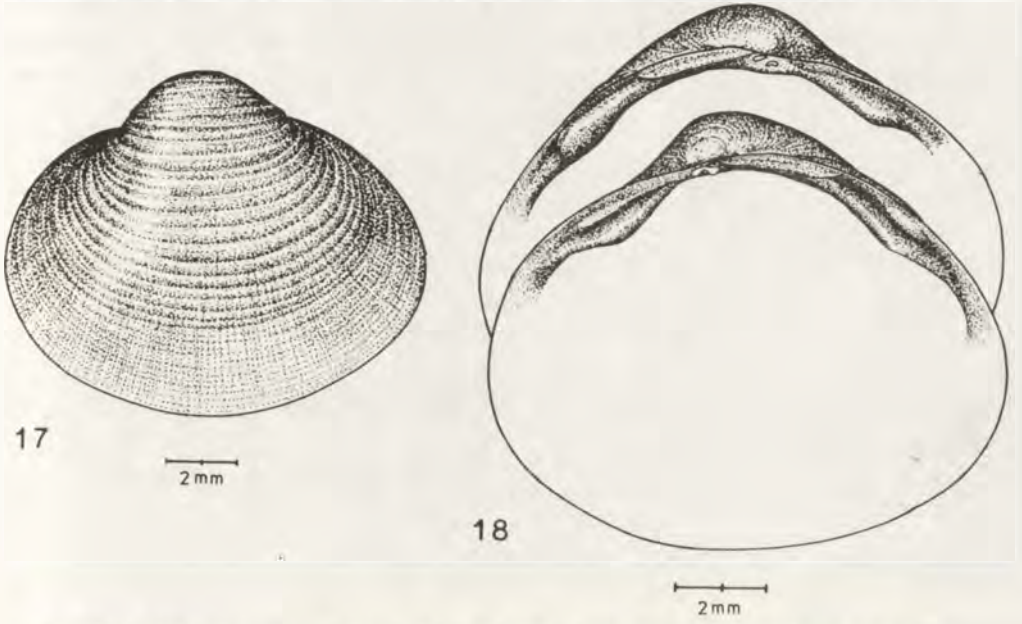
Sphaerium solidum (NORMAND, 1844)

Synonym: *Cyclas solida* NORMAND, 1844.

Shell thick, tumid, its outline oval or like an isoscales triangle. Umbones situated in its mid part, strongly protruding (especially in fully grown individuals) (Fig. 17).

Shell distinctly ribbed in which it differs from the shells of related species. The ribbing is most clearly marked in the upper part of the shell which enables an unambiguous determination of young specimens. Shell thick-walled and strong, its outer surface glossy, horny-yellow. In fully grown specimens the upper (older) part of the shell is usually darker, while the lower part is distinctly lighter. Ligament visible between the umbones.

Hinge-plate strongly marked, broad and bent. Cardinal teeth very fine; C_3 distinctly bent, in its anterior part tapered, in the posterior part knob-like thickened; C_2 and C_4 short, C_2 being somewhat larger and situated parallelly to the hinge-plate margin, C_4 situated obliquely above C_2. Both teeth can have a shape of an obtuse triangle. Lateral teeth distinct and strong, of approximately equal size in the anterior and posterior part of the shell; A I, A II, and P I, P II large, A III and P III fine, sometimes rudimentary. Ligament pit short and not very wide (Fig. 18.)



Figs 17 and 18. *Sphaerium solidum*. 17 – Shell in lateral view; 18 – left and right valve.

Dimensions: length 7.0–12.5, height 5.0–10.5, thickness 5.0–8.5.

The species is relatively little variable. Individual differences consist e.g. in more or less prominent ribbing, different thickness of the shell walls and varied colouration.

S. solidum is a species characteristic of large rivers where it inhabits places with sandy or sandy-muddy bottom. It occurs both in the main current and at the banks. It has been observed that *S. solidum* can inhabit coarse sands in sites of a considerable velocity of water flow. The clam was found burrowing in the substratum which enables it to live in places temporarily devoid of water (WOLFF

1970). *S. solidum* inhabits also old river beds, large lakes and channels (ŽADIN 1952, WOLFF 1970, REDSHAW and NORRIS 1974).

According to THIELE (1929) *S. solidum* is extremely sensitive to water pollution, however the results of WOLFF (1970) indicate that it tolerates water pollution comparatively well. On the other hand the observations from Poland (see below) suggest rather a negative effect of the pollution. The studies of WIKTOR and WIKTOR (1954) in Szczecin Firth have shown that *S. solidum* tolerates the salinity of $1.42^0/_{00}$.

The distribution area of the species includes mainly Central, Northern and Eastern Europe. It has been recorded from the USSR – from Ural to the Ponto-Caspian river basins – as well as from Poland, Germany, Belgium, Netherlands, France and Great Britain.

In Poland *S. solidum* has been recorded from the Odra River (rather numerous localities in the mid and lower course), Szczecin Firth, Warta River (Gorzów Wlkp.), Vistula River (Warsaw, Włocławskie Lake, Słońsk, Toruń, in the neighbourhood of Gdańsk), Vistula Firth and in such rivers as Brda (Bydgoszcz), Wkra (the river mouth near Gosławice), Narew (Gnojno above Pułtusk, Wierzbica, Zegrzyńskie

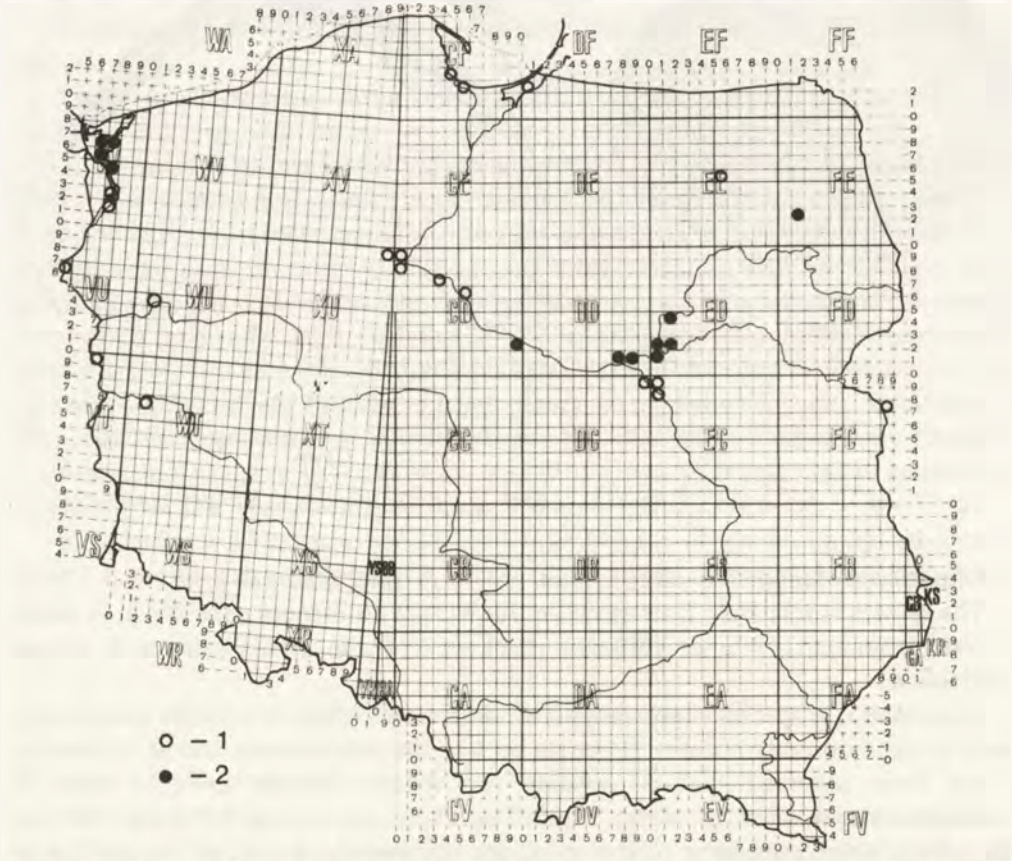


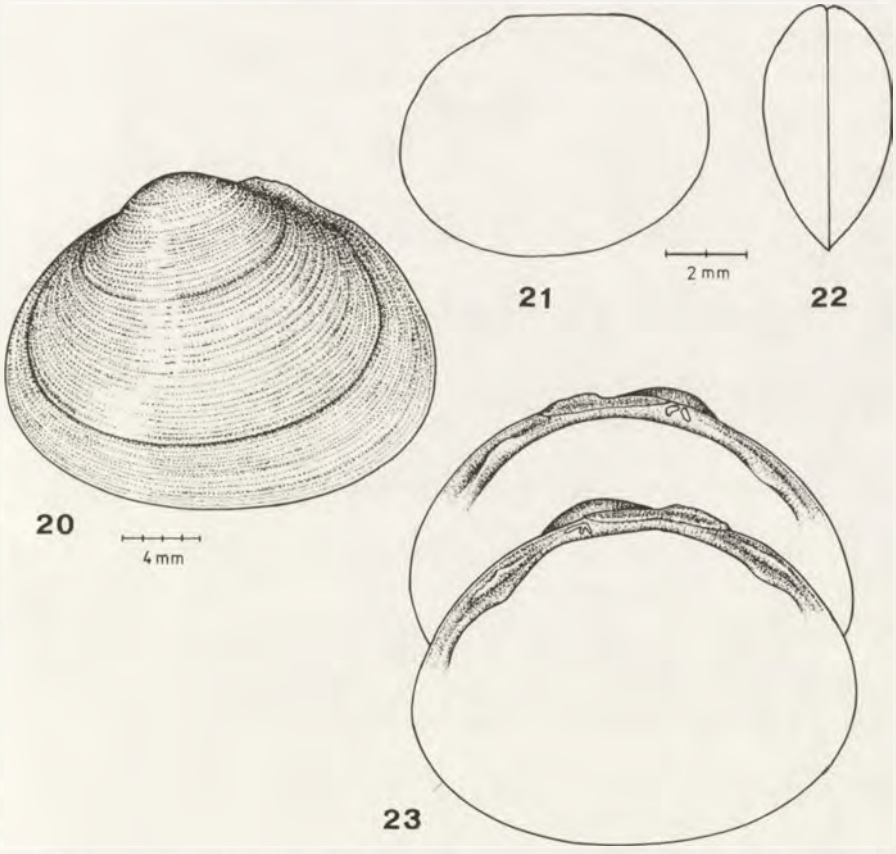
Fig. 19. Distribution of *Sphaerium solidum* in Poland. 1, stations localized till 1950 inclusive; 2, after 1950.

Lake – numerous localities (!), Pomiechówek), Biebrza (Dawidowizna), Bug (Brześć, Popowo) as well as in the lake Śniardwy (Fig. 19). The analysis of the data summarized in the paper by PIECHOCKI (1987) indicates that *S. solidum* is one of the coming to extinction species in Poland, due to the increasing pollution of large rivers. The clam has probably become extinct in the rivers Odra, Warta, lower Brda, lower Vistula and Vistula Firth where it has been not recorded recently (cf. map, Fig. 19). It is worth noting that comparatively rich populations of *S. solidum* still live in large rivers of eastern Poland, especially Biebrza and Narew as well as in Szczecin Firth.

Sphaerium rivicola (LAMARCK, 1818)

Synonym: *Cyclas rivicola* LAMARCK, 1818.

Shell large, its outline oval, umbones broad and weakly prominent, situated approximately in the mid part of the shell (Fig. 20). Shell surface shiny, distinctly



Figs 20–23. *Sphaerium rivicola*. 20 – Shell of adult specimen in lateral view; 21 – shell of young specimen in lateral view; 22 – shell of young specimen in rear view; 23 – interior of the valves of the shell of the adult clam.

and raher regularly striated, the striae getting more and more distinct as the shell grows (the umbones and their neighbourhood smooth). Colour from yellow to olive-grey. On the shells of large specimens sometimes there are visible lighter bands in their lower parts, as well as growth ridges. Shell walls mostly strong and rather thick. Young individuals extremely flat, with scarcely marked umbones (Figs 21 and 22). Ligament convex and well visible from the outside.

Hinge-plate comparatively stout. Unpaired cardinal tooth C_3 hooklike bent, in its posterior part thickened and usually divided; C_2 and C_4 short and thick, situated obliquely. Lateral teeth small, ligament pit long and wide (Fig. 23).

Dimensions: length 18.0–25.0, height 15.0–18.0, thickness 10.0–14.0.

The species is but little variable. *S. rivicola tetensi* C. R. BOETTGER described from an old bed of the river Odra near Opole, supplied with heated water, is characterized by a very flat and thinwalled shell.

S. rivicola is mostly a riverine species, though it can be found also in lakes. It inhabits large and medium-sized rivers of sandy, clayey and sandy-clayey bottom. In

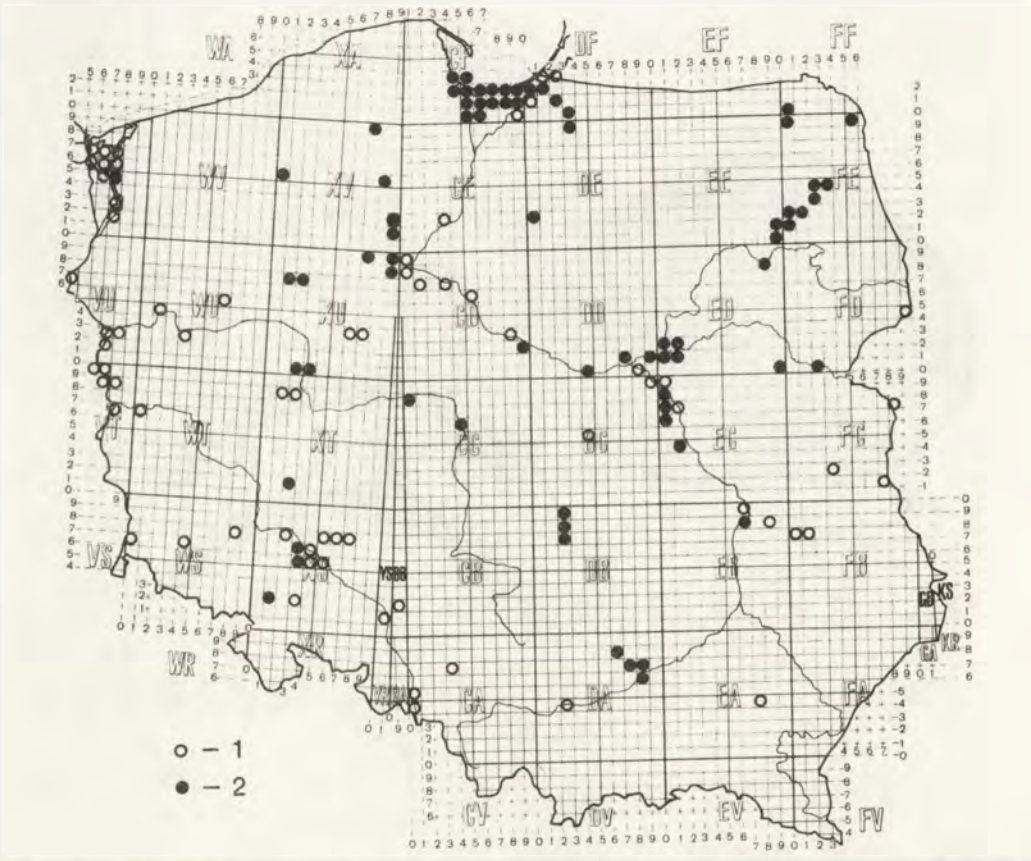


Fig. 24. Distribution of *Sphaerium rivicola* in Poland. 1, stations localized till 1950 inclusive; 2, after 1950.

lakes it occurs only in the littoral zone. Under favourable conditions, especially in the rivers, the species is sometimes very abundant. *S. rivicola* is sensative to water pollution. In Poland, however, it is still common and probably is not threatened with extinction in the nearest future.

The distribution range comprises Central and Eastern Europe.

In Poland *S. rivicola* has been recorded from the basins of the rivers Vistula, Odra and from the rivers discharging directly to Baltic Sea. It is more common and more abundant in large rivers, though it is also found in comparatively small water-courses e.g. Orla near Milicz, Świder near Mlądz or Ślęża near Wrocław. The species has been also collected in lakes e.g. Garbaś and Pomorze in Suwalskie Lake District, Wielimie near Szczecin. It has not been recorded from the mountains and uplands. The localities are presented on the map (Fig. 24).

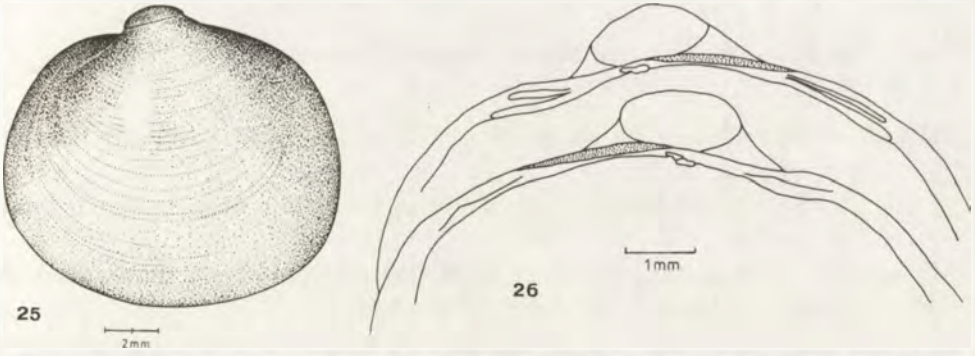
Musculium LINK, 1807

Shell medium-sized (length ca. 10.0), delicate and fragile, provided with cap-like embryonic shells situated on the umbones. Hinge-plate extremely narrow. Newly hatched young minute ($^1/_{10}-^1/_6$ parent length). Anatomical structure similar to that of *Sphaerium*, shell microstructure quite different (DYDUCH-FALNIOWSKA 1983).

Musculium lacustre (O. F. MÜLLER, 1774)

Synonyms: *Tellina lacustris* O. F. MÜLLER, 1774; *Sphaerium lacustre* (O.F. MÜLLER, 1774); *Cyclas calyculata* DRAPARNAUD, 1805; *C. ryckholti* NORMAND, 1844; *Musculium steini* (A. SCHMIDT, 1850); *M. brochonianum* (BOURGUIGNAT, 1854); *M. calyculatum* (BOUDON, 1855). Some of these names (see below) are used when distinguishing varieties.

Shell trapezoidal in outline, its angles distinctly marked, umbones strongly protruding, in most cases with embryonic shells forming "caps" (Fig. 25). Shell



Figs 25 and 26. *Musculium lacustre*. 25 – Shell in lateral view; 26 – interior of upper part of right and left valve

silky, thin and fragile, delicately striated, whitish, greyish or yellow. Ligament sunken, very poorly visible from the outside.

Hinge-plate very thin, in its subapical section so strongly constricted that the hinge teeth sometimes hardly fit in it. Cardinal teeth fine: C_3 in the shape of a thin, usually bent plate; C_2 and C_4 usually parallel, C_4 being somewhat displaced posterad. Lateral teeth in the form of long and thin folds, ligament pit narrow (Fig. 26).

Dimensions: length 7.0–15.0; height 5.5–12.0; thickness 3.5–7.5. Populations of small individuals of the maximum length of 8.0–10.0 are most often encountered.

M. lacustre is a very variable species and in this respect it resambles *Sphaerium corneum*. The variability consists in the differences in the shell outline and in the different degree of the development of the umbones (Figs 27 and 28). The following forms are most often distinguished:

Figs 27 and 28. *Musculium lacustre*, variability of the shape of the shells.

M. lacustre f. *brochonianum* BOURGUIGNAT. Shell large, comparatively flat with very distinctly marked angles.

M. lacustre f. *steini* A. SCHMIDT. Shell tumid, its outline oval, umbones broad and produced anterad.

M. lacustre f. *ryckholti* NORMAND. Shell fine, comparatively thickwalled, its outline triangular, umbones very distinctly marked.

M. lacustre occurs mainly in stagnant waters though it is sometimes found also in rivers. It inhabits most often small water bodies – ponds, overgrowned old river beds, clay pits and roadside ditches. It occurs both in reservoirs of river terrace and

water bodies situated outside the flooded areas. In isolated reservoirs, especially in clay pits and farmland ponds, it reaches high densities. In the cases of mass occurrence of *M. lacustre* the malacocoenoses are usually formed by a low number od species with the snail *Aplexa hypnorum* (L.) occuring in abudance. *M. lacustre* inhabits also the littoral zone of lakes and in dam reservoirs where it is usually not numerous. In the rivers it inhabits mainly muddy embaymants of slow water flow. The species lives also in ephemereal reservoirs and is excellently adopted to resist drought periods (MITROPOLSKIJ 1965).

M. lacustre is a Palearctic species. In Poland it is one of the most common species in both lowland and upland part of the country (Fig. 29). It occurs also in the

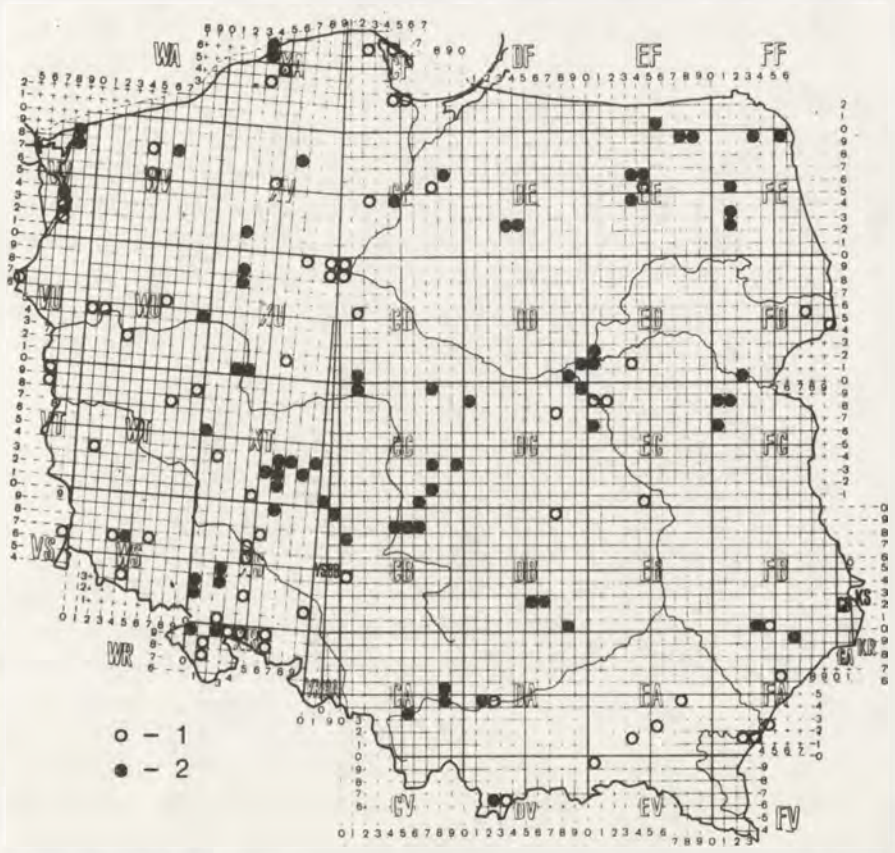


Fig. 29. Distribution of *Musculium lacustre* in Poland. 1, stations localized till 1950 inclusive; 2, after 1950.

mountains where the limit of its vertical distribution is ca. 1100 m a.s.l. (Toporowy Staw Niżny in Tatra Mts., MINKIEWICZ 1914). The comparatively low number of records of *M. lacustris* from the uplands and mountains may be due to the insufficient studies of these areas from the malacological point of view. Because of

the rapid decrease of the number of small reservoirs in our country – often resulting from inappropriate drainage – in many areas the species is threatened with extinction.

Pisidium C. PFEIFFER, 1821

Shell small, only exceptionally exceeding 10.0 in length. Umbones displaced posterad (anterior part of the shell distinctly longer). Hinge-plate and teeth comparatively thick and strong.

Siphons reduced or represented only by the exhalant (upper) siphon. Inner (anterior) gills large, triangular, outer gills displaced posterad, small or even entirely reduced (subgenera *Neopisidium* ODHNER and *Odhneripisidium* KUIPER) (Fig. 12).

Young individuals considerably more convex than those of the species of *Sphaerium*.

The species inhabiting Poland are classified in four subgenera: *Pisidium* s. str., *Cymatocyclas* DALL., *Neopisidium* ODHNER and *Odhneripisidium* KUIPER. The subgeneric divisions are based among others on the shell size, structure of gills, position of the ligament and the shape of the siphons (KUIPER 1962c, ZEISSLER 1971). In the recent fauna of Poland subgenus *Pisidium* s. str. is represented by *P. amnicum* only. *P. conventus* and *P. moitessierianum* belong to the subgenus *Neopisidium*, whereas subgenus *Odhneripisidium* includes only one species – *P. tenuilineatum*. All other species are classified in the subgenus *Cymatocyclas*.

Pisidium amnicum (O. F. MÜLLER, 1774)

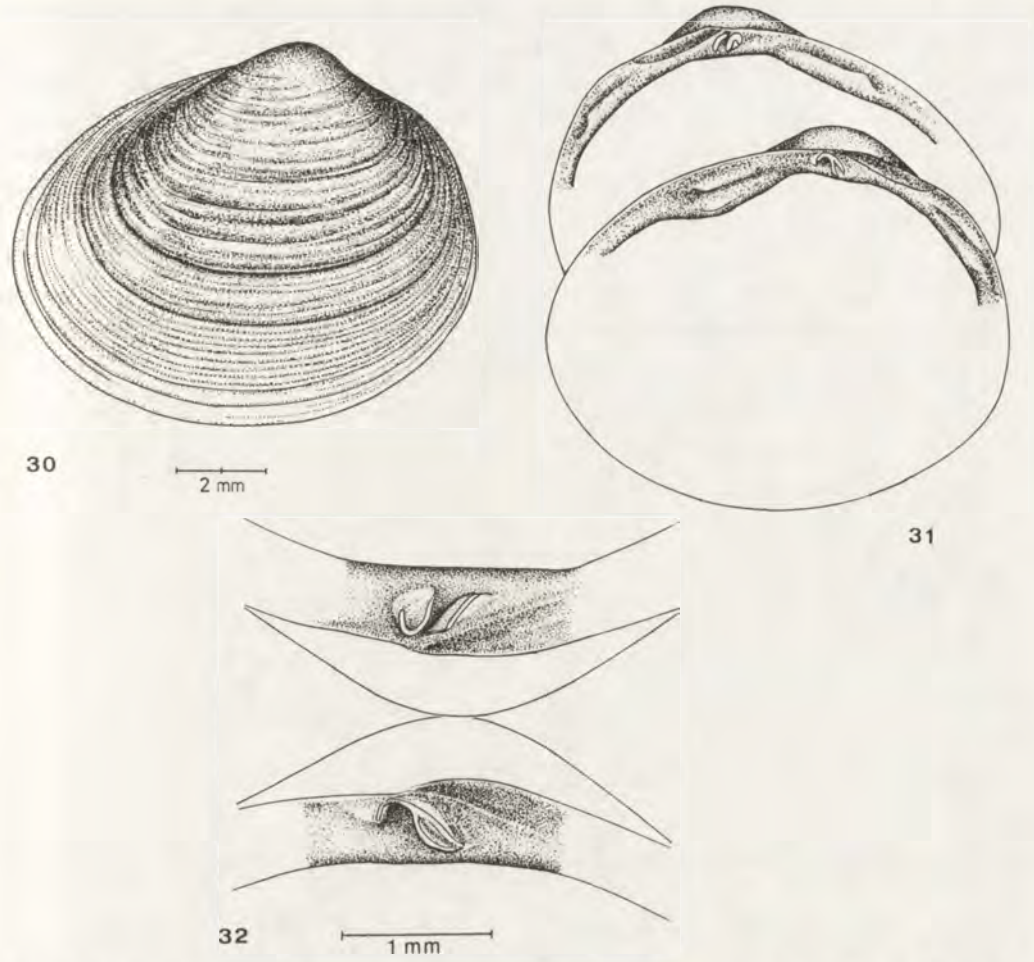
Synonyms: *Tellina amnica* O. F. MÜLLER, 1774; *Cyclas palustris* DRAPARNAUD, 1801; *C. obliqua* LAMARCK, 1818; *Pisidium obliquum* C. PFEIFFER, 1818.

Shell large, its anterior part strongly elongate, its posterior part distinctly truncated; umbones not very prominent and displaced posterad (Fig. 30). Shell comparatively thick-walled and strong, its surface distinctly but irregularly ribbed and shiny. Shells of juvenile individuals whitish-yellow, in fully grown specimens grey-yellow or brownish, in their ventral part sometimes a light band visible.

Hinge-plate thick, lateral teeth, especially in the right valve, very outstanding. Main, unpaired tooth – C_3 – strongly bent and bifurcated in its posterior section; C_2 also bent, posteriorly covered by the obliquely situated C_4. Ligament pit wide (Figs 31 and 32).

Dimensions: length 7.0–11.0, height 5.0–9.0, thickness 4.0–6.5.

The variability of this species is relatively low. Populations from various habitats can differ in their average shell dimensions, convexity, degree of the development of ribs and colour. However, *P. amnicum*, the largest representative of the genus, is always easy to distinguish from the remaining species. Young individuals are strongly flattened that easily distinguishes them from adult clams of other species.



Figs 30–32. *Pisidium amnicum*. 30 – Shell in lateral view; 31 – left and right valve; 32 – cardinal teeth.

P. amnicum inhabits mostly running waters where it is found both in small, sometimes marshy streams and in large rivers with clean bottom. In running waters it sometimes reaches high densities. It lives also in lakes, dam reservoirs, large ponds, old river beds and river embayments. Out of stagnant waters it most often inhabits lakes, being a common species in the littoral. It avoids small, ephemeral reservoirs despite its ability to survive outside water relatively long (PIECHOCKI 1969). The species is very sensitive to water pollution and inhabits mainly oligosaprobic and β-mesosaprobic waters.

A Palearctic species of the distribution area from Kamtschatka to Pyrenean Peninsula. Recorded also from North Africa and North America (probably introduced there). In Northern Europe (north of Alps and Pyrenees) much more common than in the south.

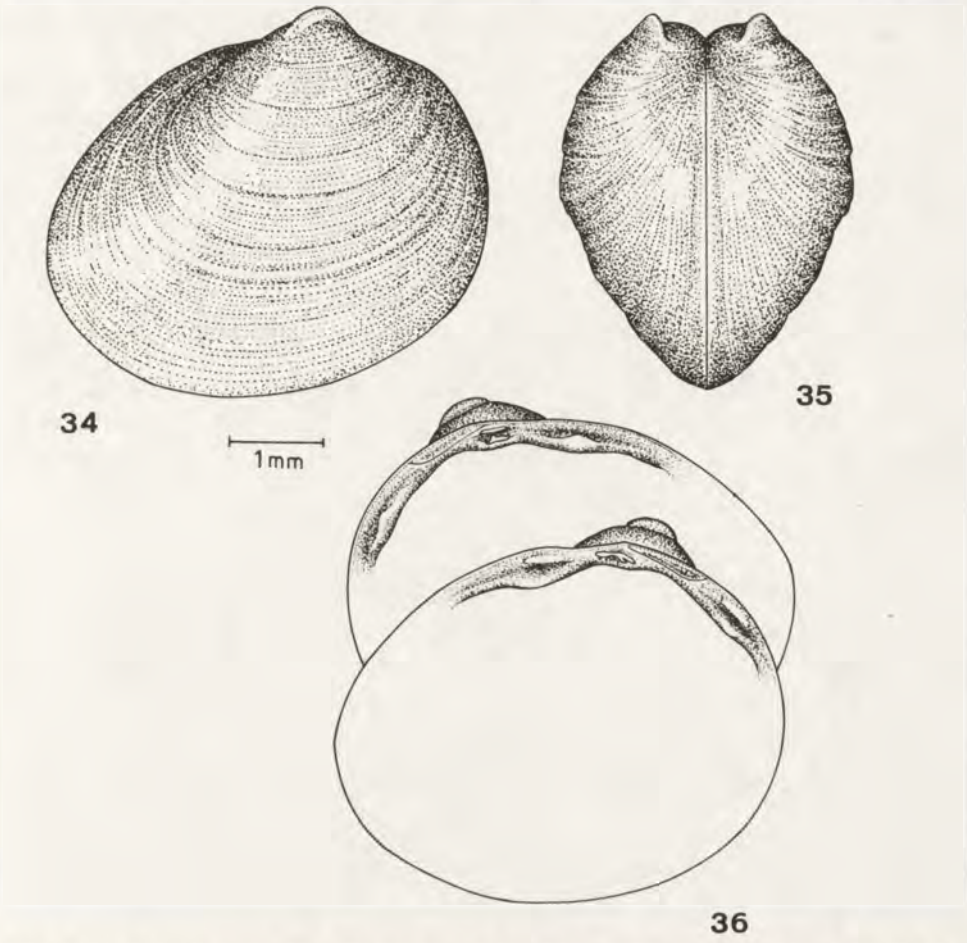
In Poland *P. amnicum* is common in entire lowland part of the country where it inhabits all the rivers of sufficiently clean water and many lakes. Fairly numerous localities are known from Lower and Upper Silesia, Małopolska Upland, Świętokrzyskie Mts., Roztocze, Sandomierska Lowland, Western Sudetes Mts., Western Beskidy Mts., Nowotarska Basin, and Eastern Beskidy Mts. It has not been hitherto recorded from higher altitudes and it seems unlikely that it occurs there. The distribution of the species in Poland is presented in Fig. 33.

Fig. 33. Distribution of *Pisidium amnicum* in Poland. 1, stations localized till 1950 inclusive; 2, after 1950.

Pisidium henslowanum (SHEPPARD, 1823)

Synonyms: *Tellina henslowana* SHEPPARD, 1823; *Cyclas appendiculata* TURTON, 1831; *Pisidium appendiculatum* (TURTON, 1831).

Shell outline asymmetric oval. Shell not very convex, umbones prominent and narrow, displaced posterad; ridges obliquely situated on umbones. Elongate anterior tip of the shell is situated below the half of its height (as in *P. subtruncatum*);



Figs 34–36. *Pisidium henslowanum*. 34 – Shell in lateral view; 35 – shell in rear view; 36 – left and right valve.

posterior tip "truncated" (Figs 34 and 35). Shell surface strongly and regularly striated, its colour whitish-yellow, often with a violet tint (visible in shells not covered with sediment).

Hinge-plate strong and slightly bent. Cardinal tooth C_2 hook-like, C_4 straight, most often situated obliquely behind C_2; C_3 strong and bent, in its posterior thickened and usually bifurcated. Lateral teeth distinctly marked, especially A I and A II; P I and P III parallel or at most slightly converging anterad. Ligament pit comparatively long and narrow (Fig. 36).

Dimensions: length 3.4–5.5, height 2.6–4.3, thickness 2.3–3.5. Sometimes unusually large specimens are found, reaching $6.6 \times 5.8 \times 4.6$ (ELLIS 1978).

P. henslowanum shows generally a small variability and is usually easy to distinguish from other species. Individuals inhabiting the lake littoral zone are

thick-walled and have very strong hinge which makes them similar to *P. supinum* (cf. p. 273).

P. henslowanum f. *inappendiculata* STEENBERG is a well delimited form whose shell is devoid of umbonal appendiculae. This variety – especially individuals with shortened shells – may resemble *P. lilljeborgii*. According to ZEISSLER (1971) both species differ in their hinge structure (in *P. lilljeborgii* P I and P III distinctly converge anterad). The above form differs from *P. subtruncatum* and *P. casertanum* in its deeper and more regular striation, more prominent umbones and longer and narrower ligament pit.

P. henslowanum f. *distans* STELFOX also devoid of the umbonal appendiculae is a similar form, found – like f. *inappendiculata* – by FELIKSIAK (1938) in Białowieża Forest. Its shells are flatter, thin-walled and provided with a weak hinge. According to DYDUCH-FALNIOWSKA (1983a) both the mentioned forms and the typical *P. henslowanum* are inter-connected by series of individuals with intermediate characters.

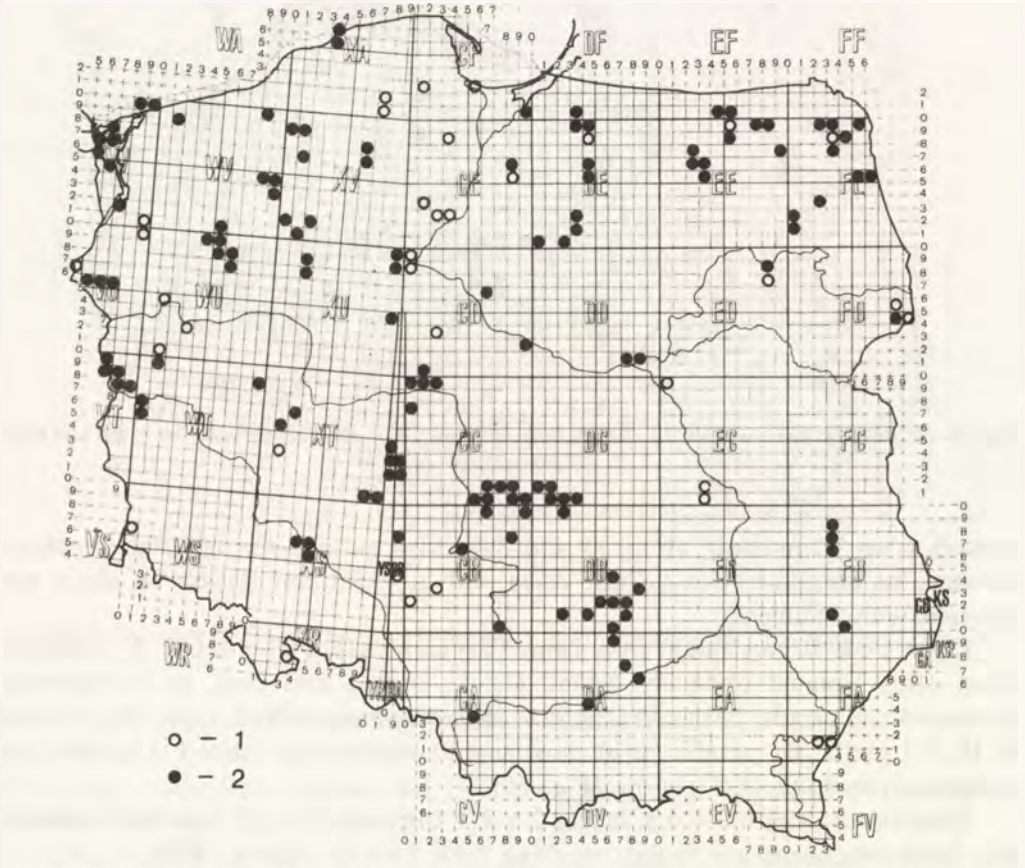


Fig. 37. Distribution of *Pisidium henslowanum* in Poland. 1, stations localized till 1950 inclusive; 2, after 1950.

P. henslowanum in Poland inhabits almost all kinds of fresh water habitats except high mountain lakes, ephemeral reservoirs, fast flowing streams and cold springs. It has been found that the optimal conditions are met in places with perceptible water flow or movement – rivers, old river beds and lake littoral (PIECHOCKI 1969 and in press). It should be stressed that the species avoids waters with strong flow, as well as those completely stagnant. It has been observed to prefer fine grain sediments – muddy and sandy – and to be a calcifilous species (KUIPER and WOLFF 1970, MEIER-BROOK 1975). The vertical distribution of the species is narrow and e.g. in the Alps it does not reach 1000 m a.s.l. (KUIPER 1974). In large lakes it may occur in the sublittoral zone attaining the depth of 40 m (ELLIS 1978).

A Palearctic species, recorded also from North America where it has been probably introduced (KUIPER 1966).

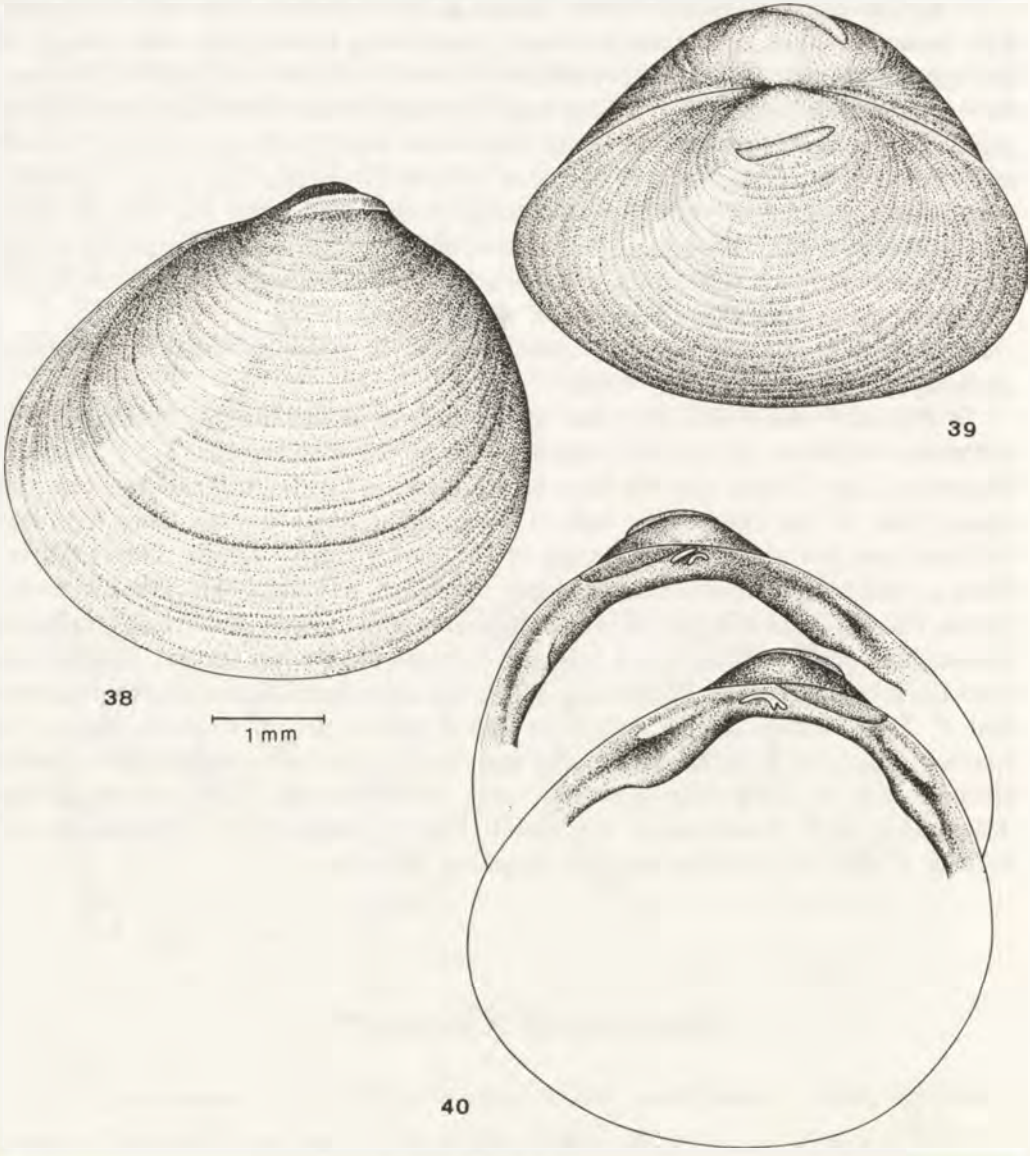
In Poland *P. henslowanum* is one of the most common lowland sphaeriids. Its numerous localities are known especially from the Pomeranian Lake District, Mazurian Lake District and Wielkopolsko-Kujawska Lowland. It inhabits also the upland part of the country as well as submontane areas though there it is less common and less abundant. It occurs in our largest rivers: Vistula, Odra, Warta, Pilica as well as in medium-sized and small rivers, e.g. Krutynia, Wel, Pasłęka, Brda, Gwda, Piława, Nida and Grabia. In some rivers (upper Gwda, Krutynia, Grabia) it reaches high densities, in others it belongs to comparatively rare species. The records from the lakes of Western Pomerania, Mazurian Lake District and Kujawy evidence that *P. henslowanum* can be numerous and common also in stagnant waters. In southern Poland it is much less common and inhabits reservoirs situated at moderate altitudes e.g. in Świętokrzyskie Mts. and West Sudetes. The pattern of the distribution of *P. henslowanum* in Poland (Fig. 37) supports the observations of KUIPER (1974) of a narrow vertical range of this clam.

Pisidium supinum A. SCHMIDT, 1851

Synonyms: *Pisidium fontinale* STEIN, 1850; *P. conicum* BAUDON, 1857; *P. baudoni* CLESSIN, 1872.

Shell triangular in outline, its length only slightly exceeding its height. Umbonal appendiculae situated obliquely on sharp umbones (Figs 38 and 39). Shell not very tumid but strong and thick-walled, yellowish-white, covered with strong and rather thick striae, or ribbed. Shell surface often covered with rusty-black sediment which may blur its sculpture and mask the umbonal appendiculae.

Hinge very strong, its plate very thick and strongly bent which is particularly well visible in the left valve. C_2 hook-like, C_4 straight and situated parallelly to the posterior arm of C_2; C_3 bent, thickened and bifurcated at its posterior end. Lateral teeth very strongly developed, especially A I and P I. Ligament pit comparatively narrow (Fig. 40).



Figs 38–40. *Pisidium supinum*. 38 – Shell in lateral view: 39 – dorsal view of shell; 40 – left and right valve.

Dimensions: length 3.3–5.2, height 2.8–4.9, thickness 2.0–3.8.

A poorly variable species. In some populations the umbonal appendiculae are poorly marked or even disappear. *P. supinum* is most often mistaken for *P. henslowanum* and *P. casertanum* f. *ponderosum*. The shell of *P. henslowanum* is usually distinctly longer (oval), more thin-walled, more delicately striated and has

a weaker hinge-plate (Figs 34–36). The shell of *P. casertanum* f. *ponderosum* is smooth, devoid of umbonal appendiculae and has a very broad ligament pit (Figs 66 and 67).

According to KUIPER and WOLFF (1970) *P. supinum* is a species characteristic of large rivers where it inhabits mostly slow flowing sections of a sandy, fine grain bottom. In Poland the clam occurs in small and large rivers, lakes and sometimes also in deep ponds. Its optimal conditions are met in rivers (PIECHOCKI in press). The necessary condition of the occurrence of the discussed clam in water bodies is the presence of constant flow or water movements. The species prefers sandy-gravel substrates where largest individuals are found. Its high oxygen demands make it susceptible to water pollution. The species is associated with lowland areas, e.g. in France it is not found above 300 m a.s.l. (KUIPER 1966).

A Holarctic species. Its distribution range comprises a great part of Europe, eastern areas of North America and a part of Siberia to the Ob River (ZEISSLER 1971, ELLIS 1978).

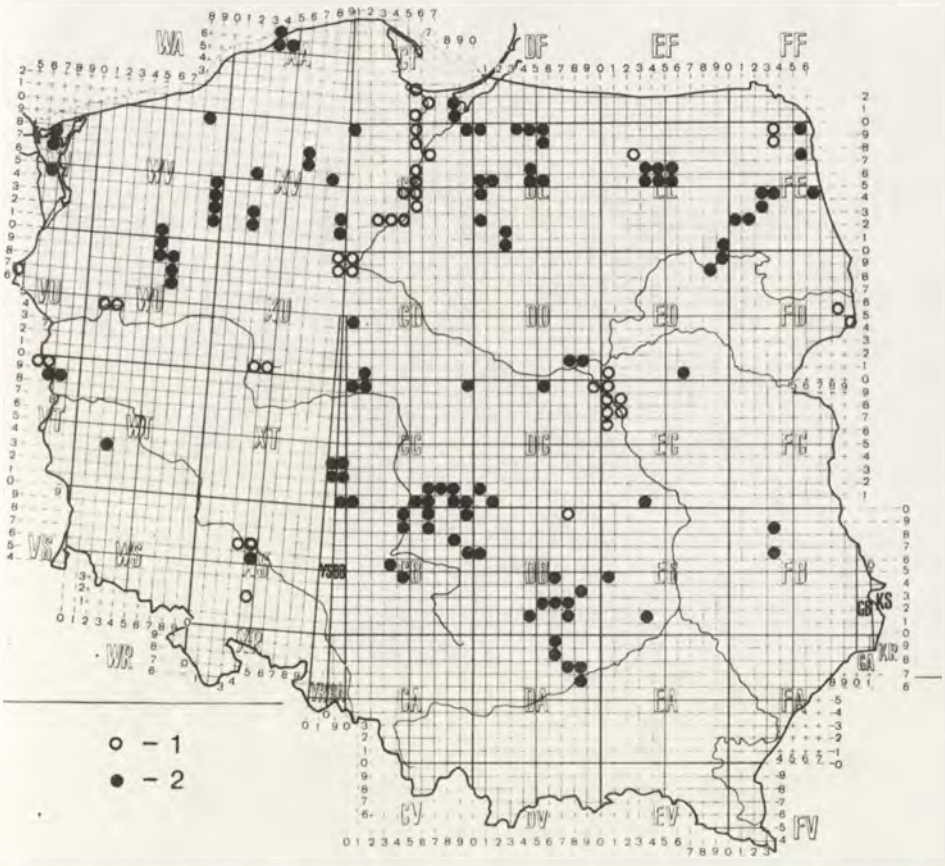


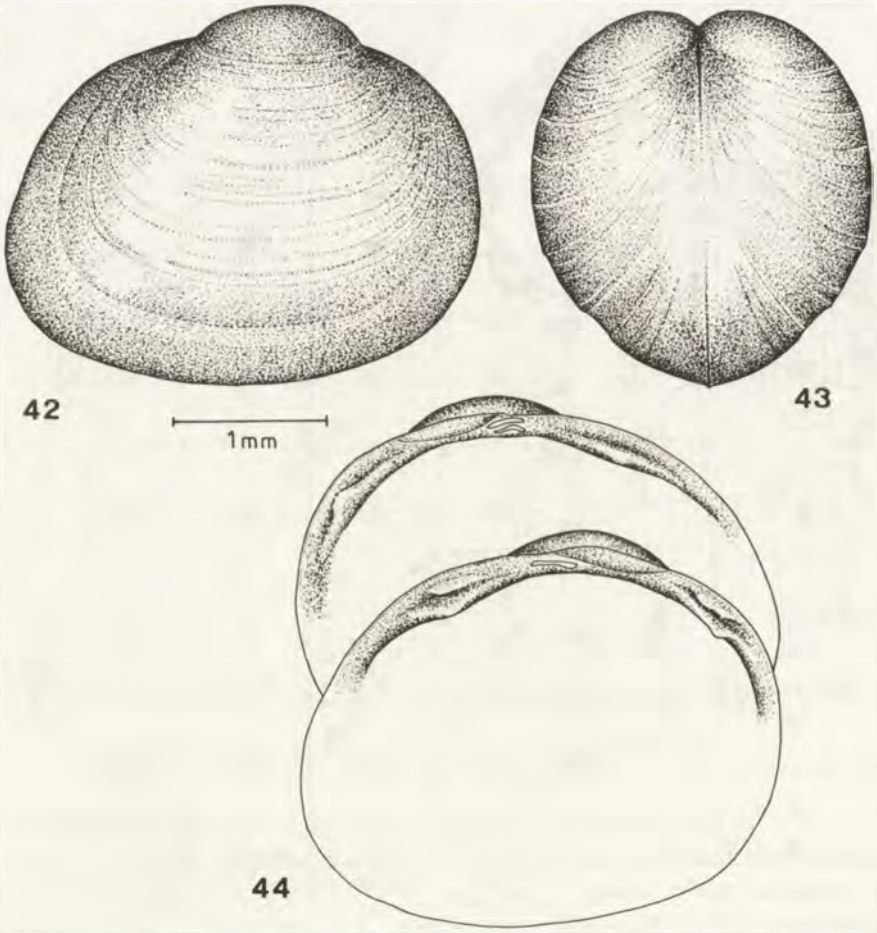
Fig. 41. Distribution of *Pisidium supinum* in Poland. 1, stations localized till 1950 inclusive; 2, after 1950.

In Poland *P. supinum* occurs commonly in rivers and lakes in the lowland and partly also the upland part of the country. It has not been recorded from the mountains. The localities are presented in Fig. 41.

Pisidium milium HELD, 1836

Synonyms: *Pisidium tetragonum* NORMAND, 1854; *P. arcaeforme* MALM, 1855; *P. gassiesianum* BOUDON, 1857.

Shell outline rhomboidal and strongly convex, resembling in its shape a grain of millet. Umbones broad and distinctly protruding, somewhat displaced posterad. Upper margin short, parallel to the lower margin which is very weakly bent. In the place of junction of the anterior and lower margin a strong "beak-like" bent;



Figs 42–44. *Pisidium milium*. 42 – Shell in lateral view; 43 – shell in rear view; 44 – left and right valve.

posterior margin almost vertical (Figs 42 and 43). Shell surface very strongly shiny, irregularly striated, whitish, yellowish or horny.

Hinge-plate comparatively weak, constricted near the umbones. C_3 long, slightly bent and somewhat thickened at its posterior end; C_2 and C_4 parallel and approximately of equal length; lateral teeth A I and A III as well as P I and P III distinctly parallel. Ligament pit comparatively wide (Fig. 44).

Dimensions: length 1.8–3.75, height 1.6–3.0, thickness 1.5–2.75. Individuals of the highest size class are met only rarely.

P. milium shows a slight variability and is usually easy to distinguish from other species. It differs from somewhat similar *P. pseudosphaerium* in its exceptionally rhomboidal, more convex and strongly shiny shell (cf. p. 278). Larger and less convex forms are considered by the Soviet malacologists as a distinct species – *Euglesa tetragona* (NORM.) (= *Pisidium tetragonum* NORM.) (STAROBOGATOV 1977, STADNIČENKO 1984).

P. milium var. *pulchelloides* KUIP. is a well marked form with deeply and regularly striated shell.

Fig. 45. Distribution of *Pisidium milium* in Poland. 1, stations localized till 1950 inclusive; 2, after 1950.

P. milium occurs mainly in small stagnant reservoirs – old river beds, marshes, turf-pits as well as in the coastal zone of lakes and rivers (PIECHOCKI in press). It prefers reservoirs overgrown with plants. In spite of the fact that it is a common species, it is usually not abundant. In small reservoirs, e.g. small marshes, it may sometimes reach high densities (PIECHOCKI 1981).

The vertical range of this clam is considerable; the species was found from the lowland to the altitude of over 2300 m a.s.l. In lakes it usually does not descend to the profundal zone (KUIPER 1966). According to TETENS and ZEISSLER (1964) the clam avoids springs, streams and oligotrophic lakes.

A species of a Holarctic distribution, widespread in Europe (mainly north from Alps), in North Africa, in wide areas of the U.S.S.R. and in North America (KUIPER and WOLFF 1970, ZEISSLER 1971).

In Poland it is common in the northern and central part of the country, while it is rare in the south (montane and submontane areas). Most numerous localities have been recorded from Pomeranian Lake District, Mazurian Lake District, in the southern part of Wielkopolsko-Kujawska Lowland and in Małopolska Upland (Fig. 45).

The vertical range of the species in Poland requires further studies. From the paper of DYDUCH-FALNIOWSKA (1983a) it follows that it occurs in Bieszczady Mts.

Pisidium pseudosphaerium SCHLESCH, 1947

Synonyms: *Pisidium milium* var. *pseudosphaerium* JUTTING et KUIPER, 1942; *P. favrei* KUIPER, 1947. The term "*pseudo-Sphaerium*" was used by FAVRE (1927) when describing hunger forms of numerous species of *Pisidium*, among others *P. milium* HELD. Because of this J. FAVRE can not be regarded as an author of the species (SCHLESCH 1947, KUIPER 1962, 1972).

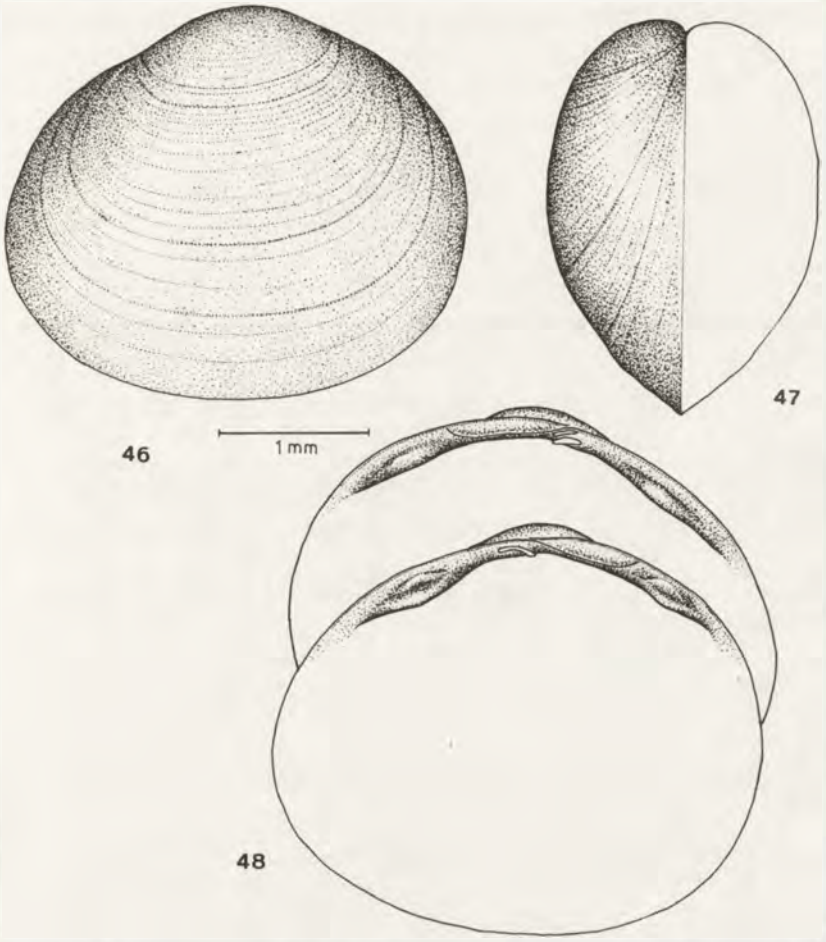
Shell oval in outline, comparatively flat, in its shape resembling small individuals of *S. corneum*. Umbones broad, rounded and poorly protruding, situated approximately in the mid part of the shell. Weak angles can be marked at the junction of the dorsal and anterior and the dorsal and posterior margin – then the shell outline is somewhat rectangular (Figs 46 und 47).

Shell thin and fragile, shiny, covered with delicate, strongly incised striae which disappear near the umbones.

Hinge-plate narrow, very weakly bent, roughly of the same thickness on its whole length. Cardinal teeth weak, thin and barely fitting on the plate; C_3 slightly bent, C_2 and C_4 almost parallel, straight (C_4 may be somewhat inclined upwards). Lateral teeth poorly marked, A I and A III as well as P I and P III almost parallel. Ligament pit long and comparatively very broad (Fig. 48).

Dimensions: length 2.5–3.25, height 1.9–2.8, thickness 1.4–1.8.

The species is relatively little variable, however when identifying it can be mistaken for *P. milium*, *P. nitidum* and small individuals of *S. corneum*. The main characters distinguishing it from *P. milium* are: more rounded outline and flatter shell, less prominent umbones, narrower hinge-plate with the ligament pit occupying



Figs 46–48. *Pisidium pseudosphaerium*. 46 – Shell in lateral view; 47 – shell in rear view; 48 – left and right valve.

almost its whole breadth, and higher situated adductor scars. It differs from *P. nitidum* first of all in the lack of concentric lines around the umbones, and from *S. corneum* – in more delicate striation, thinner shell and different structure of the hinge.

P. pseudosphaerium is a typically lowland species inhabiting reservoirs situated at altitudes not exceeding 500 m a.s.l. It occurs almost exclusively in stagnant waters; in the rivers in lotic habitats it is rare (KUIPER 1972, PIECHOCKI in press). Its characteristic habitats are peat bogs, marshes and flooded meadows at the shores of larger reservoirs. It is often found together with *S. corneum* f. *nucleus* STUD. and snails: *Anisus vorticulus* (TROSCH), *Gyraulus riparius* (WEST.) (KUIPER 1962, PIECHOCKI 1969).

The distribution range of this species comprises central and western Europe. The area is divided into several parts, of which the largest spreads from Netherlands through Germany, Denmark, Poland and Baltic republics of the U.S.S.R. to the south of Finland. Besides, the clam occurs in the British Isles, southern Scandinavia, Switzerland, northern Italy, Austria, Hungary and Czechoslovakia (KUIPER 1972).

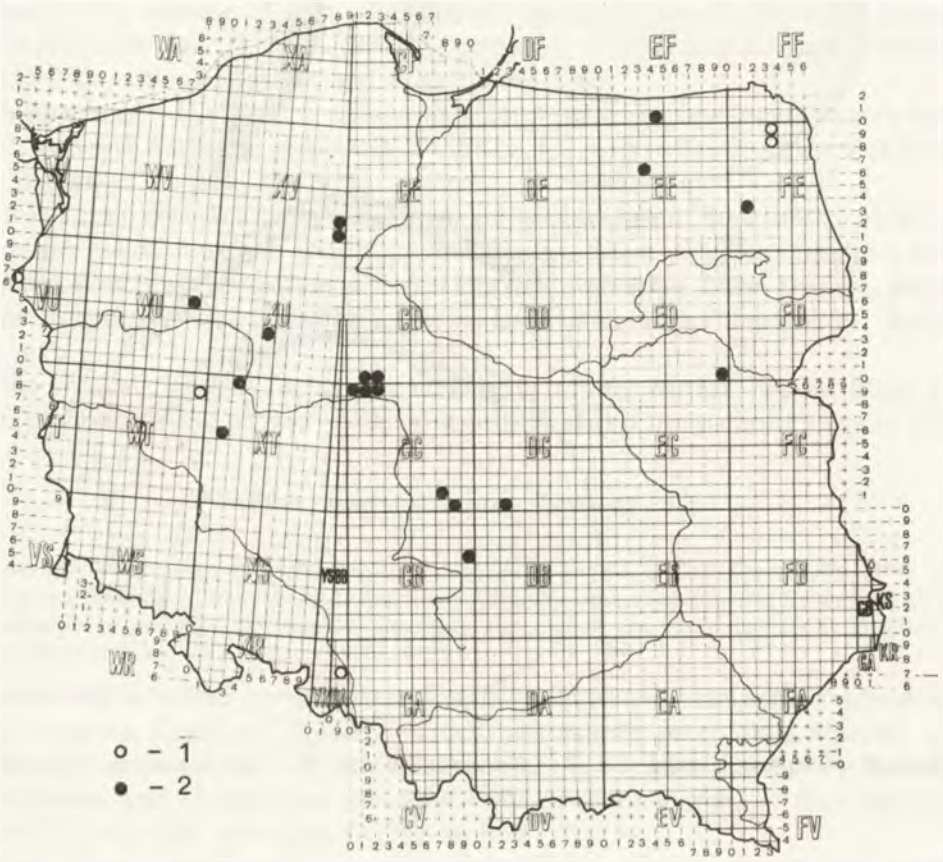


Fig. 49. Distribution of *Pisidium pseudosphaerium* in Poland. 1, stations localized till 1950 inclusive; 2, after 1950.

First reports on the occurrence of this species in Poland are those of BERGER (1959) who recorded it from the Wielkopolski National Park and near Włókno Duże near Sława. Further localities are known from Mazurian Lake District (BERGER 1960), southern Wielkopolska (BERGER 1961), valleys of Słubia and Bóbr Rivers, and the basin of middle Drawa River (TETENS and ZEISSLER 1964), valley of Grabia River (PIECHOCKI 1969) and Konińskie Lakes (BERGER and DZIĘCZKOWSKI 1977).

New localities:

1. Bielinek on Odra River, a swamp near the mill, leg. T. SCHMIERER, 1938, ZMB.
2. Grodzisk Wielkopolski (no detailed data), leg. E. MÜLLER, ZMB.
3. The vicinity of Koźle, Upper Silesia, leg. W. BAU, 1941, SMF.
4. Lake Wigry, shore between the hydrobiological station in Stary Folwark and Leszczówek, leg. S. FELIKSIAK, 1935, IZ PAN.
5. Lake Koronowskie on Brda River, a muddy bay near Pieczyska, leg. A. PIECHOCKI, 1984.
6. River Miała below village Hamrzyska, leg. A. PIECHOCKI, 1973.
7. An old river bed near the outlet of Biebrza River to Narew River, leg. A. PIECHOCKI, 1967.
8. A marshy tributary of the Biebrza River near the village Dawidowizna, leg. A. PIECHOCKI, 1967.
9. Peat bog on the lake Inulec near Mrągowo, leg. A. PIECHOCKI, 1972.
10. Peat bog at Modlica near Łódź, leg. A. PIECHOCKI, 1967.
11. River Widawka in Kletnia, leg. E. ZAJĄCZKOWSKA, 1975.

The distribution of the species in Poland is presented in Fig. 49.

Pisidium subtruncatum MALM, 1855

Synonym: *Pisidium pallidum* CLESSIN, 1884.

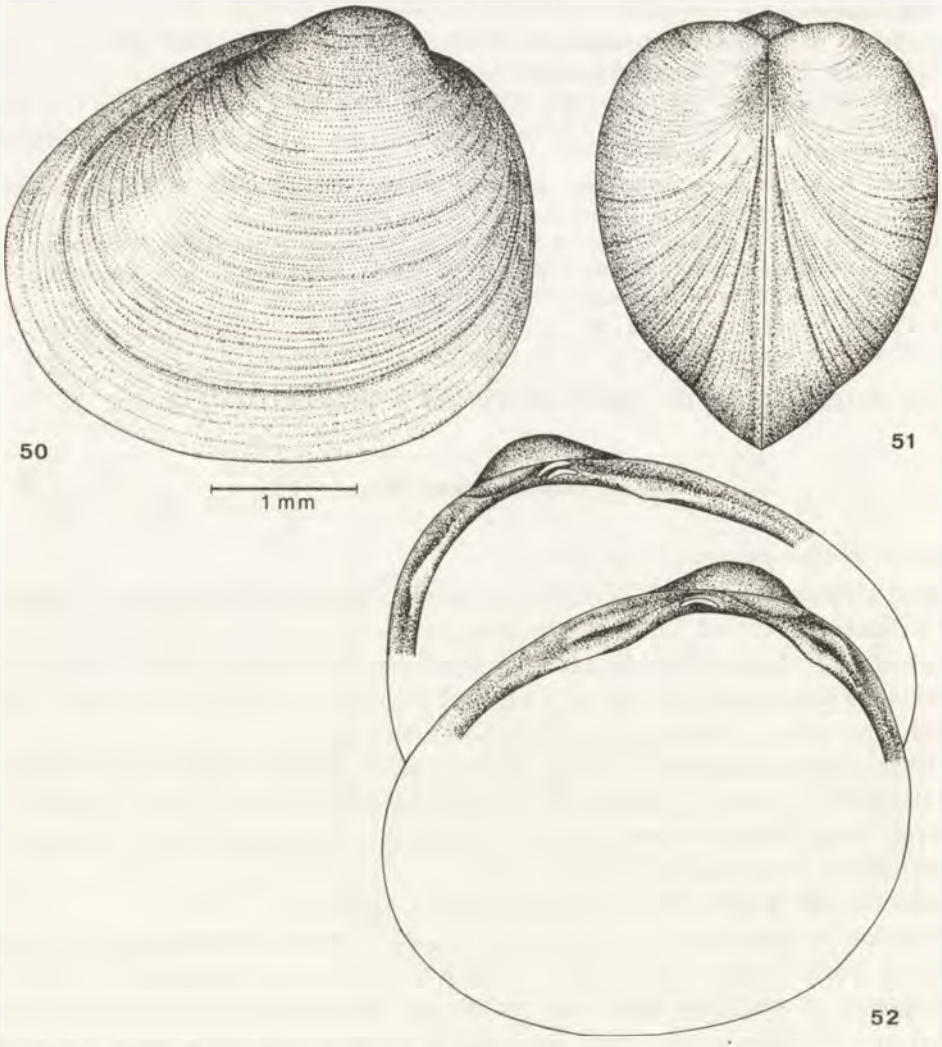
Shell asymmetrically oval in outline, its anterior part strongly elongate, posterior part distinctly shortened. Umbones narrow, prominent, distinctly displaced posterad and inclined posterad (Figs 50 and 51). Shell usually strongly convex though the character is sometimes only weakly marked (especially in fluviatile forms). Shell whitish, mat-shiny, delicately and irregularly striated.

Hinge-plate comparatively thick, cardinal teeth situated closer to the anterior lateral teeth; C_2 and C_4 parallel, C_4 being distinctly longer and C_2 higher; C_3 relatively long, straight or bent, usually thickened at its posterior end. Ligament pit comparatively long and broad (Fig. 52).

Dimensions: length 2.5–4.5, height 2.0–3.7, thickness 1.3–3.0.

Pisidium subtruncatum is an extremely variable species. Populations of various lotic and lenitic habitats can differ markedly in their shell outline, the extent of development of umbones and their inclination, dimensions (especially shell convexity) and the shell colour. Also the hinge is variable, the plate being sometimes very thin and the structure of teeth deviate from the above description. For instance C_4 can be not longer than C_2. The variability range, however, is not so wide as to make the extreme forms – dwarf or especially large – deserve the name of varieties or be regarded as a distinct species. Probably because of the fact that *P. subtruncatum* is relatively easy to distinguish, also earlier authors did not describe any greater number of varieties or subspecies within this species. DYDUCH-FALNIOWSKA (1983 a) observed that the variability in *P. subtruncatum* is more continuous than in other *Pisidium*-clams.

P. subtruncatum f. *tenuilineatiformis* FELIKSIAK described from the lake Wigry and found also in Germany (FELIKSIAK 1938, TETENS and ZEISSLER 1964) is probably a distinct form. It is characterized by a short, tumid shell devoid of prominent



Figs 50–52. *Pisidium subtruncatum*. 50 – Shell in lateral view; 51 – shell in rear view; 52 – left and right valve.

umbones. In the outline of its shell it resembles *P. tenuilineatum*, but differ from it e.g. in the lack of characteristic ribbing (instead there occurs striation).

Individuals from lacustrine and pond populations have usually the most typical shape. Shells of individuals living in running waters, especially in fast flowing streams, have most often weakly marked umbones and are poorly convex. The clams inhabiting marshy (often acid) waters are usually small, thin-shalled and their hinge is weakly developed. MEIER-BROOK (1963) observed that specimens inhabiting muddy sediments are more elongate than those living in a sandy bottom.

P. subtruncatum can be sometimes mistaken for *P. casertanum* and *P. henslowanum*. The diagnostic characters of *P. casertanum* have been presented when describing that species (p. 291). *P. henslowanum*, in its shell outline much resembling *P. subtruncatum*, differs in the presence of umbonal appendiculae, much stronger hinge-plate and in C_2 and C_3 being bent (compare also *P. henslowanum* f. *inappendiculata*, p. 273).

P. subtruncatum is an euryoecious species, which in the variety of its habitats is exceeded only by *P. casertanum*. Its optimum conditions are met in small rivers and lower sections of streams with sandy-muddy or loess bottom in which it reaches sometimes very high densities (PIECHOCKI 1986). In the upper current of streams and in springs it is rare or absent (PIECHOCKI 1969, 1984, BRAUN 1980). In the lakes it inhabits mostly the littoral zone though it can be found also in the profundal area, reaching sometimes the depth of more than 60 m. In the mountains (Pyrenees) it reaches the altitude of 2300 m (KUIPER 1966, 1974a). According to MEIER-BROOK

Fig. 53. Distribution of *Pisidium subtruncatum* in Poland. 1, stations localized till 1950 inclusive; 2, after 1950.

(1975) the occurrence of *P. subtruncatum* does not depend on the presence of calcium.

The species has a Holarctic distribution, its distribution range includes Europe, North Africa, Siberia to Baikal Lake and North America (ELLIS 1978).

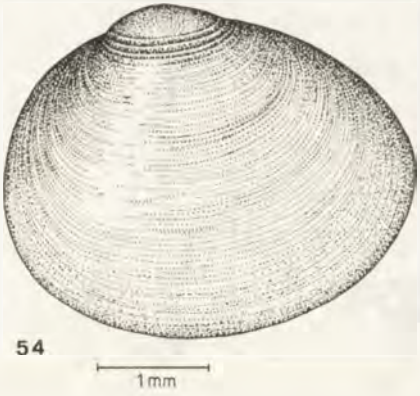
P. subtruncatum is the most common sphaeriid species in Poland (PIECHOCKI in press). It inhabits all the lowland part of the country and many upland regions. It has been recorded also from lower mountain altitudes (West Sudety Mts., East Sudety Mts., West Beskidy Mts., Bieszczady Mts.). The records from the lakes in the Tatra Mts. (WIERZEJSKI 1882, MINKIEWICZ 1910, 1914) need confirmation. The distribution of *P. subtruncatum* in Poland is presented in Fig. 53.

Pisidium nitidum JENYNS, 1832

Synonyms: *Pisidium foreli* CLESSIN, 1874; *P. pusillum* WOODWARD, 1913.

Shell trapezoidal in outline, its angles rounded; umbones broad, slightly displaced posterad, surrounded by 3–5 incised grooves (!) – the character is best visible in young individuals. Shell yellowish or horny-yellow, strongly shiny (!), covered with striae which can be delicate (typical form, Fig. 54) or even rib-like (f. *arenicola* STELF.).

Hinge-plate long and strong, cardinal teeth comparatively short; C_3 more or less bent at its end (it can be also bifurcated), C_2 and C_4 parallel, C_4 being distinctly longer. Lateral teeth widely spaced. Ligament pit short and wide (Fig. 55).



Figs 54 and 55. *Pisidium nitidum*. 54 – Shell in lateral view; 55 – left and right valve.

Dimensions: length 2.6–4.3, height 2.1–3.5, thickness 1.4–2.7.

P. nitidum is one of the most variable *Pisidium*-clams. The variability consists in differences in the shell dimensions, and in the surface sculpture as well as the hinge-plate. MEIER-BROOK (1963) is of the opinion that the shell striation depends on a substratum. Populations of the muddy bottom are weakly striated while those living on sandy bottom are strongly striated or ribbed.

The following forms have been found in Poland:

P. nitidum f. *arenicola* STELF. Shell very strongly striated thus resembling *P. pulchellum* (differences consist in different hinge structure and position of the umbones). It lives in running waters with sandy bottom. I have found this form in the Koprzywianka River at Baćkowice (Sandomierska Upland).

P. nitidum f. *bohemica* WEST. Shell flat, umbones narrow, hinge-plate thicker than in the typical form. It has been recorded from the lake Gardno (DYDUCH-FALNIOWSKA 1983 a).

P. nitidum f. *crassa* STELF. is usually also listed with the forms of *P. nitidum*. It is characterized by an exceptionally thick-walled shell provided with a very strong and large hinge-plate (KUIPER 1965, ELLIS 1978, GLÖER, MEIER-BROOK and OSTERMANN 1978). Because of the exceptionally big differences in the shell morphology I consider this "form" as a distinct species (cf. p. 286), though according to DYDUCH-FALNIOWSKA (1983 a) the fine structure of its shell does not differ significantly from that of the typical form. It is worth mentioning that in some lakes, e.g. Grądy Lake in the basin of Wel (Mazurian Lake District) I have observed the typical and the thick-shalled form to occur together. Also PIROGOV and STAROBOGATOV (1974) and DYDUCH-FALNIOWSKA (1983 a) reported the co-occurrence of the two forms (species). It should be stressed that other Polish authors (KASPRZAK 1975, 1982, BERGER and DZIĘCZKOWSKI 1977) had already considered *P. crassum* to be a distinct species.

P. nitidum is an euryoecious species, inhabiting almost all kinds of water reservoirs. Its ecological preferences, however, have not been unambiguously estimated. According to KUIPER (1974 a) the species inhabits most of all small reservoirs with flowing water, according to MEIER-BROOK (1975) it lives mainly in lakes and large rivers, while KASPRZAK (1975) regards it as a species characteristic of the sphaeriids association of running waters. The studies of PIECHOCKI (in press) have shown recently that in the lowlands of Poland *P. nitidum* is found equally often both in running and stagnant waters, old river beds and lakes being its preferred habitats. The species avoids springs and mountain streams and lakes. Also BRAUN (1980) observed that *P. nitidum* does not occur in springs and upper sections of streams.

P. nitidum lives in a variety of substrata, however – according to the experiments of MEIER-BROOK (1969) – it prefers coarse grain sediments. It is also resistant to periodical salinity increase and tolerates relatively well water pollution (KUIPER and WOLFF 1970). In the Alps the vertical distribution of the species reaches 2500 m a.s.l., in lakes it reaches the depth of 25 m (KUIPER 1974a, ELLIS 1978).

Fig. 56. Distribution of *Pisidium nitidum* in Poland. 1, stations localized till 1950 inclusive; 2, after 1950.

A Holarctic species, reaching to the north beyond the Polar Circle (KUIPER and WOLFF 1970).

In Poland *P. nitidum* is common in both lowland and upland regions, while in the mountains – like most sphaeriids – it is found rarely and only at lower altitudes (Fig. 56). Its records are most numerous in Pomerania Lake District, Mazurian Lake District, Wielkopolsko-Kujawska Lowland and Małopolska Upland. In the mountains recorded only from West Sudety Mts., East Sudety Mts. and West Beskidy Mts.

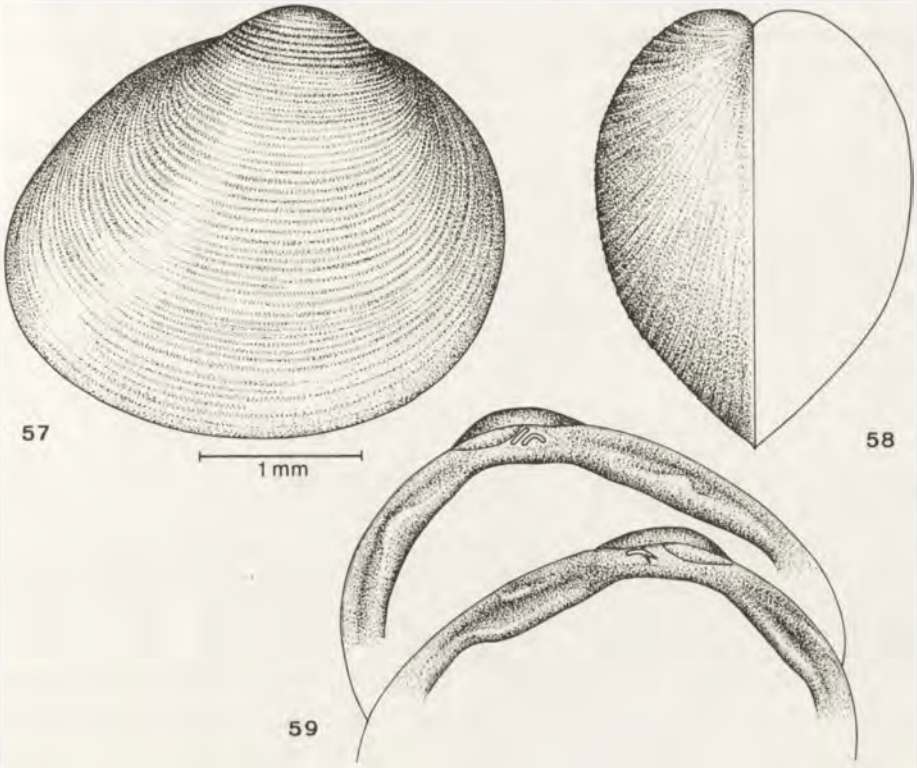
Pisidium crassum STELFOX, 1918

Synonyms: *Pisidium nitidum* var. *crassa* STELFOX, 1918; *P. nitidum* f. *crassa* STELFOX, 1918; *Euglesa crassa* (STELFOX, 1918).

Shell oval or trapezoidal in outline, thus resembling that of *P. nitidum*, but its umbones are narrower and sharper, and the surface is covered with thick striae or

ribs. Shell strongly shiny; embryonic shell bounded by 3–5 incised grooves which because of the strong striation are less visible than those in *P. nitidum* (Figs 57 and 58).

Hinge-plate very thick and strong, distinctly bent in its subapical part. Calcareous material forming the hinge as if "melted" because of which the teeth loose sometimes their sharp outline and are blunt. Cardinal teeth very fine, situated close to the umbones; C_3 bent and thickened at its tip, C_2 hook-like, C_4 situated parallely to the posterior arm of C_2. Ligament pit comparatively very narrow (Fig. 59).



Figs 57–59. *Pisidium crassum*. 57 – Shell in lateral view; 58 – shell in rear view; 59 – interior of upper part of left and right valve.

Dimensions: length 2.4–3.6, height 2.1–3.0, thickness 1.5–2.4.

The variability range in this species, which is often regarded as a variety of *P. nitidum* (see p. 285), requires a more detailed study. *P. crassum* can be sometimes mistaken for *P. pulchellum* or *P. lilljeborgii*. In both cases an exceptionally thick hinge-plate in *P. crassum* is a diagnostic character.

Available data indicate that *P. crassum* is a species characteristic of lakes, though it can be found also in small and medium sized rivers (Piechocki in press). In lakes it occurs in the littoral zone, sometimes descending to upper part of the sublittoral (Kasprzak 1975, 1982, Stadničenko 1984).

Probably a Palearctic species. It has been recorded from many European countries and the USSR (STADNIČENKO 1984).

In Poland it has been found in the Łoniewskie Lake near Leszno (BERGER 1959, 1962), Zbęchy Lake in Krzywińskie Lake District (Wielkopolska) (KASPRZAK 1982), lakes Kwiecko, Kamienne and Bobięcino Wlk. in Western Pomerania (TETENS and ZEISSLER 1964), lake Gardno and the island Wolin (sic!) – in figure explanations (DYDUCH-FALNIOWSKA 1983 a), Konińskie Lakes (BERGER 1959, BERGER and DZIĘCZKOWSKI 1977), river Krutynia in Mazurian Lake District (BERGER 1960, 1962) and Grabia River with its tributaries (PIECHOCKI 1969).

New or hitherto unpublished records:

1. A marsh at Rydzyna near Leszno, leg. SCHADEL, 1917, det. KUIPER, SMF.
2. Lake Gopło near Kruszwica, leg. SCHADEL, 1917, det. KUIPER, SMF.
3. Lake Miedwie, leg. GEYER (No detailed data), SMF.
4. River Piława near Dołgie Lake (basin of Gwda River), ex coll. SCHILCKUM, 1944, SMF.
5. Lake near Morąg (no detailed data), leg. GOLDBACK, 1932, SMF.
6. Lake Koronowskie on Brda River near Zamrzenica, leg. A. PIECHOCKI, 1984.
7. Lake Czos near Mrągowo, leg. A. PIECHOCKI, 1972.
8. Lake Grądy in the basin of Wel River (Mazurian Lake District), leg. A. PIECHOCKI, 1982.
9. Lake Szwałk Wielki near Czerwony Dwór (Mazurian Lake District), leg. A. PIECHOCKI, 1985.
10. River Biebrza near Chwojnowszczyzna, leg. A. PIECHOCKI, 1967.
11. River Nida in Chroberz, leg. A. PIECHOCKI, 1978.

Pisidium obtusale (LAMARCK, 1818)

Synonyms: *Cyclas obtusalis* LAMARCK, 1818; *Pisidium scholtzi* CLESSIN, 1873; *P. obtusalastrum* WOODWARD, 1921.

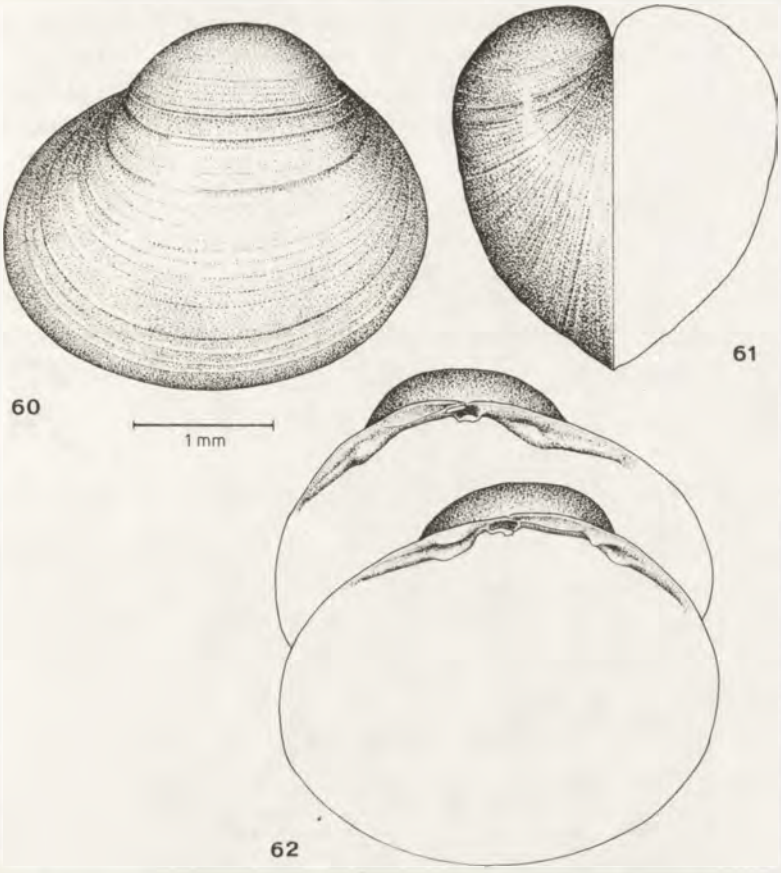
Shell nearly sphaerical, tumid, umbones broad and strongly protruding, somewhat displaced posterad. Dorsal margin very short, passing moderately into the anterior and posterior edges (angles not marked); ventral margin also regularly curved (Figs 60 and 61).

Shell thin, yellowish or horny-brown, distinctly glossy, irregularly striated with stronger lines of periodical growth inhibition. The colour, gloss and sculpture are usually masked by a reddish sediment covering the shells. In inner shell surface numerous pores.

Hinge-plate narrow and very short (!) – the distance between A I and P I 2.5–3 × shorter than the shell. C_3 straight or slightly bent, C_2 and C_4 short, parallel (C_4 displaced posterad) and protruding to the inside of the shell. At the junction of P I and P III a distinct thickening, the so called pseudocallus (!). Ligament pit short and very broad (Fig. 62).

Dimensions: length 2.4–3.5, height 1.9–2.9, thickness 1.5–2.7.

P. obtusale is one of the most variable sphaeriids. Individuals of particular populations can strongly differ in their shell outline, convexity, colour and shape of the umbones. An exceptionally well delimited form, regarded as a subspecies or even a distinct species – *P. obtusale lapponicum* CLESS. – is characterized by a small size and very strongly protruding umbones. This form occurred in Central Europe (and



Figs 60–62. *Pisidium obtusale*. 60 – Shell in lateral view; 61 – shell in rear view; 62 – left and right valve.

in Poland) during cold phases of Pleistocene. At present it lives only in arctic and subarctic areas (LOŽEK 1964, HOLOPAINEN and KUIPER 1982).

P. obtusale f. *acidicola* STELFOX occurs sometimes in acid waters. Its shell is larger and the hinge weakly developed.

Because of the external similarity *P. obtusale* can be mistaken for *P. personatum*, *P. casertanum* and *P. hibernicum*, with which it often co-occurs in the same reservoirs. It differs from those species in its sphaerical shape and hinge structure (cf. description above).

P. obtusale is a species of small reservoirs, inhabiting mainly marshes, turf pits, flooded meadows, and drainage ditches. It can also be found in the coastal zone of lakes and rivers, as well as in ponds and old river beds (PIECHOCKI 1969 and in press). The species is resistant to dessication which enables it to occur even in ephemeral reservoirs. According to KLIMOWICZ (1959) it can well tolerate even very

low water pH reaching 4–5. In the mountains *P. obtusale* was found sometimes at considerable altitudes, e.g. in Pyrenees above 2000 m a.s.l. (KUIPER 1966). A great role in the dispersal of this species is probably played by birds and aquatic insects.

The distribution range of the species comprises Palearctic (STELFOX, KUIPER, MCMILLAN and MITCHELL 1972).

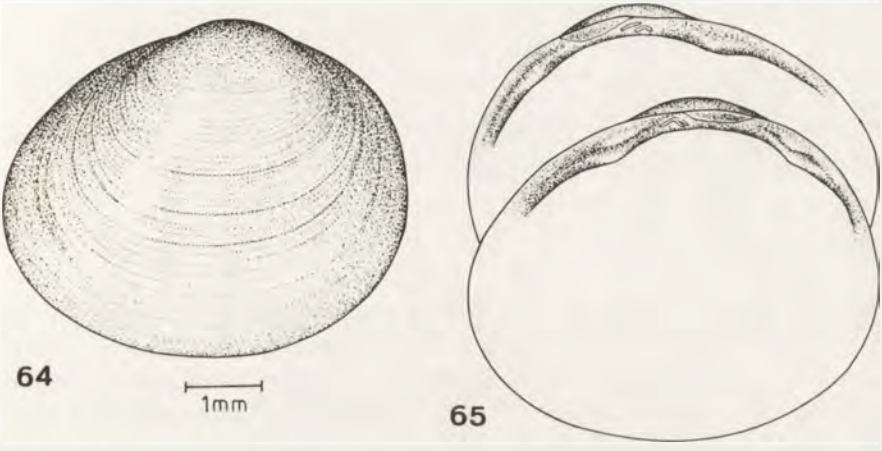
Fig. 63. Distribution of *Pisidium obtusale* in Poland. 1, stations localized till 1950 inclusive; 2, after 1950.

In Poland *P. obtusale* is common in the entire country and has been recorded from nearly all the regions – from the Baltic Coast to the Tatra Mts. The highest situated localities in Poland are Toporowe Stawy in the Tatra Mts. and Gronikowy Stawek on the hill Gubałówka in Podhale (ca. 1100 m a.s.l.) (WIERZEJSKI 1882, MINKIEWICZ 1910, 1914, WOJTUSIAK 1977). The distribution in Poland is presented in Fig. 63.

Pisidium casertanum (POLI, 1791)

Because of its enormous variability range and huge distribution area *P. casertanum* was described under numerous names. The following synonyms are most often found in the European literature: *Cardium casertanum* POLI, 1791; *Pisidium fontinale* C. PFEIFFER, 1821; *P. cinereum* ALDER, 1838; *P. intermedium* GASSIES 1855; *P. fossarinum* CLESSIN, 1873. Comprehensive lists of synonyms have been presented among others by GERMAIN (1931), RICHNOVSZKY and PINTÉR (1979) and KUIPER (1964, 1983).

Shell oval in outline, umbones broad and not very strongly protruding, somewhat displaced posterad (Fig. 64). Shell surface delicately and irregularly striated, usually with distinctly marked ridges of periodical growth inhibition, mat or slightly shiny. Shell colour whitish-yellow, brown or grey-green, often masked by a reddish sediment of iron oxides. Shell walls most often strong and thick.



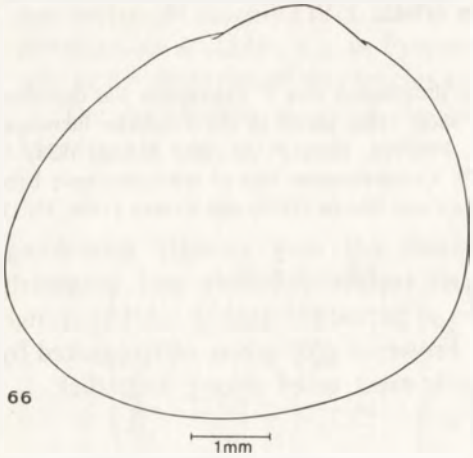
Figs 64 and 65. *Pisidium casertanum*. 64 – Shell in lateral view; 65 – left and right valve.

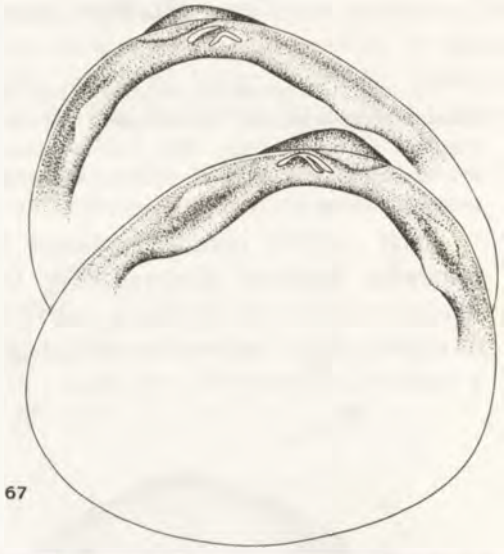
Hinge-plate distinctly marked, sometimes thick; all hinge teeth well developed: C_3 hook-like bent and most often bifurcated in its posterior tip; C_2 hook-shaped, C_4 situated obliquely behind it (usually also bent). Lateral teeth large, especially A I and A II. Ligament pit long and wide. (Fig. 65).

Dimensions: length 3.5–6.5, height 3.0–5.5, thickness 2.0–4.0. *P. casertanum* is one of the largest pisidies; huge specimens can attain size within the lower size limit of *P. amnicum*.

The species is extremely variable, forming many varieties most of which are ecological forms arising under the effect of habitat conditions. In Poland the following forms have been found:

P. casertanum f. *ponderosum* STELFOX (Figs 66 and 67). Shell thick-walled, triangular in outline, provided with a thick hinge-plate on which cardinal and lateral





Figs 66 and 67. *Pisidium casertanum* f. *ponderosum*. 66 — Outline of shell in lateral view; 67 — left and right valve.

teeth are very strongly marked. The form is much similar to large individuals of *P. supinum* from which it differs in the lack of umbonal appendiculae and ribbing. Some authors, e.g. EHRMANN (1933), URBAŃSKI (1957), STAROBOGATOV (1977) regard *P. ponderosum* as a distinct species. This is contradicted by the results of the studies of other malacologists who have found that the form *ponderosum* is connected with the typical form by series of intermediate individuals (KUIPER 1963, PIECHOCKI 1972). The recent studies of DYDUCH-FALNIOWSKA (1983 a) have thrown a new light on the problem. She has found that the specimens with the triangular, thick-walled shells differ distinctly from the typical form in their shell microstructure. On this basis DYDUCH-FALNIOWSKA considers *P. ponderosum* to be a distinct species, suggesting that along with the typical *P. ponderosum* there exist also thick-walled populations of triangular shells, representing an ecological form of *P. casertanum*.

The author's own observations incline him to regard the thick-walled form *ponderosum* as a variety of *P. casertanum* arising under favourable habitat conditions, i.e. waters rich in calcium and food materials. This is evidenced by the fact that it is impossible to distinguish juvenile and medium-sized individuals of f. *ponderosum* from the typical *P. casertanum* which was also stressed by KUIPER (1963), as well as the fact that full grown individuals representing both typical specimens of forms (species?) have never been found to occur together.

P. casertanum f. *ponderosum* occurs in lakes and rivers.

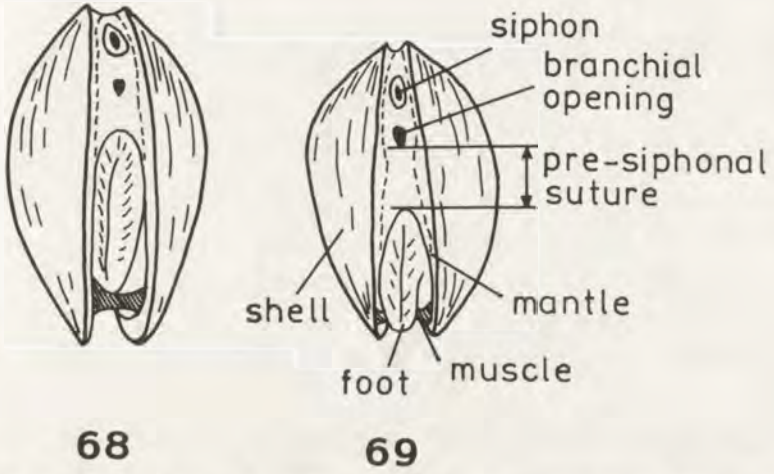
P. casertanum f. *globulare* (CLESSIN). Shell sphaerical, thin-walled, convex with

prominent umbones. It resembles large individuals of *P. obtusale*. The form occurs sometimes in marshy mountain and lowland reservoirs.

P. casertanum f. *humeriforme* (STELFOX). Shell somewhat trapezoidal in outline, flat, thick-walled, with a strong hinge. It occurs in lakes e.g. lake Wigry (FELIKSIAK 1938).

P. casertanum f. *roseum* (SCHOLTZ). A dwarf, thin-walled form, with a reddish hue; described from Karkonosze Mts. (REINHARDT 1874, MERKEL 1894, GEYER 1927).

P. casertanum is sometimes mistaken for *P. subtruncatum* and *P. personatum*. It differs from the first of the two species in a larger incision of the mantle at the place of foot extension and in a different size of the pre-siphonal suture (Figs 68 and 69),



Figs 68 and 69. Foot slit and pre-siphonal suture in *Pisidium casertanum* and *P. subtruncatum*. (After HOLOPAINEN and KUIPER).

in the distinct bend of the cardinal teeth (in *P. subtruncatum* C_2 and C_4 are parallel) and in its umbones being directed upwards (in *P. subtruncatum* they are directed posterad). The presence of callus (thickening) on the hinge-plate is a good character distinguishing *P. personatum* (see p. 303).

P. casertanum is an extremely euryoecious species, inhabiting all kinds of water bodies. Enormous adaptative capabilities of this clam enabled it to colonize large areas and at present it is considered to be the most common and the widest distributed species of freshwater clams (ELLIS 1978).

P. casertanum lives in running and stagnant waters, permanent and ephemeral water bodies and also in brackish waters where it can survive a mean year salinity of ca. 0.3‰ Cl^-; in the mountains it reaches 3600 m a.s.l. (KUIPER and WOLFF 1970). It lives both in shallow, muddy puddles and deep oligotrophic lakes. The density of

this clam can reach many thousands of specimens per 1 m² or in an adequate volume sample (KUIPER 1974 a, PIECHOCKI 1984). The wide distribution of the species is favoured by its resistance to dessication and a comparative resistance to water pollution (KUIPER and WOLFF 1970, HINZ 1972).

A cosmopolitic species, in the Northern Hemisphere however it is much more common that in the Southern one where its range is sometimes disjunct and limited to localities at high altitudes (KUIPER 1983).

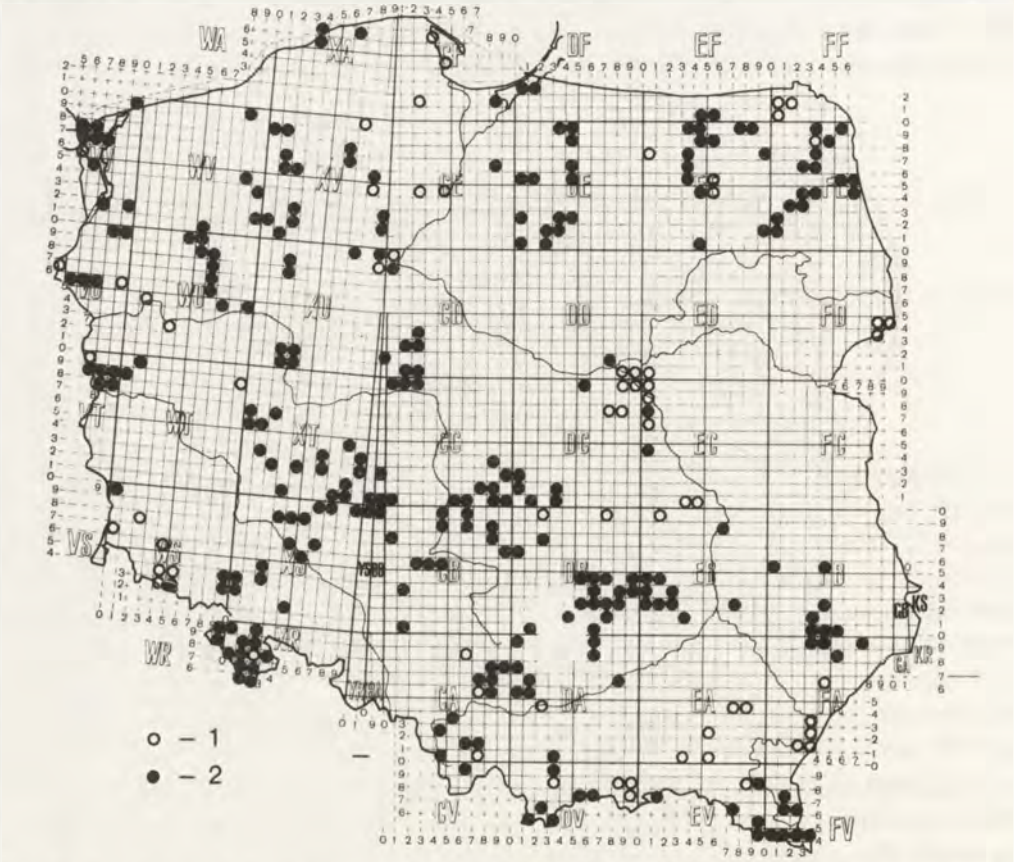


Fig. 70. Distribution of *Pisidium casertanum* in Poland. 1, stations localized till 1950 inclusive; 2, after 1950.

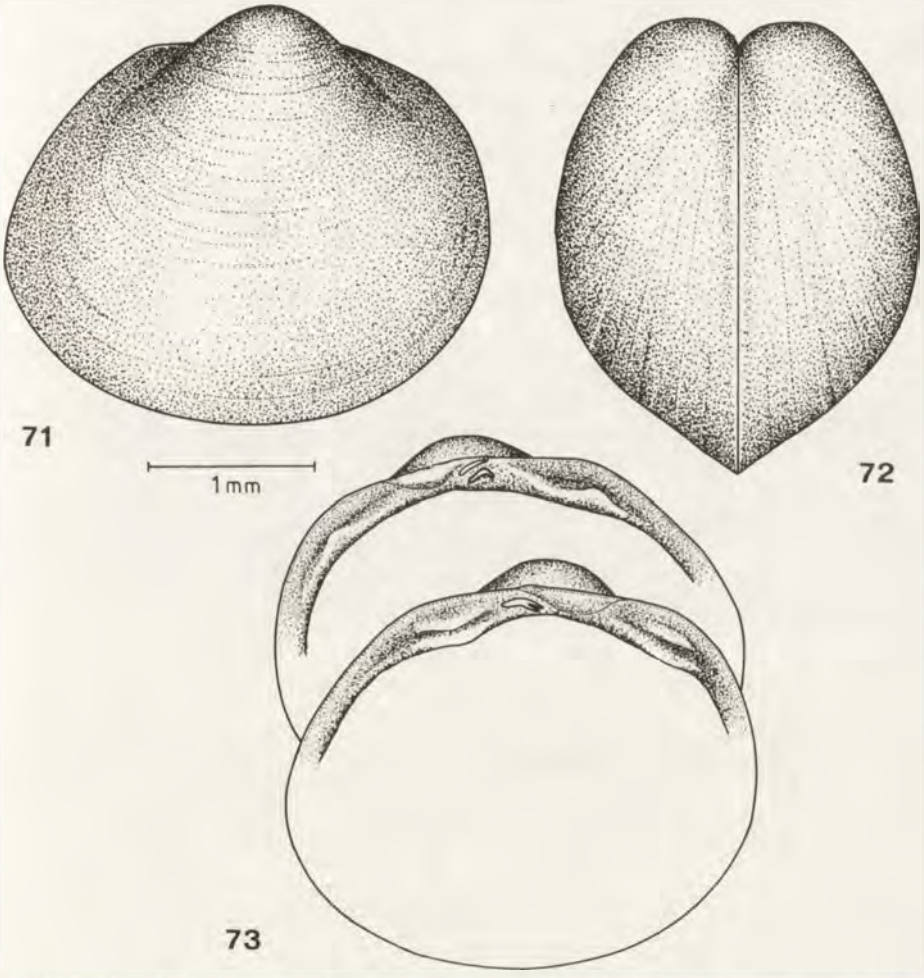
In Poland *P. casertanum* is one of the most common species of the *Sphaeriidae*. In lowland reservoirs it is rivaled in frequency of occurrence by *P. subtruncatum* and *Sphaerium corneum*, while in mountain waters it is undoubtly the most frequent and abundant species (PIECHOCKI in press). The records of this clam are known from the entire area of lowland, upland and montane Poland – from Sudety Mts. to

Bieszczady Mts. In the Tatra Mts. it occurs e.g. in Morskie Oko (1393 m a.s.l.) and in Zadni Staw in Dolina Pięciu Stawów Polskich (1890 m a.s.l.). Its distribution is presented in Fig. 70.

Pisidium hibernicum WESTERLUND, 1894

Synonym: *Pisidium parvulum* CLESSIN, 1873 (in WESTERLUND).

Shell oval, tumid, umbones narrow and strongly protruding situated in the mid part of the shell (Figs 71 and 72). At the junction of the dorsal margin into anterior and posterior margin rounded angles can be marked. Anterior part of the shell



Figs 71–73. *Pisidium hibernicum*. 71 – Shell in lateral view; 72 – shell in rear view; 73 – left and right valve.

somewhat elongate. Shell surface smooth or very delicately striated, mat shiny, its colour yellowish.

Hinge-plate short and not very wide, usually narrowed in its subapical part. Cardinal teeth not very long, C_2 and C_4 almost parallel. Ligament pit wide and rather short (Fig. 73).

Dimensions: length 2.0–3.2, height 2.0–2.7, thickness 1.4–2.0. Exceptionally very large individuals are found exceeding 5 mm in length (KUIPER 1974 a).

The variability range of the species is rather wide. Even within the same population individuals can occur that are fairly diversified with respect to their convexity, degree of the development of angles and shape of the hinge-plate. However – due to the protruding umbones – *P. hibernicum* is usually easy to distinguish from other *Pisidium*-species. It is most easily mistaken for *P. obtusale*, but the latter has a very short hinge-plate and a pseudocallus on the right valve (see p. 288).

Fig. 74. Distribution of *Pisidium hibernicum* in Poland. 1, stations localized till 1950 inclusive; 2, after 1950.

P. hibernicum lives in various kinds of water bodies, though in Poland it is most often found in lakes, turf pits and rivers (PIECHOCKI in press). In the lakes it inhabits mainly the littoral. It appears that the species is little sensitive to changes on environmental factors (temperature, pH, calcium, changes in water level), due to which it can occur also under severe climatic conditions, e.g. in high mountains. The vertical range of the species in the Alps reaches 2760 m a.s.l. (ZEISSLER 1971).

A Palearctic species with boreo-alpine distribution (PIECHOCKI 1981).

In Poland *P. hibernicum* was regarded as one of the rarest and least known species (URBAŃSKI 1947). However, within the last years many new localities of this clam have been described from both lowland and upland part of the country (BERGER 1959, 1960, 1961, JAECKEL 1962, TETENS and ZEISSLER 1964, PIECHOCKI 1969, 1972, 1981, BERGER and DZIĘCZKOWSKI 1977, DYDUCH-FALNIOWSKA 1983 b).

New or hitherto unpublished localities:

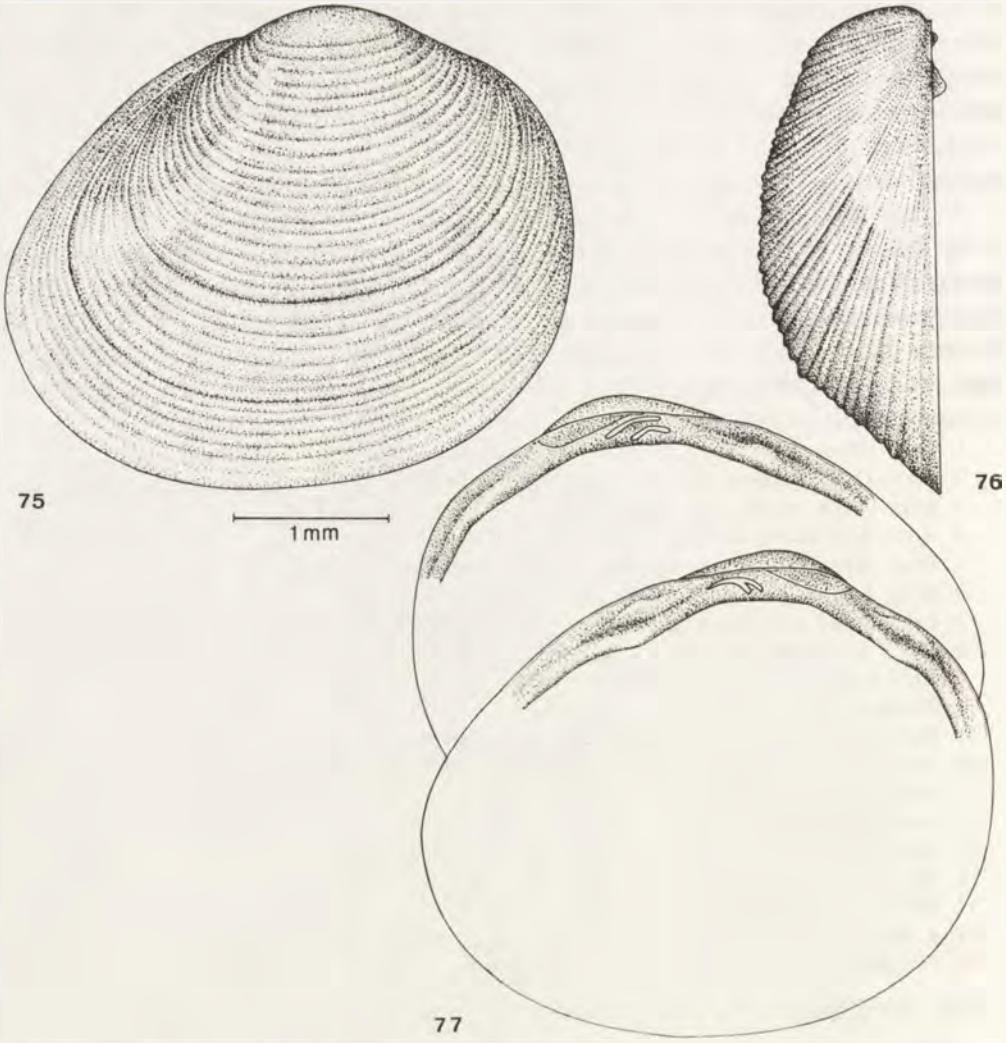
1. Lake Dzierzgoń near Prabuty, leg. E. ZULEWSKA, 1983, det. A. PIECHOCKI.
2. River Gwda between the lakes Studnica and Wierzchowo, leg. A. PIECHOCKI, 1981.
3. Lake Dołgie on the river Piława (basin of Gwda River), leg. A. PIECHOCKI, 1983.
4. River Brda above the lake Płęsno, leg. A. PIECHOCKI, 1984.
5. River Biebrza 7 km below Lipsk – Błoto Biebrzańskie, leg. A. PIECHOCKI, 1967.
6. River Biebrza near Rogożyniec, leg. A. PIECHOCKI, 1967.
7. Lake Blizno near Ateny (Suwalskie Lake District), leg. A. PIECHOCKI, 1982.
8. River Blizna 300 m above the lake Blizno, leg. A. PIECHOCKI, 1982.
9. Lake Łażno near Czerwony Dwór (Mazurian Lake District), leg. A. PIECHOCKI, 1979.
10. Wolbórka River at Wola Kutowa (Central Poland), leg. I. ZARZYŃSKA, 1983, det. A. PIECHOCKI.
11. Peat bog in Modlica near Łódź, leg. A. PIECHOCKI, 1967.
12. Wieprz River in Żurawnica, leg. C. ŁUCZAK, 1986, det. A. PIECHOCKI.
13. Mostowe Błoto near the mouth of the Reda River, leg. T. JACZEWSKI, 1935, IZ PAN.
14. Lake Hańcza (Suwalskie Lake District), leg. S. FELIKSIAK, 1935, IZ PAN.
15. Lake Wigry near Leszczówek, leg. S. FELIKSIAK, 1935, IZ PAN.
16. Drawa River near Zatom, leg. SCHMIERER, 1943, SMF.
17. Old bed of the Odra River in Opole, leg. A. TETENS, SMF.
18. A marsh near the village Pilce near Kamieniec Ząbkowicki (Lower Silesia), coll. JETSCHIN, SMF.
19. Neighbourhood of Koźle (no detailed data), leg. W. BAU, 1941, SMF.

The distribution of *P. hibernicum* in Poland is presented in Fig. 74.

Pisidium pulchellum JENYNS, 1832

Shell broad oval in outline, umbones displaced posterad which makes the posterior shell part distinctly truncated. Dorsal margin short, passing moderately into the anterior and posterior edge (sometimes weakly marked angles in those places). Ventral margin strongly curved, especially at its junction with the anterior margin (Figs 75 and 76). Shell surface strongly and regularly ribbed (!), distinctly shiny or even irridescent; between ribs fine pores visible.

Hinge-plate strong; C_3 bent and thickened at its posterior end (sometimes bifurcated), C_2 and C_4 parallel, C_4 being distinctly longer. Ligament pit wide (Fig. 77).



Figs 75–77. *Pisidium pulchellum*. 75 – Shell in lateral view; 76 – rear view of left valve; 77 – left and right valve.

Dimensions: length 3.2–4.0, height 2.7–3.5, thickness 2.0–2.8.

The species is little variable and because of its strong ribbing and the hinge structure usually easy to distinguish from other *Pisidium*-species. It is most often mistaken for *P. crassum* from which it differs in the umbones displaced strongly posterad, in its more distinct ribbing and thiner hinge-plate (see also p. 286).

The species is characteristic of reservoirs remaining after turf excavation and small (clean!) currents of muddy bottom. It occurs also in ponds, marshes, coastal zone of lakes, old river beds and flooded meadows (PIECHOCKI 1969 and in press). It

lives at small depths, usually in muddy sediments. The clam is sensitive to the pollution of water with municipal sewage (STADNIČENKO 1984). The high demands of the species with respect to the quality of water and the progressing drainage render it threatened with extinction.

The distribution area of *P. pulchellum* comprises countries of north, west and central Europe as well as large areas in the U.S.S.R. (ELLIS 1978, STADNIČENKO 1984).

In Poland *P. pulchellum* is known from many localities scattered over the area of the Pomeranian Lake District and Wielkopolsko-Kujawska Lowland (SCHUMANN 1887, 1905, BOETTGER 1926 a, JAECKEL 1955, 1962, BERGER 1961, TETENS and ZEISSLER 1964), Mazurian Lake District (BERGER 1960, 1962), Białowieża Forest (GEYER 1917, FELIKSIAK 1938), Mazowiecka Lowland (JANKOWSKI 1933), Małopolska Upland (PIECHOCKI 1969) and Sandomierska Lowland (DYDUCH-FALNIOWSKA 1983 b). The record of PIECHOCKI (1981) from the basin of Nida has been based on

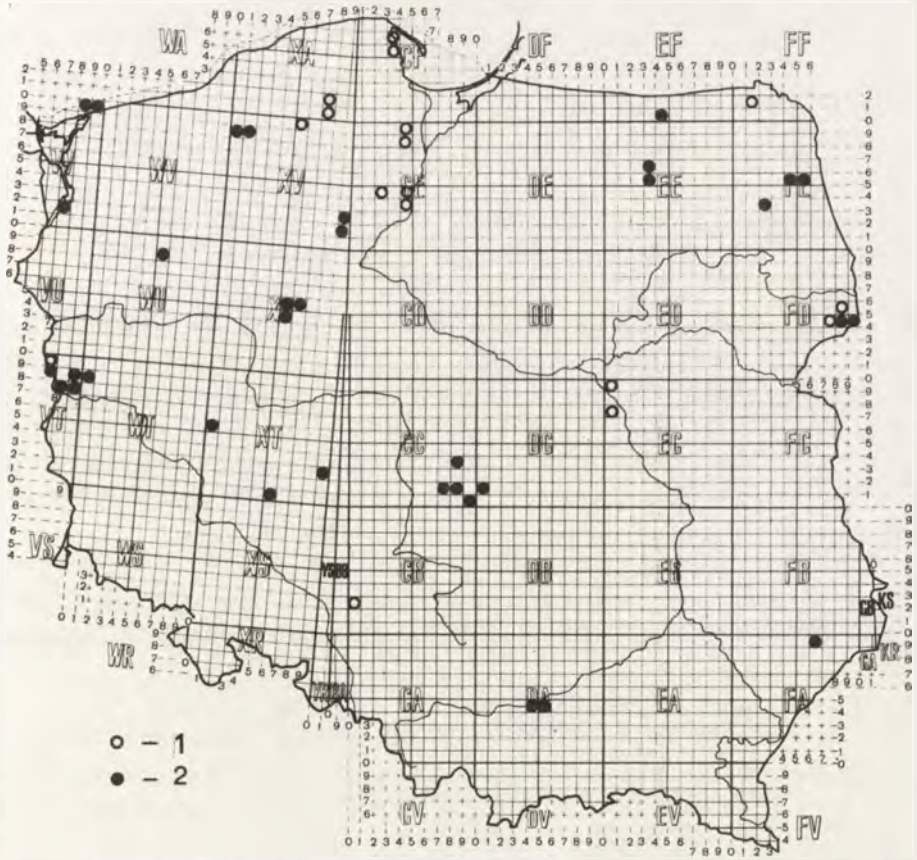


Fig. 78. Distribution of *Pisidium pulchellum* in Poland. 1, stations localized till 1950 inclusive; 2, after 1950.

other species. The specimens collected in the river Nida in Chroberz were actually *P. crassum*, those coming from Łośna River were atypical *P. subtruncatum*. Also information of GOLDFUSS (1895) on the occurrence of this clam near Wleń in Lower Silesia needs a correction since SCHMIERER (1939) showed that the sample concerned contained actually specimens of *P. subtruncatum* and *P. casertanum*.

New or hitherto unpublished localities:

1. Lake Koronowskie on the Brda River, bay near Pieczyska, leg. A. PIECHOCKI, 1984.
2. Błoto Biebrzańskie, 7 km below Lipsk, leg. A. PIECHOCKI, 1967.
3. River Biebrza naer Małowisty, leg. A. PIECHOCKI, 1967.
4. River Biebrza near Dolistowo, leg. A. PIECHOCKI, 1967.
5. River Pliszka, 6 km below the village Kosobudki, leg. A. PIECHOCKI, 1972.
6. River Orłówka 1 km above its outlet to Narewka River (Białowieża Forest), leg. J. SICIŃSKI, 1982, det. A. PIECHOCKI.
7. A small reservoir overgrown with vegetation in Prusianowice near Lutomiersk (vicinity of Łódź), leg. H. JAKUBOWSKI, 1967, det. A. PIECHOCKI.
8. Muddy, upper section of the river Wieprz at Tarnawatka, leg. C. ŁUCZAK, 1986, det. A. PIECHOCKI.
9. A ditch in a peat land at the mouth of Reda River, leg. T. JACZEWSKI, 1935, IZ PAN.
10. Lake Hańcza (Suwalskie Lake District), a strip of reeds and a ditch discharging to the lake, leg. S. FELIKSIAK, 1935, IZ PAN.
11. Turf-pit in Zacisze near Warsaw, leg. S. FELIKSIAK, 1933, 1937, BANULSKI, 1937, IZ PAN.
12. River Drawa near Zatom, leg. SCHMIERER, 1943, ZMB.

The distribution of *P. pulchellum* in Poland is presented in Fig. 78.

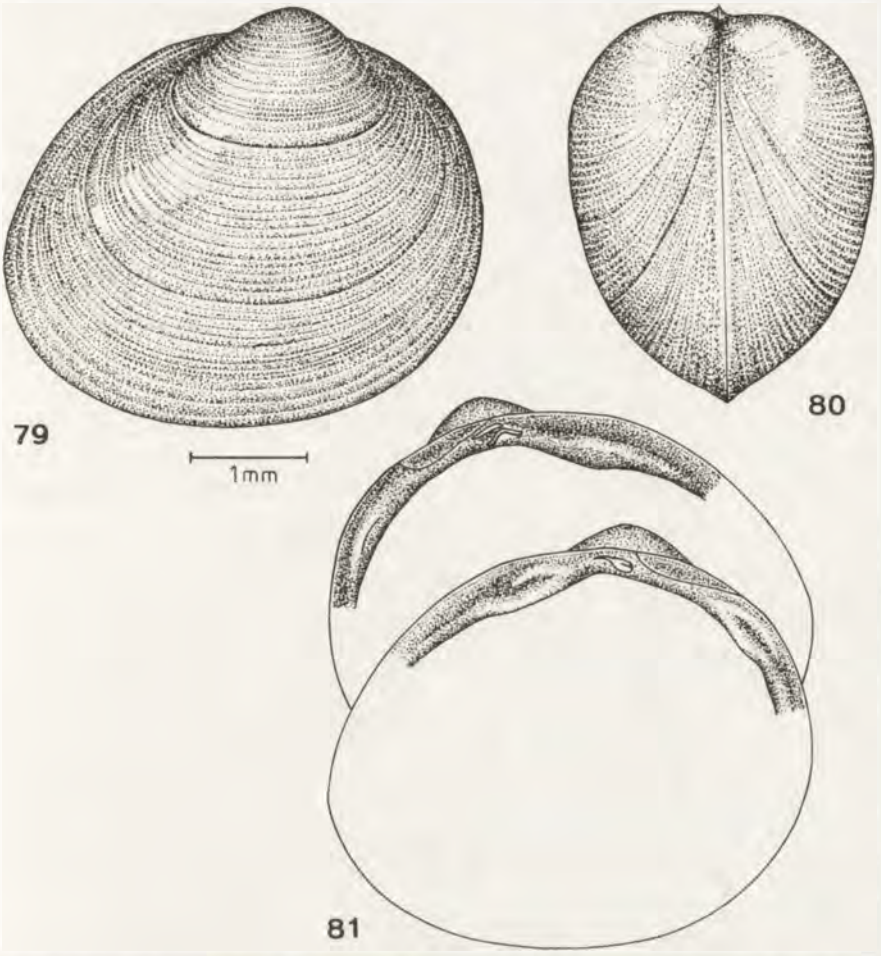
Pisidium lilljeborgii CLESSIN, 1886

Shell circular-oval in outline or sometimes trapezoidal with rounded angles. Umbones comparatively narrow but distinctly protruding above the dorsal margin which is short. Angles can be marked at the junction of the dorsal with the anterior and posterior margin (!). Ventral margin usually regularly rounded, though sometimes it also forms angles at its junction with the anterior and posterior margin (Figs 79 and 80). Shell surface usually strongly and irregularly striated (sometimes ribbed), slightly shiny, its colour yellowish or yellow-brown.

Hinge-plate strong, bent in the middle. C_3 most often hook-like, in its posterior part thickened and sometimes incised; C_2 more or less bent, C_4 straight, situated above C_2 and as if touching it; P I and P III convergent anterad (!). Ligament pit long and narrow (Fig. 81).

Dimension: length 3.5–4.6, height 3.0–4.4, thickness 2.3–3.3.

The variablity in *P. lilljeborgii* consists in differences in the general outline of the shell and its external sculpture. For instance, populations from eastern Pyrenees (lakes in the massif of Carlit) have spherical-oval shells, covered with irregular ribbing, while the clams from the Central European Lowland are trapezoidal and their surface is striated. Specimens collected in the lake Miedwie near Szczecin are an example of the latter form.



Figs 79–81. *Pisidium lilljeborgii*. 79 – Shell in lateral view; 80 – shell in rear view; 81 – left and right valve.

In the populations of *P. lilljeborgii* sometimes specimens with umbonal appendiculae are found (var. *cristata* STERKI) which can be difficult to distinguish from *P. henslowanum*. On the other hand, *P. lilljeborgii* f. *constricta* KUIPER has been also described from quaternary deposits in Northern Ireland. This form is characterized by an obliquely truncated and little convex shell (STELFOX, KUIPER, MCMILLAN and MITCHELL 1972). The form resembles *P. henslowanum* f. *distans* (see p. 272).

P. lilljeborgii is a lacustrine species associated mostly with the littoral zone. It lives in clean, oligotrophic or mesotrophic lakes in sandy and sandy-muddy sediments. It occurs usually on the bottom devoid of vegetation, though it can be also found among macrophytes (COMBES, KUIPER and DE STEFANO 1971). Experiments of MEIER-BROOK (1969) showed that *P. lilljeborgii* prefers fine grain

sediments of a grain diameter below 0.5 mm and leads an active life embedded below the sediment surface. The species has low demands with respect to the presence of calcium in water (MEIER-BROOK 1963). Contrary to the suppositions of former authors, *P. lilljeborgii* occurs mainly in shallow waters and the depth reached by the clam in lakes does not exceed 25 m; its vertical range is the largest in the Pyrenees – up to 2300 m a.s.l. (KUIPER 1974 a). It is sometimes found also in running waters (DANCE 1970, PIECHOCKI 1985). The clam can reach considerable densities.

A Holarctic species with boreo-alpine distribution. In Europe it occurs in Scandinavia, Finland, Great Britain, Ireland, France, Switzerland, Austria, northern Italy, northern Germany, Poland, Baltic countries and northern part of the U.S.S.R (KUIPER 1966, ELLIS 1978, PIECHOCKI 1985). In the arctic and high mountain lakes it is usually the dominating species.

In Poland *P. lilljeborgii* is at present one of the rarest and the least known *Pisidium*-species. Only the following localities have been described to date: lake Wigry, lake Raduń near Wałcz, lake Miedwie, lake Kamienne and lake Bobięcino

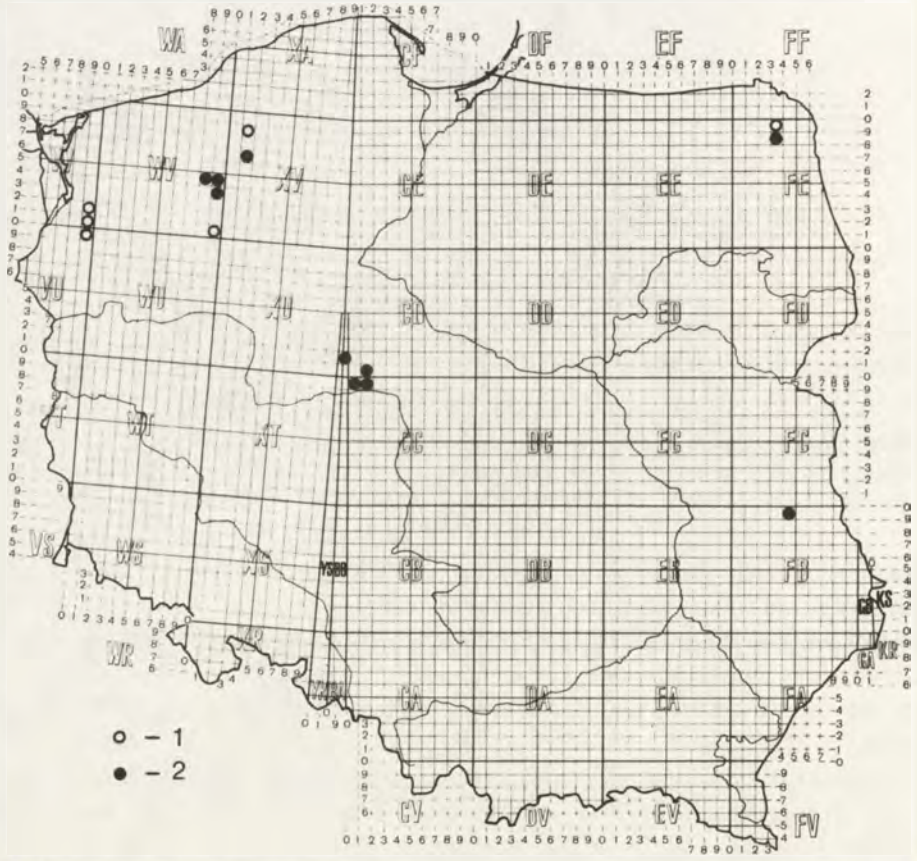


Fig. 82. Distribution of *Pisidium lilljeborgii* in Poland. 1, stations localized till 1950 inclusive; 2, after 1950.

Wielkie near Miastko, river Gwda between the lakes Studnica and Wierzchowo, lake Komorze, lake Strzeszyno (basin of Piława River), lakes Gosławickie and Ślesińskie (Wielkopolsko-Kujawska Lowland) (POLIŃSKI 1928, FELIKSIAK 1938, JAECKEL 1950, TETENS and ZEISSLER 1964, BERGER and DZIĘCZKOWSKI 1977, PIECHOCKI 1985). Besides, the species has been recorded from quaternary deposits in many localities.

New localities:

1. Lake Piaseczno in Łęczyńsko-Włodawskie Lake District, littoral, leg. W. ZWOLSKI, 1985, det. A. PIECHOCKI.
2. Lake Budziszewskie near Anastazewo (Wielkopolsko-Kujawska Lowland), sandy littoral at northern shore, leg. A. PIECHOCKI, 1985.
3. Lake Blizno near Ateny (Suwalskie Lake District), sandy littoral at southern shore, leg. A. PIECHOCKI, 1982.

P. lilljeborgii in Poland is probably an early postglacial relict; its recent distribution is presented in Fig. 82.

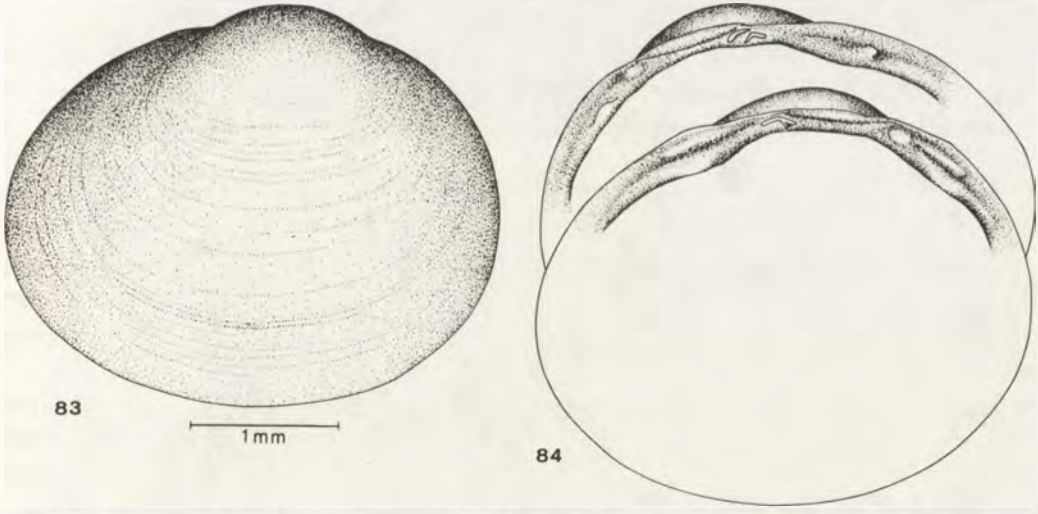
Pisidium personatum MALM, 1855

Synonyms: *Pisidium pusillum* CLESSIN, 1871; *P. bulgaricum* ODHNER, 1929.

Shell irregularly oval in outline, comparatively flat, umbones broad and weakly protruding situated in its mid part (Fig. 83). At the junction of the dorsal with the anterior and posterior margins angles can be marked.

Shell surface mat shiny, very delicately and irregularly striated. Periostracum yellow, grey-yellow or brown, its colour often masked by a reddish or black sediment. Shell perforated with canals visible as numerous pores reaching periostracum.

Hinge-plate relatively strongly marked. C_3 bent and thickened at its end, C_2 usually hook-like. C_4 straight and situated obliquely behind it. On the right valve



Figs 83 and 84. *Pisidium personatum*. 83 – Shell in lateral view; 84 – left and right valve.

between P III and the ligament is situated a callus (!). A similar callus can occur on the left valve – between P II and the ligament – though as a rule it is more weakly developed. Ligament pit relatively wide (Fig. 84).

Dimensions: length 3.0–4.0, height 2.5–3.5, thickness 1.6–2.5. The largest specimen described to date had the dimensions: $5.0 \times 4.2 \times 3.5$ mm (KUIPER 1982).

Depending on the habitat conditions the shell outline can vary – from regularly oval to triangular – as well as the hinge. KUIPER (1982) showed that the callus on the right valve undergoes a wide variability. It can be distinctly separated from P III, united with it, and sometimes it can even disappear. The shape of the callus also varies. The above differences can not, however, serve as a base for distinguishing subspecies or varieties within *P. personatum*.

Due to the presence of the callus *P. personatum* is usually easy to distinguish from other *Pisidium*-species. Individuals with poorly marked callus can resemble *P. obtusale* though the latter species has its hinge-plate strongly shortened and

Fig. 85. Distribution of *Pisidium personatum* in Poland. 1, stations localized till 1950 inclusive; 2, after 1950.

a distinctly shiny shell (see p. 288). In its general shape *P. personatum* somewhat resembles *P. casertanum*.

P. personatum is a typical inhabitant of cold springs. It lives also in helocrene marshes, wells, in the marginal zone of mountain rivers and streams, marsh reservoirs, drainage ditches supplied with ground water and at muddy banks of lowland rivers (PIECHOCKI in press). It often occurs also in the profundal zone of lakes (KUIPER 1982). In the Alps it reaches 2500 m a.s.l. (KUIPER 1974 a). In streams it reaches usually the headwaters being there one of the dominating species (PIECHOCKI 1984). JACKIEWICZ (1962) found *P. personatum* in humid land habitats near waters. The density of *P. personatum* is usually considerable.

The distribution range of the species comprises Europe, Asia Minor and the coast of North Africa (KUIPER 1982).

According to URBAŃSKI (1947) *P. personatum* was one of the rarest *Pisidium*-clams in Poland. Later studies showed that the species is common in our country and is distributed from the Baltic Coast to West Sudety Mts., Tatra Mts., Pieniny Mts. and Bieszczady Mts. (Fig. 85). Its records from the mountains, submontane areas and Wielkopolsko-Kujawska Lowland are most numerous. Some of the localities are situated at considerable altitudes, e.g. in Sudety Mts. – 750 m, in the Tatra Mts. – 1000 m (and probably higher), in the Pieniny Mts. – 585 m, and in the Bieszczady Mts. 500–700 m (WIKTOR 1964 and own data). Most mountain localities are seepages of spring waters and muddy banks of the streams. A very interesting locality of *P. personatum* has been described from Ołdrzychowice near Kłodzko where the clam occurs in sulphuric springs (TISCHBIEREK 1939). At mountain localities it usually co-occurs with *P. casertanum* for which it is often mistaken.

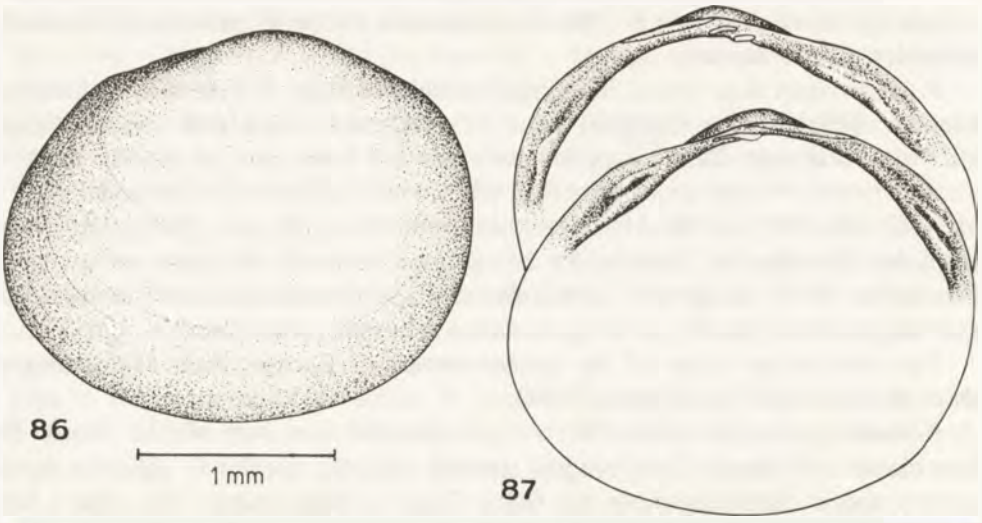
Pisidium conventus CLESSIN, 1877

Synonyms: *Pisidium urinator* CLESSIN, 1876; *P. abyssorum* STERKI, 1898; *P. clessini* SURBECK, 1899; *P. tornense* ODHNER, 1908.

Shell small, rhomboidal or oval-rhomboidal in outline, weakly convex, very delicate and fragile. Umbones flat and broad, situated more or less in the mid part of the shell. Anterior and posterior shell margins roughly parallel and obliquely directed anterad. At the junction of the dorsal with the anterior and also posterior margins angles are marked (Fig. 86). Shell surface delicately and irregularly striated, the striae disappearing in the vicinity of the umbones. Under the shell surface and parallel to it run delicate canals. Periostracum yellowish, mat shiny.

Hinge-plate very narrow and long, due to which the cardinal teeth, especially C_3 which is long and thickened at its tip, protrude to the inside of the shell. Lateral teeth lamellate, often poorly developed; A III and P III show a tendency for reduction. Ligament pit very long and narrow (Fig. 87).

Dimensions: length 2.2–3.0, height 1.7–2.2, thickness 1.2–1.5. The largest individuals can exceed 3.0 mm in length.



Figs 86 and 87. *Pisidium conventus*. 86 – Shell in lateral view; 87 – left and right valve.

The variability of the species has been poorly studied. It appears, however, that it is relatively small. *P. conventus* f. *infirmum* PIAGET is a well delimited form occurring at large depths. The form is characterized by a small, rhomboidal shell and a very narrow hinge-plate. The deep water pisidies described unter various names by S. CLESSIN and departing very slightly from the typical form, represented actually *P. conventus* (CASTAGNOLO, FRANCHINI and GIUSTI 1980).

P. conventus can sometimes be mistaken for *P. personatum* from which it differs in the lack of the callus on the hinge-plate (see p. 303). The lack of inhalant (siphonal) aperture and the reduction of the posterior gills are also important diagnostic characters (GLÖER, MEIER-BROOK and OSTERMANN 1978).

P. conventus is a typical lacustrine species, inhabiting mainly the profundal zone. According to most authors the clam is a species prefering high oxygen content and low temperature. This is partly denied by the observations of MEIER-BROOK (1963) who found *P. conventus* under the conditions of a temporary oxygen deficiency in a lake. *P. conventus* can occur in waters of a very low calcium content which probably has an effect on the fragility of its valves and is the reason why it is poorly preserved in deposits (MEIER-BROOK 1975).

The vertical range of the species reaches 2000 m a.s.l. In lakes it can occur at considerable depth e.g. Lago Maggiore – 350 m, Leman Lake – 300 m (KUIPER 1974 a).

A Holarctic species whose range comprises a large part of North America, Europe and partly Siberia. Most localities in Europe are situated in the area of Fennoscandia, in the British Isles, at the foot of Alps, which suggests a northern – prealpine distribution (KUIPER 1974 b). In many papers there exists an opinion that *P. conventus* is a glacial relict. According to KUIPER (1974 b) localities situated

outside the main distribution range originated due to water birds which easily transport pisidies clinging to their feathers and legs.

In Poland it is one of the rarest and poorest known species. The following localities are known at present:

1. Lake Wigry near Powały, depth 25 m (FELIKSIAK 1938).
2. Lake Tałtowiska near Mikołajki (Mazurian Lake District), depth 30 m (BERGER 1960).
3. Lake Babięty at Rybno near Szczytno (Mazurian Lake District), depth 53 m (BERGER 1960).
4. Lake Miedwie near Szczecin (Pomerania Lake District) (KUIPER 1974 b).

New locality:

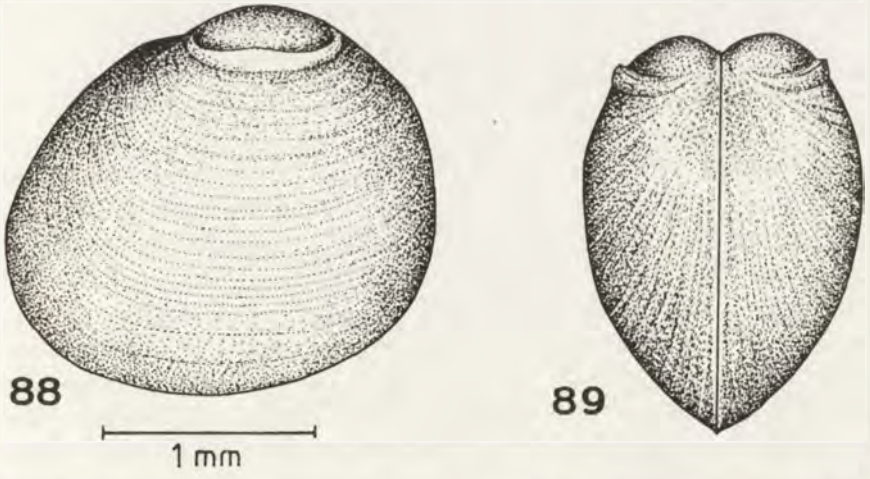
1. Lake Wigierki Wschodnie (Suwalskie Lake District), depth 36–39 m, leg. A. LITYŃSKI, 1926, det. A. PIECHOCKI, IZ PAN.

It can be supposed that a detailed study on the profundal of the Pomeranian and Mazurian lakes should reveal new localities of *P. conventus*.

Pisidium moitessierianum PALADILHE, 1866

Synonyms: *Pisidium punctatum* STERKI, 1895; *P. parvulum* WOODWARD, 1913; *P. torquatum* STELFOX, 1918.

Shell triangular in outline, small and usually strongly convex, provided with umbonal appendiculae which form collar-like thickenings and run parallely to the growth ridges. Umbones prominent, displaced posterad. At the junction of the dorsal with the posterior and anterior margin angles marked, which gives the shell a pentagonal outline (together with umbones) (Figs. 88 and 89). Shell thick-walled, strong, covered with delicate ribs which disappear toward the umbones, colour white-yellow.



Figs 88 and 89. *Pisidium moitessierianum*. 88 – Shell in lateral view; 89 – shell in rear view.

Hinge-plate very thick, strongly arched with distinct lateral teeth (especially A I and P I). C_3 bent downwards, thickened at its end and often incised; C_2 and C_4 short and usually bent. Ligament pit short and rather wide (Fig. 90).

Dimensions: length 1.5–2.2, height 1.4–2.1, thickness 1.0–1.8.

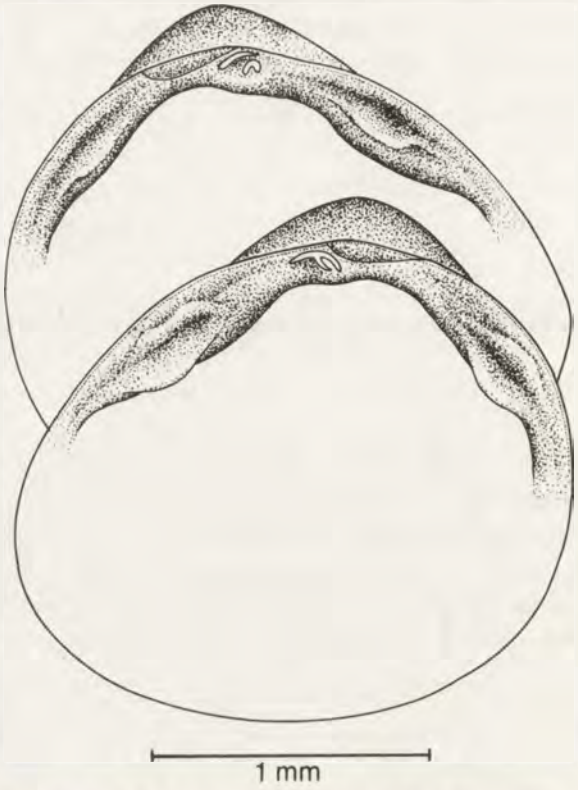


Fig. 90. Left and right valve of *Pisidium moitessierianum*.

The shell outline and the ribbing are variable. *P. moitessierianum* can be mistaken for juvenile *P. supinum*, it differs, however, in the stronger shell convexity, a different position of the umbonal appendiculae, comparatively much thicker hinge-plate and a distinctly "full grown" shape combined with the small size.

P. moitessierianum occurs in large and small rivers and lakes. Its optimum conditions are met in slow flowing sections of rivers, where the bottom is covered with fine sand, silt or clay. In such habitats it reaches sometimes high densities and is a dominant species. This is evidenced by author's own observations (river San near Rzeczpol) and the literature data (JAECKEL 1950, TETENS and ZEISSLER 1964). The studies of BRODNIEWICZ (1960) showed that individuals from fluviatile populations attain larger size than those living in lakes. The studies carried on in many Polish rivers (see below) prove that *P. moitessierianum* can occur in water flows of various

size, and sometimes is very numerous in small streams. The locality in East Beskidy Mts. (San River) indicates, that the clam is not a typically lowland species, contrary to the common opinion (KUIPER and WOLFF 1970, DYDUCH-FALNIOWSKA 1983 a).

In lakes *P. moitessierianum* inhabits the littoral and the sublittoral, only exceptionally descending deeper (20–35 m) (JAECKEL 1962). According to MEIER-BROOK (1975) the clam is a calcicole and in the lakes it inhabits most often the zone of deposition of the shell tanatocenosis. The species is sensitive to water pollution.

Probably a Palearctic species. Its distribution range comprises Europe to the Balcan Peninsula and Asia to the lake Baikal (ELLIS 1978).

In Poland it has been recorded from the Baltic Coast (DYDUCH and FALNIOWSKI 1979), Pomeranian Lake District (JAECKEL 1950, 1962, TETENS and ZEISSLER 1964), Mazurian Lake District (BERGER 1958, 1960, 1962, BRODNIEWICZ 1960, PIECHOCKI

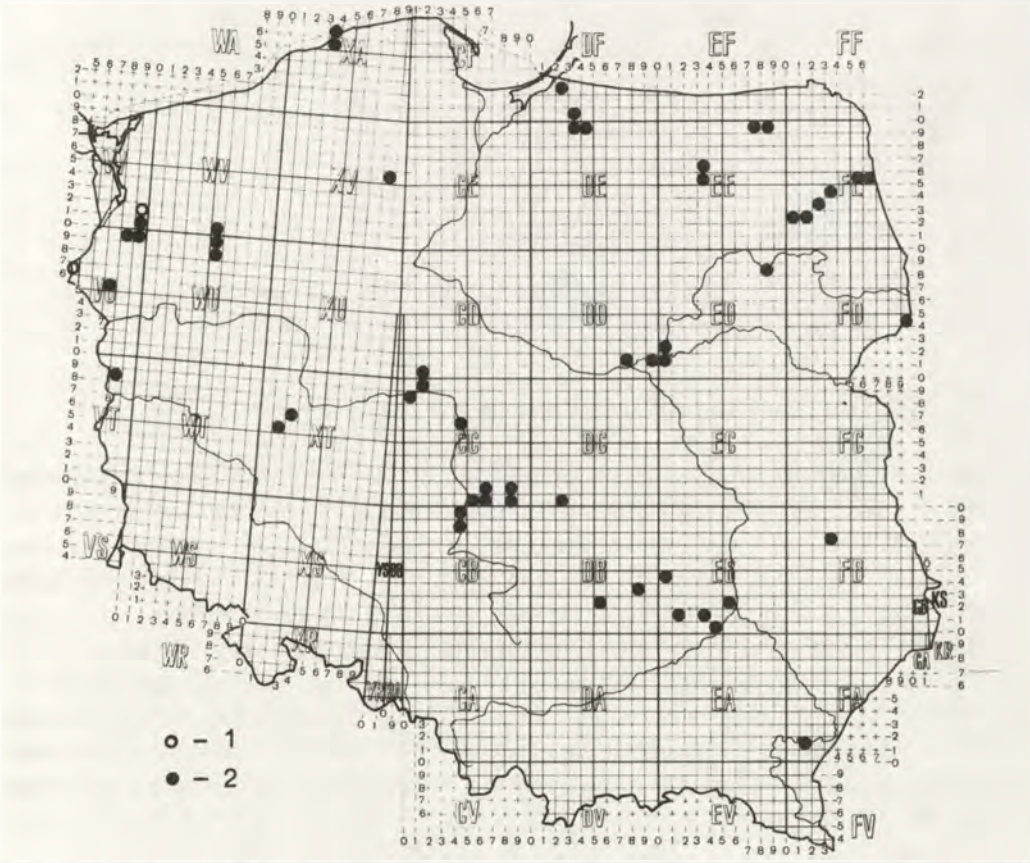


Fig. 91. Distribution of *Pisidium moitessierianum* in Poland. 1, stations localized till 1950 inclusive; 2, after 1950.

1972), Wielkopolsko-Kujawska Lowland (BERGER 1958, 1959, 1961, BERGER and DZIĘCZKOWSKI 1977, TETENS and ZEISSLER 1964, BANASZAK and KASPRZAK 1980), Mazowiecka Lowland (JANSSEN 1980), Małopolska Upland (PIECHOCKI 1969, 1981, 1986, JANSSEN 1980) and Świętokrzyskie Mts. (PIECHOCKI 1981).

New and hitherto unpublished localities:

1. River Brda 1 km above the village Woziwoda, leg. A. PIECHOCKI, 1984,
2. Lake Szwałk Wielki near Czerwony Dwór (Mazurian Lake District), leg. A. PIECHOCKI, 1985.
3. Upper current of the Biebrza River near village Koniuszki, leg. A. PIECHOCKI, 1967.
4. River Biebrza 7 km below Lipsk, leg. A. PIECHOCKI, 1967.
5. River Biebrza between Dwugły and Jagłowo, leg. A. PIECHOCKI, 1967.
6. River Biebrza in Dolistowo, leg. A. PIECHOCKI, 1967; I. MIGAŁOWA, 1977.
7. River Biebrza in Dawidowizna, leg. A. PIECHOCKI, 1967; I. MIGAŁOWA, 1977.
8. River Biebrza in Szafranki, leg. I. MIGAŁOWA, 1977.
9. River Biebrza 3 km below the railway bridge in Osowiec, leg. A. PIECHOCKI, 1967.
10. River Narew 0.5 km below the mouth of Gać River, leg. A. PIECHOCKI, 1967.
11. River Narewka in Białowieża, leg. J. SICIŃSKI, 1981, det. A. PIECHOCKI.
12. River Warta in Konopnica, leg. A. PIECHOCKI, 1964.
13. River Warta in Osjaków, leg. A. PIECHOCKI, 1964.
14. River Widawka near Widawa (Central Poland), leg. A. PIECHOCKI, 1967.
15. Old bed of the river Wolbórka in Zawada (Central Poland), leg. I. ZARZYŃSKA, 1983, det. A. PIECHOCKI.
16. River Koprzywianka in Iwaniska (Sandomierska Upland), leg. A. PIECHOCKI, 1981.
17. River Koprzywianka in Koprzywnica, leg. A. PIECHOCKI, 1981.
18. River Koprzywianka in Andruszkowice, leg. A. PIECHOCKI, 1981.
19. River Wieprz in Milejów, leg. C. ŁUCZAK, 1986, det. A. PIECHOCKI.
20. River San in Rzeczpol, leg. A. PIECHOCKI, 1968.
21. River Odra in Bielinek, leg. SCHMIERER, 1938, ZMB

The distribution of *P. moitessierianum* in Poland is presented in Fig. 91.

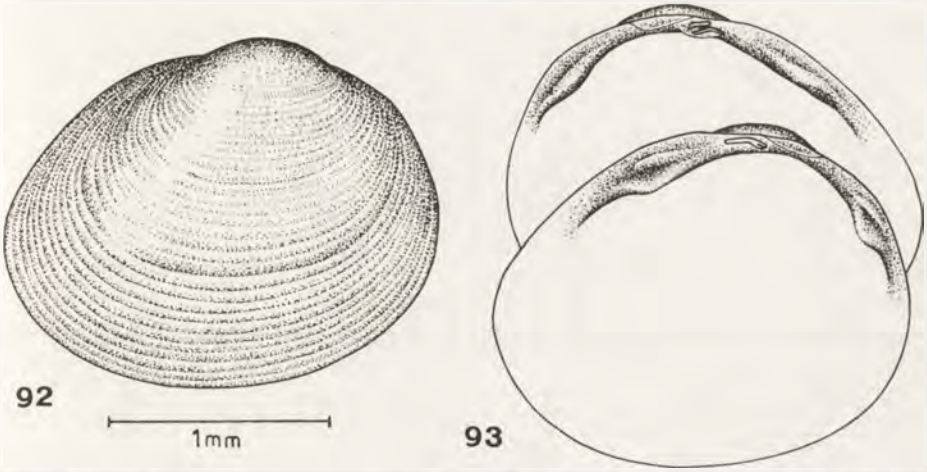
Pisidium tenuilineatum STELFOX, 1918

Shell asymmetrically oval, in its general outline resembling that of *P. subtruncatum* but considerably smaller and with a distinctly marked angle at the junction of the dorsal and anterior margin. Anterior part of the shell tapered, umbones narrow, rather prominent and displaced posterad (Fig. 92). Shell surface covered with delicate and regularly spaced ribs (!), its colour whitish or yellowish.

Hinge-plate bent and narrowed in its mid part, at the same time strongly broadened at is ends (especially in the right valve). Cardinal teeth situated closer to the anterior than to the posterior lateral teeth; C_3 thickened at its end, C_2 and C_4 parallel and often bent. Lateral teeth, especially A I and P I, strongly developed. Ligament pit rather long and strongly widened in its posterior part where it occupies almost the whole breadth of the hinge-plate (Fig. 93).

Dimensions: length 1.7–2.3, height 1.0–2.1, thickness 1.1–1.6.

The outline of the shell can deviate from the above description. It is sometimes more oval with less distinctly marked umbones.



Figs 92 and 93. *Pisidium tenuilineatum*. 92 – Shell in lateral view; 93 – left and right valve.

P. tenuilineatum is sometimes mistaken for *P. subtruncatum tenuilineatiformis* FEL., from which it differs in the presence of ribbing and in the hinge structure (cf. p. 281).

P. tenuilineatum was found in various kinds of running and stagnant waters. However its characteristic habitats are small lowland rivers with fine bottom sediments (PIECHOCKI 1986 and in press). In the flows of this kind the species can be abundant. Until recently the clam was considered to be a typical lowland species, since most European localities were situated below 500 m a.s.l. Only a few years ago a North African locality in the Atlas Mts. in Marocco was discovered, situated at 1700 m a.s.l. (KUIPER 1981 b). A calciphilous species, sensitive to water pollution (TETENS and ZEISSLER 1964, MEIER-BROOK 1975).

The distribution area of *P. tenuilineatum* includes western Palearctic – from Ireland and southern Sweden to the European part of the U.S.S.R., Spain, Marocco, Israel and Jordan (KUIPER 1962 b, 1981 b).

P. tenuilineatum is one of the rarest Polish *Pisidium*-species, however, due to extensive studies in various regions of the country, it has been recorded from many localities. In some of its habitats the clam reaches high densities. For instance, small rivers of the Sandomierska Upland on the loess substratum – Świślina and Opatówka – constitute such a characteristic habitat (PIECHOCKI 1986).

The localities recorded to date are situated in Pomerania Lake District (JAECKEL 1950, TETENS and ZEISSLER 1964), Mazurian Lake District (PIECHOCKI 1972), Wielkopolsko-Kujawska Upland (BERGER 1959, 1961, TETENS and ZEISSLER 1964), in the area of Trzebnickie Hills (BERGER 1961), Krakowsko-Wieluńska Upland (DYDUCH-FALNIOWSKA 1983 b) and Małopolska Upland (PIECHOCKI 1981, 1986).

New localities:

1. River Pliszka below the village Kosobudki (Wielkopolsko-Kujawska Lowland), leg. A. PIECHOCKI, 1972.

Fig. 94. Distribution of *Pisidium tenuilineatum* in Poland; all stations localized or published after 1950.

2. River Blizna 300 m upstream of the lake Blizno (Suwalskie Lake District), leg. A. PIECHOCKI, 1982.
3. River San in Rzeczpol, leg. A. PIECHOCKI, 1968.
4. River Widawka in Kletnia, leg. E. ZAJĄCZKOWSKA, 1975.

The distribution of the species in Poland is presented in Fig. 94.

VI. RESULTS OF THE STUDIES

The clams of the family *Sphaeriidae* in Poland are represented by the following 21 species:

1. (1.) *Sphaerium corneum* (LINNAEUS, 1758)
2. (2.) *Sphaerium solidum* (NORMAND, 1844)
3. (3.) *Sphaerium rivicola* (LAMARCK, 1818)
4. (1.) *Musculium lacustre* (O. F. MÜLLER, 1774)

5. (1.) *Pisidium amnicum* (O. F. MÜLLER, 1774)
6. (2.) *Pisidium henslowanum* (SHEPPARD, 1823)
7. (3.) *Pisidium supinum* A. SCHMIDT, 1851
8. (4.) *Pisidium milium* HELD, 1836
9. (5.) *Pisidium pseudosphaerium* SCHLESCH, 1947
10. (6.) *Pisidium subtruncatum* MALM, 1855
11. (7.) *Pisidium nitidum* JENYNS, 1832
12. (8.) *Pisidium crassum* STELFOX, 1918
13. (9.) *Pisidium obtusale* (LAMARCK, 1818)
14. (10.) *Pisidium casertanum* (POLI, 1791)
15. (11.) *Pisidium hibernicum* WESTERLUND, 1894
16. (12.) *Pisidium pulchellum* JENYNS, 1832
17. (13.) *Pisidium lilljeborgii* CLESSIN, 1886
18. (14.) *Pisidium personatum* MALM, 1855
19. (15.) *Pisidium conventus* CLESSIN, 1877
20. (16.) *Pisidium moitessierianum* PALADILHE, 1866
21. (17.) *Pisidium tenuilineatum* STELFOX, 1918

The studies of PIECHOCKI (in press) on the materials collected in the whole area of Poland and verified by the author have shown that the most common species in the lowland and upland regions are: 1) *Pisidium subtruncatum*, 2) *Sphaerium corneum*, 3) *P. casertanum*, 4) *P. amnicum*, 5) *P. supinum*, 6) *P. henslowanum*, 7) *P. nitidum*.

The rarest species are: 1) *Pisidium conventus*, 2) *P. crassum*, 3) *Sphaerium solidum*, 4) *P. tenuilineatum*, 5) *P. pseudosphaerium*. The remaining of the 21 species inhabiting the lowlands and uplands of Poland represent a moderately frequent element.

In the mountains of Poland (the areas elevated above 500 m a.s.l.) the most frequent and the most abundant species is *Pisidium casertanum*. *P. personatum* is also found there very often (PIECHOCKI in press). Other sphaeriid species are found in the mountains sporadically and usually live at lower altitudes.

Some rare species e.g. *S. solidum* were much more common in Poland quite recently but their distribution area is diminishing as a result of the increasing pollution and eutrophication of the waters (PIECHOCKI 1987). Also other species sensitive to pollution are threatened with extinction — *Pisidium pulchellum*, *P. lilljeborgii*, *P. conventus*, *P. tenuilineatum*.

The sphaeriids of Poland can be divided into five following ecological groups:

1. Euryoecious species: *Sphaerium corneum*, *Pisidium subtruncatum*, *P. nitidum*, *P. milium*, *P. casertanum*, *P. hibernicum*.

2. Fluviatile species: *Sphaerium solidum*, *S. rivicola*, *Pisidium amnicum*, *P. henslowanum*, *P. supinum*, *P. moitessierianum*, *P. tenuilineatum*. Most of the fluviatile species can occur also in lakes, the rivers however are their main habitat (PIECHOCKI in press).

3. Lacustrine species: *Pisidium crassum, P. casertanum* f. *ponderosa, P. lilljeborgii, P. conventus*. Except for *P. conventus* all the species just mentioned are sometimes found also in rivers (see above).

4. Species of small reservoirs (ponds, peat bogs, marshes): *Musculium lacustre, Pisidium pseudosphaerium, P. obtusale, P. pulchellum*.

5. Species inhabiting springs and cold waters: *Pisidium personatum*.

The extremely rich material analyzed during the studies made it possible to estimate the variability range of particular species of the *Sphaeriidae*. The results of these studies inclined the present author to accept the broad species concept, assuming a large variability of the clams under the effect of habitat conditions. Such a species concept is compatible with the view of most contemporary malacologists e.g. J. G. J. Kuiper, C. Meier-Brook and A. E. Ellis. It stands, however, in contradiction with the opinions of the Soviet malacologist who distinguish within the *Sphaeriidae* much more "fine" species. In Poland I have not found *Pisidium*--species described recently from the U.S.S.R. On the contrary, my opinion is that some of the species distinguished by the Soviet malacologists or accepted by them are actually ecological forms of the species known for a long time and occurring also in Poland. It appears that the Soviet specialists attribute too great importance to such characters as the dentition of the hinge-plate, external sculpture or some numerical indices. Such characters, and thus also the indices, undergo extremly large changes — an expression of the enormous variability of the *Sphaeriidae*.

REFERENCES

Banaszak J., Kasprzak K. 1980. Evaluation of occurrence and density of *Oligochaeta, Mollusca* and *Chironomidae* in bottom deposits of lake Zbęchy and in melioration channel within agricultural landscape. Pol. ecol. Stud., Warsaw, **6**: 221–245.

Berger L. 1958. Nowe stanowiska *Pisidium moitessierianum* Paladilhe 1866 (*Bivalvia, Moll.*). Pr. Kom. biol. PTPN, Poznań, **19**: 5–9.

Berger L. 1959. Wyniki wstępnych badań nad groszkówkami (*Pisidium*) Wielkopolski. Przyr. Pol. zach., Poznań, **2**: 279–284.

Berger L. 1960. Badania nad mięczakami (*Mollusca*) Pojezierza Mazurskiego. Bad. fizjogr. Pol. zach., Poznań, **6**: 7–49.

Berger L. 1961. Mięczaki pogranicza Wielkopolski, Śląska i Jury Krakowsko-Wieluńskiej. Pr. Kom. biol. PTPN, Poznań, **25**: 1–124.

Berger L. 1962. Uwagi o rozmieszczeniu małżów *Sphaeriidae* w Krutyni na Pojezierzu Mazurskim. Fragm. faun., Warszawa, **10**: 1–9.

Berger L., Dzięczkowski A. 1977. *Mollusca*. In: Bottom fauna of the heated Konin Lakes. Monografie Fauny Polski, Kraków, **7**: 151–179.

Boettger C. R. 1926 a. Die Weichtierfauna des Gebietes von Frankfurt an der Oder. Helios, Berlin, **29**: 13–45.

Boettger C. R. 1926 b. Die Weichtierfauna der Umgebung von Landsberg an der Warthe. Helios, Berlin, **29**: 46–54.

Braun G. 1980. Zum Vorkommen und zur Verbreitung von Kleinmuscheln im Naturpark "Hoher Vogelsberg". Beitr. Naturkde. Osthessen, Fulda, **16**: 13–37.

BRODNIEWICZ I. 1960. *Pisidium moitessierianum* PALADILHE (*Lamellibranchiata*) i porównanie jego populacji współczesnej z plejstoceńską. Acta paleont. pol., Warszawa, **5**: 349–365.

CASTAGNOLO L., FRANCHINI D., GIUSTI F. 1980. Guide per il riconoscimento delle specie animali delle acque interne italiane. 10. Bivalvi (*Bivalvia*). Verona, 64 pp.

COMBES C., KUIPER J. G. J., DE STEFANO Y. 1971. Ecologie des especes du genre *Pisidium* PF. (Mollusques, *Sphaeriidae*) dans les etangs du Carlit (Pyrenees). Terre et la Vie, Paris, **25**: 96–131.

DANCE S. P. 1970. *Pisidium lilljeborgii* CLESSIN in the River Teifi, West Wales. J. Conch., London, **27**: 177–181.

DYDUCH-FALNIOWSKA A. 1982. Oscillations in density and diversity of *Pisidium* communities in two biotopes in southern Poland. Hydrob. Bull., **16**: 123–132.

DYDUCH-FALNIOWSKA A. 1983 a. Shell microstructure and systematics of *Sphaeriidae* (*Bivalvia, Eulamellibranchiata*). Acta zool. cracov., Kraków, **26**: 251–296.

DYDUCH-FALNIOWSKA A. 1983 b. Age structure of the populations of *Pisidium* species from two localities in southern Poland. Hydrobiol. Bull., 17: 111–117.

DYDUCH-FALNIOWSKA A. 1988. The conchological variability of *Sphaerium corneum* (LINNAEUS, 1758) in the Polish waters. Folia Malacologica, Kraków, **2:** 83–96.

DYDUCH A., FALNIOWSKI A. 1979. Mięczaki jeziora Gardno i konieczność ich ochrony. Ochr. Przyr., Kraków, **42**: 151–182.

EHRMANN P. 1933. Mollusken (Weichtiere). Die Tierwelt Mitteleuropas, **2**, 1. Leipzig, 264 pp., 13 tt.

ELLIS A. E. 1978. British Freshwater Bivalve *Mollusca*. Synopses of the British Fauna (New series), **11**, London, New York, San Francisco, 93 pp, 15 tt.

FAVRE J. 1927. Les Mollusques post-glaciaires et actuels du bassin de Genève. Mém. Soc. Phys. et Hist. nat. Genève, Genève, **40**: 171–434.

FELIKSIAK S. 1938. *Pisidium subtruncatum* MALM v. *tenuilineatiformis* v. n. oraz kilka nowych lub rzadkich dla Polski groszkówek (*Pisidium* C. PFEIFFER). Fragm. faun. Mus. zool. pol., Warszawa, **3**: 485–493.

GERMAIN L. 1931. Mollusques terrestres et fluviatiles (deuxieme partie). Faune de France, **22**. Paris, 893 pp., 26 tt.

GEYER D. 1919. Die Mollusken des Urwaldes von Bialowies. Abh. senckenberg. naturf. Ges., Frankfurt a.M., **37**: 39–67.

GEYER D. 1927. Unsere Land- und Süsswasser-Mollusken. 3 Aufl. Stuttgart, XI + 224 pp., 33 tt.

GLÖER P., MEIER-BROOK C., OSTERMANN O. 1978. Süsswassermollusken. Hamburg. 73 pp.

GOLDFUSS O. 1883. Beitrag zur Mollusken-Fauna Ober-Schlesiens. Nachrbl. dtsch. malakozool. Ges., Frankfurt a.M., **15**: 33–44.

GOLDFUSS O. 1895. Die Molluskenfauna der Umgegend von Lähn in Schlesiens. Nachrbl. dtsch. malakozool. Ges., Frankfurt a.M., **27**: 89–98.

HAZAY J. 1885. Die Mollusken-Fauna der "Hohen Tatra" und über einige Vorkommnisse der nördlichen Karpathen. Jahrb. dtsch. malak. Ges., Frankfurt a.M., **12**: 20–45.

HINZ W. 1972. Siedlungsdichtebestimmung und Trockenresistenzbeobachtung an zwei *Pisidium*-Arten (*Eulamellibranchiata*). Decheniana, Bonn, **125**: 255–258.

HOLOPAINEN J., KUIPER J. G. J. 1982. Notes on the morphometry and anatomy of some *Pisidium* and *Sphaerium* species (*Bivalvia, Sphaeriidae*). Ann. zool. fenn., Helsinki, **19**: 93–107.

JACKIEWICZ M. 1962. Występowanie *Pisidium personatum* MALM (*Mollusca, Bivalvia*) w biotopach lądowych. Ekol. pol. B, Warszawa, **8**: 75–78.

JAECKEL S. 1950. Zur Molluskenfauna der Neumark und Grenzmark. Verh. dtsch. Zool. (in Mainz), Leipzig, **1949**: 84–95.

JAECKEL S. 1955. Die Wassermollusken der Nuthe-Niederung und des Raumes zwischen mittlerer Elbe und Warthe. Abh. Ber. Naturkd. Vorgesch., Magdeburg. **9**: 185–217.

JAECKEL S. 1962. Ergänzungen und Berichtigungen zum rezenten und quartären Vorkommen der mitteleuropäischen Mollusken. Die Tierwelt Mitteleuropas, **2**, 1, Ergänzung. Leipzig, pp. 25–294.

JANKOWSKI A. 1933. Mięczaki Warszawy. Spraw. Kom. fizjogr., Kraków. **67**: 99–114.

JANSSEN A.W. 1980. Report on some samples of land- and freshwater molluscs, collected during

geological fieldwork in Poland and Hungary in 1979. Repport of Rijksmuseum van Geologie en Mineralogie. Leiden, 68, 17 pp.

KASPRZAK K. 1975. Zgrupowania małżów z rodzaju *Pisidium* sensu lato (*Bivalvia*) w różnych typach zbiorników wodnych. Fragm. faun., Warszawa, **20**: 131–141.

KASPRZAK K. 1982. Nowe dane o występowaniu i liczebności *Potamopyrgus jenkinsi* (E. A. SMITH) (*Gastropoda*), *Pisidium ponderosum* STELF. i *Pisidium crassum* STELF. (*Bivalvia*) w Wielkopolsce. Bad. fizjogr. Pol. zach., ser. C, Poznań, **33**: 159–163.

KASPRZAK K. 1986. Role of *Unionidae* and *Sphaeriidae* (*Mollusca, Bivalvia*) in the eutrophic lake Zbęchy and its outflow. Int. Revue ges. Hydrobiol., Leipzig, **71**: 315–334.

KLIMOWICZ H. 1960. Tentative classification of small water bodies on the basis of the differentiation of the molluscan fauna. Pol. Arch. Hydrobiol., Warszawa, **6**, 19 (1959): 85–103.

KUIPER J. G. J. 1962 a. Zur Nomenklatur und Verbreitung von *Pisidium pseudosphaerium*. Arch. Moll., Frankfurt a. M., **91**: 183–189.

KUIPER J. G. J. 1962 b. Systematische Stellung und geographische Verbreitung von *Pisidium tenuilineatum*. Arch. Moll., Frankfurt a. M., **91**: 173–181.

KUIPER J. G. J. 1962 c. Note sur la systematique des pisidies. J. Conch., Paris, **102**: 53–57.

KUIPER J. G. J. 1963. Hauptzüge der Verbreitung des Genus *Pisidium* in Europa. Arch. Moll., Frankfurt a. M., **92**: 247–252.

KUIPER J. G. J. 1964. Kritische Übersicht der in Nord-Afrika lebenden Arten des Genus *Pisidium*. Arch. Moll., Frankfurt a. M., **93**: 127–137.

KUIPER J. G. J. 1965. Familie *Pisidiidae*. In: JANSSEN A. W., VOGEL E. F.: Zoetwatermollusken van Nederland. Den Haag, pp. 95–111.

KUIPER J. G. J. 1966. La distribution des espèces vivantes du genre *Pisidium* C. PF. en France. J. Conch., Paris, **105**: 181–215.

KUIPER J. G. J. 1972. Neue Erkenntnisse über die Verbreitung von *Pisidium pseudosphaerium*. Basteria, Leiden, **36**: 7–20.

KUIPER J. G. J. 1974 a. Die Pisidien der Hochalpengewässer. Arch. Moll., Frankfurt a. M., **104**: 1–27.

KUIPER J. G. J. 1974 b. Een pleistocene vondst van *Pisidium conventus* CLESSIN in Nederland en de huidige geografische verspreiding van deze soort in Europa. Basteria, Leiden, **38**: 27–40.

KUIPER J. G. J. 1981 a. In: *Sphaeriidae* in *Mollusca* and *Insecta*: Comments on proposals to remove the homonymy (3). Bull. zool. Nomencl., London, **38**: 159–161.

KUIPER J. G. J. 1981 b. The distribution of *Pisidium tenuilineatum* STELFOX and *Pisidium annandalei* PRASHAD in the Mediterranean area. Basteria, Leiden, **45**: 79–84.

KUIPER J. G. J. 1982. Zur Frage der geographischen Unterarten bei Pisidien, insbesondere bei *Pisidium personatum* MALM. Arch. Moll., Frankfurt a. M., **112**: 9–19.

KUIPER J. G. J. 1983. The *Sphaeriidae* of Australia. Basteria, Leiden, **47**: 3–52.

KUIPER J. G. J., WOLFF W. J. 1970. The *Mollusca* of the estuarine region of the rivers Rhine, Meuse and Scheldt in relation to the hydrography of the area. III. The genus *Pisidium*. Basteria, Leiden, **34**: 1–42.

LOŽEK V. 1964. Quartärmollusken der Tschechoslowakei. Rozpr. Ústř. úst. geol., Praha, **31**. 374 pp., 32 tt.

MEIER-BROOK C. 1963. Über die Mollusken der Hochschwarzwald- und Hochvogesengewässer. Arch. Hydrobiol., Suppl., Stuttgart, **28**: 1–46.

MEIER-BROOK C. 1969. Substrate relations in some *Pisidium* species (*Eulamellibranchiata*: *Sphaeriidae*). Malacologia, Ann Arbor, Mich., **9**: 121–125.

MEIER-BROOK C. 1975. Der ökologische Indikatorwert mitteleuropäischer *Pisidium*-Arten (*Mollusca, Eulamellibranchiata*). Eiszeitalter u. Gegenwart, Öhringen, **26**: 190–195.

MERKEL E. 1894. Molluskenfauna von Schlesien. Breslau, 293 pp.

MINKIEWICZ S. 1910. Przyczynek do fauny jezior tatrzańskich. Pam. Tow. tatrz., Kraków, **31**: 16–30.

MINKIEWICZ S. 1914. Przegląd fauny jezior tatrzańskich. Spraw. Kom. fizjogr. PAU, Kraków, **48**: 114–137, 5 tt.

MITROPOLSKIJ V. I. 1965. Nabljudenija nad žiznennym ciklom, tempom rosta i sposobnostju k perenes-

jeniju vysyhanija u *Musculium lacustre* (MÜLLER). Ekol. i Biol. presn. Besp. Tr. Inst. Biol. Vnutr. Vod. A. N. SSSR, Moskva–Leningrad, **8**, 11: 118–124.

ODHNER N.H. 1929. Die Molluskenfauna des Tåkern. Sjön Tåkerns Fauna och Flora, Stockholm, **8**: 1–129.

PIECHOCKI A. 1969. Mięczaki (*Mollusca*) rzeki Grabi i jej terenu zalewowego. Fragm. faun., Warszawa, **15**: 111–197.

PIECHOCKI A. 1972. Materiały do poznania mięczaków (*Mollusca*) rzeki Pasłęki. Fragm,. faun., Warszawa, **18**: 121–139.

PIECHOCKI A. 1981. Współczesne i subfosylne mięczaki (*Mollusca*) Gór Świętokrzyskich. Acta Univers. Lodz., Monogr., Łódź, 175 pp., 6 maps.

PIECHOCKI A. 1984. Die Mollusken-Fauna des Breitenbachs und des Rohrwiesenbachs (Schlitzerland/Hessen). Beitr. Naturk. Osthessen, Fulda, **20**: 85–95.

PIECHOCKI A. 1985. Reliktowe stanowiska występowania *Pisidium lilljeborgii* CLESS. (*Bivalvia, Sphaeriidae*) w Polsce. Prz. zool., Wrocław, **29**: 481–486.

PIECHOCKI A. 1986. Studies on *Pisidium* species (*Bivalvia, Sphaeriidae*) of the Polish loess area rivers. Proc. 8th Int. Malac. Congr. Budapest (1983), Budapest, pp. 187–192.

PIECHOCKI A. 1987. Aktualny stan występowania *Sphaerium solidum* (NORMAND) (*Bivalvia, Sphaeriidae*) w Polsce. Prz. zool., Wrocław, **31**: 457–464.

PIECHOCKI A. in press. The *Sphaeriidae* (*Bivalvia, Eulamellibranchia*) of Poland and their ecological preferences. Proc. 9th Int. Malac. Congr., Edinburgh (1986).

PIROGOV V. V. 1972. Krupnye molljuski semejstva *Pisidiidae* v del'te Volgi. Zool. Ž., Moskva, **51**: 1798–1803.

PIROGOV V.V., STAROBOGATOV Ja. I. 1974. Mielkie dvustvorčatye molljuski semejstva *Pisidiidae* il'menja Bol'šoj Karabulak v del'te Volgi. Zool. Ž., Moskva, **53**: 325–337.

REDSHAW E.J., NORRIS A., 1974. *Sphaerium solidum* (NORMAND) in the British Isles. J. Conch., London, **28**: 209–212.

REINHARDT O. 1874. Ueber die Molluskenfauna der Sudeten. Arch. Naturg., Leipzig, **40**: 179–259.

RICHNOVSZKY A., PINTÉR L. 1979. A vizicsigák és kagylók (*Mollusca*) kishatározója. Vizügyi hydrobiológia, **6**, Budapest, 205 pp.

SCARLATO O.A. 1981. Research of the Soviet malacologists in recent years. Venus, Tokyo, **40**: 160–176.

SCHLESCH H. 1947. The Pisidia of the Tövelde Klint. Proc. malac. soc. London, London, **27**: 137–140.

SCHUMANN E. 1887. Zur Kenntnis der Weichtiere Westpreussens. Schr. naturf. Ges. Danzig, N.F., **6**: 159–167.

SCHUMANN E. 1905. Verzeichnis der Weichtiere der Provinz Westpreussen. Ber. westpr. bot.-zool. Ver., Danzig, **26/27**: 26–42.

STADNIČENKO A. P. 1981. Novye vidy presnovodnyh molljuskov (*Bivalvia, Cycladidae*) fauny SSSR. Vestnik Zool., Kiev, **2**: 29–34.

STADNIČENKO A. P. 1982. Novye i maloizvestnye vidy semejstva *Cycladidae* fauny Ukrainy. Soobščenie II. Vestnik Zool., Kiev, **3**: 28–32.

STADNIČENKO A. P. 1983. Novye vidy presnovodnyh molljuskov (*Bivalvia, Cycladidae*). Vestnik Zool., Kiev, **4**: 24–27.

STADNIČENKO A. P. 1984. Molljuski, perlivnycebi, kul'kavi (*Unionidae, Cycladidae*). Fauna Ukraïni, **29**. Kyïv, 402 pp.

STAROBOGATOV Ja. I. 1977. Klass dvustvorčatye molljuski *Bivalvia*. In: KUTIKOVA L. A., STAROBOGATOV Ja. I. – Opredelitel' presnovodnyh bespozvonočnyh Evropejskoj časti SSSR, Leningrad, 512 pp.

STELFOX A. W., KUIPER J. G. J., MCMILLAN N. F., MITCHELL G. F. 1972. The Late Glacial and Post-Glacial *Mollusca* of the White Bog, Co. Down. Proc. Royal Irish Acad., Dublin, **72**: 185–207.

TETENS A., ZEISSLER H. 1964. Über das Vorkommen der seltenen Pisidienarten im Norddeutsch-Polnischen Raum. Malak. Abh. staatl. Mus. Tierk. Dresden, Leipzig, **1**: 89–133.

THIEL M.E. 1929. Zur Biologie unserer Süsswasser-Muscheln. Zeitschr. Morph. Ökol. Tiere, Berlin, **13**: 65–116.

Timm V. 1974. The *Pisidiidae* of Lake Vortjärv. Estonian Contrib. of IBP, Tallin, **4**: 201–262.
Timm V. 1976. On the *Pisidiidae* of Lake Peipsi-Pihkva. Izv. AN Est. SSR, Biologia, **25**: 37–52.
Tischbierek H. 1939. Die Tierwelt der Schwefelquellen von Bad Landeck und Bad Gross Ullersdorf. Beitr. Biol. Glatzer Schneeberges, Breslau, **5**: 459–481.
Turoboyski L. 1979. Hydrobiologia techniczna. Warszawa, 444 pp.
Urbański J. 1947. Krytyczny przegląd mięczaków Polski. Ann. UMCS, Sect. C, Lublin, **2**: 1–35.
Urbański J. 1957. Krajowe ślimaki i małże. Warszawa, 276 pp.
Wierzejski A. 1882. Materyjały do fauny jezior tatrzańskich. Spraw. Kom. fizyjogr., Kraków, **16**: 215–238.
Wiktor A. 1964. Mięczaki Ziemi Kłodzkiej i gór przyległych. Studium faunistyczno-zoogeograficzne. Pr. Kom. biol. PTPN, Poznań, **29**: 1–129.
Wiktor J., Wiktor K. 1954. Jakościowe i ilościowe badania fauny dennej Zalewu Szczecińskiego. Prace MIR w Gdyni, Gdynia, **7**: 127–152.
Wojtusiak A. 1977. Zarys fauny Gronikowego Stawku na wzniesieniu Gubałówki na Podhalu. Acta hydrobiol., Kraków, **19**: 169–177.
Wolff W. J. 1970. The *Mollusca* of the estuarine region of the rivers Rhine, Meuse and Scheldt in relation to the hydrography of the area. IV. The genus *Sphaerium*. Basteria, Leiden, **34**: 75–90.
Zeissler H. 1971. Die Muschel *Pisidium*. Bestimmungstabelle für mitteleuropäischen Sphaeriaceae. Limnologica, Berlin, **8**: 453–503, tt. VI–XIV.
Žadin V. I. 1952. Molljuski presnyh i solonovatyh vod SSSR. Opred. po faune SSSR, **46**. Moskva–Leningrad, 376 pp.

Uniwersytet Łódzki
Zakład Zoologii Bezkręgowców
i Hydrobiologii
ul. S. Banacha 12/16
90-237 Łódź

STRESZCZENIE

[Tytuł: *Sphaeriidae* Polski (*Bivalvia, Eulamellibranchia*)]

Praca stanowi rewizję małży z rodziny *Sphaeriidae* występujących w Polsce. Uwzględniono w niej materiały własne autora, materiały muzealne oraz wiarygodne dane literaturowe.

Wykazano, że współczesna fauna *Sphaeriidae* Polski obejmuje 21 gatunków (trzy gatunki z rodzaju *Sphaerium* Scop., jeden gatunek *Musculium* Link i 17 gatunków *Pisidium* Pfeiff.). Fauna *Sphaeriidae* obszarów górskich jest bardzo uboga i znacznie odbiega od stosunkowo bogatej fauny stwierdzonej w nizinnych i wyżynnych regionach kraju.

Najpospolitszymi gatunkami w Polsce nizinnej i wyżynnej są kolejno: *Pisidium subtruncatum* Malm, *Sphaerium corneum* (L.), *P. casertanum* (Poli), *P. amnicum* (O. F. Müll.), *P. supinum* (A. Schm.), *P. henslowanum* (Shep.), *P. nitidum* Jen. W górach, tj. na obszarach wzniesionych ponad 500 m n.p.m., pospolicie i licznie występują tylko *P. casertanum* (Poli) i *P. personatum* Malm.

Do najrzadszych gatunków w skali całego kraju należą: *Pisidium conventus* CLESS., *P. crassum* STELF., *Sphaerium solidum* (NORM.), *P. tenuilineatum* STELF. i *P. pseudosphaerium* SCHL.

Wśród *Sphaeriidae* Polski można wyodrębnić pięć następujących grup ekologicznych: 1) gatunki eurytopowe, 2) rzeczne, 3) jeziorne, 4) drobnozbiornikowe, 5) zamieszkujące źródła i zimne wody.

Szczegółowy opis wszystkich gatunków występujących w Polsce wraz z ich charakterystyką ekologiczną i zasięgami występowania przedstawiowo w rozdziale V.

Badania wykazały, że w przypadku *Sphaeriidae* należy przyjąć szeroką koncepcję gatunku, uwzględniającą bardzo dużą zmienność tych małży. Zdaniem autora wąska koncepcja gatunku uznawana przez malakologów radzieckich nie znajduje uzasadnienia i prowadzi do błędnych interpretacji.

РЕЗЮМЕ

[Заглавие: *Sphaeriidae* Польши (*Bivalvia, Eulamellibranchia*)]

Работа представляет ревизию двустворчатых моллюсков из семейства *Sphaeriidae*, встречающихся в Польше. В ней использованы материалы собранные автором, музеальные коллекции и достоверные литературные данные.

Констатировано, что современная фауна *Sphaeriidae* Польши охватывает 21 вид (три вида из рода *Sphaerium* SCOP., один вид *Musculium* LINK и 17 видов *Pisidium* PFEIFF.). Фауна *Sphaeriidae* горных массивов крайне бедна по сравнению с относительно богатой фауной, констатированной на низменных территориях и на возвышенностях в стране.

Наиболее обычными в Польше на низменностях и возвышенностях являются в очередности: *Pisidium subtruncatum* MALM, *Sphaerium corneum* (L.), *P. casertanum* (POLI), *P. amnicum* (O. F. MÜLL.), *P. supinum* (A. SCHM.), *P. henslowanum* (SHEP.), *P. nitidum* JEN. В горах, то-есть на территориях лежащих на уровне свыше 500 м н.у.м., обычными и многочисленными являются только *P. casertanum* (POLI) и *P. personatum* MALM.

К наиболее редко встречающимся видам в масштабах всей страны относятся: *Pisidium conventus* CLESS., *P. crassum* STELF., *Sphaerium solidum* (NORM.), *P. tenuilineatum* STELF. и *P. pseudosphaerium* SCHL.

Sphaeriidae Польши можно разделить на пять экологических групп: 1) эвритопные виды, 2) речные, 3) озерные, 4) виды малых водоемов, 5) виды населяющие источники и холодные воды.

Подробное описание всех всречающихся в Польше видов с их экологической характеристикой и географическими ареалами приведено в V главе.

Как показали исследования, по отношению к *Sphaeriidae* следует принять широкую концепцию вида, учитывающую очень значительную изменчивость этих моллюсков. Принятая советскими маллакологами узкая концепция не находит обоснования и ведет к ошибочным интерпретациям.

Praca wykonana w ramach problemu MR.II.3

Redaktor pracy – prof. dr A. Riedel

Cena 250 zł

ISBN 83-01-09006-5
ISSN 0003-4541