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A systematic study on the complex species *Erpobdella testacea* (SAVIGNY, 1820) (*Hirudinea, Erpobdellidae*)

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ABSTRACT. Studies on *Erpobdella testacea* (SAVIGNY, 1820) have revealed that it is actually a complex of two distinct species - *E. testacea* (SAVIGNY, 1820) and *E. monostriata* (LINDENFELD et PIETRUSZYŃSKI, 1890). They differ in the structure of reproductive system and bionomics. Variation of morphological characters and habitat preferences are given for both taxa. The name *Erpobdella monostriata* (GEDROYĆ, 1916) sensu PAWŁOWSKI, 1948, junior homonym of *E. monostriata* (LINDENFELD et PIETRUSZYŃSKI, 1890), should be replaced with a junior synonym *Erpobdella vilnensis* LISKIEWICZ, 1927.

INTRODUCTION

SAVIGNY (1820) distinguished a new species *Erpobdella testacea*, (under a generic synonym *Nephelis*) within a complex of species *Hirudo vulgaris* MÜLLER, 1774. The species was later repeatedly described under the names: *Nephelis cinerea* MOQUIN-TANDON, 1826, *Nephelis sexoculata* SCHNEIDER, 1883, *Nephelis hexoculata* SELIGO, 1890. This resulted from the variation in body colour and number of eyes. In 1890 LINDENFELD et PIETRUSZYŃSKI distinguished a variety *monostriata* within *Erpobdella testacea*. LISKIEWICZ (1927) described also forms *typica* and *grisea*, the latter regarded as a synonym of f. *typica* in the paper of PAWŁOWSKI (1968). Bionomics and morphology of the typical form and f. *monostriata* were studied by numerous authors (LISKIEWICZ 1934, PAWŁOWSKI 1936b, BENNIKE 1943, SERAFIŃSKA, 1958, WOJTAS 1962, KALBE 1965, WILKIALIS 1970, LUKIN, 1976, AGAPOW 1982, 1988, BIELECKI et al. 1987), who considered f. *monostriata* to be an expression of interspecific variability. Examination of abundant materials of both forms from Poland has revealed an array of morphological

and bionomical differences which, in our opinion, justify their treatment as distinct species.

MATERIAL AND METHODS

Specimens collected by AGAPOW (1982) in the Pomeranian Lake District and by BIELECKI et al. (1987) on the Baltic Coast served as a basis for the analysis of *Erpobdella monostriata* (LIND. et PIET.) and *Erpobdella testacea* (SAV.). They came from three lakes: Barlineckie, Lipie and Żarnowieckie. The first two abound in springs where water temperature varies within a narrow range. A detailed analysis of conditions at localities of both species was also carried out. In the lake Barlineckie the studies were repeated in 1985/86 and 1988/89 by both authors. Main attention was paid to the structure of reproductive system; the length of ovaries and vasa deferentia was measured (using the number of nervous ganglia i.e. neurosomites as a reference point), and their relative position was determined. The results were subject to cluster analysis which allowed to distinguish two groups of leeches of the most similar reproductive system. Also the occurrence of *Erpobdella monostriata* and *Erpobdella testacea* in water bodies of the Baltic Coast and Pomeranian Lake District was analysed using the same method.

RESULTS

COMPARATIVE MORPHOLOGY: The material was arranged according to:

a: body colour. It was observed that *Erpobdella monostriata* had a lighter body with a dark median streak which is in accordance with the data of PAWŁOWSKI (1936b) and LISKIEWICZ (1934). It was also found that the length and width of the streak might vary. Besides the median streak, on the dorsal body side of a few specimens there were dark spots. *E. testacea* is darker coloured than *E. monostriata*, and numerous specimens have a light median streak, also in accordance with the data of LISKIEWICZ (1934), PAWŁOWSKI (1936b), SERAFIŃSKA (1958) and KALBE (1965).

b: length and width of leeches. Based on 280 measured specimens of *E. monostriata* it was found that its mean length was 21.8 mm, width 3 mm. The mean length of 135 specimens of *E. testacea* was 29.7 mm, mean width 3.2 mm. The results are close to those of SERAFIŃSKA (1958), who found that *E. monostriata* (l. 2-2.5 cm, w. 3 mm) was smaller than *E. testacea* (l. 4 cm, w. 3 mm).

c: variation of eye arrangement. In 168 specimens of (60%) *E. monostriata* was characteristic of the genus *Erpobdella* DE BLAINVILLE (on II body ring 2 pairs of eyes, on IV also 2 pairs). In 112 specimens (40 %) an atypical eye arrangement was observed. Two specimens were blind. In 95 specimens (70 %) of *E. testacea* the eye arrangement was characteristic of the genus *Erpobdella* DE BLAINVILLE. In 40 specimens (30 %) the eye arrangement was atypical. One specimen was blind. LISKIEWICZ (1934) maintains that in *E. testacea* there are always 8 eyes. Our studies indicate a considerable variation in their number and arrangement. In *E. testacea* 27.6 % specimens had eyes arranged atypically for the genus *Erpobdella* DE BLAINVILLE. An even greater variation was observed in *E. monostriata*. As much as 48 % leeches of that species had their eye arrangement atypical for the genus. It is known that the variation in the arrangement of

eyes in species of the genus *Erpobdella* is fairly wide and thus of little diagnostic value.

d: variation in the position of gonopores. 271 specimens of *E. monostriata* were examined of which only one departed in this respect from the average. The distance between the male and female gonopore in that leech was 2.5 ring. Various positions of the gonopores in *E. monostriata* are presented in tab. 1. It follows from the table that the male gonopore is always situated between 8 and 9 rings of the clitellum, while the female gonopore has a variable position. Specimens with gonopores full 4 rings apart constitute the highest percentage. All examined specimens of *E. testacea* had a constant distance of 4 rings between their gonopores. Our results in this respect are compatible with those of PAWŁOWSKI (1936b) and LISKIEWICZ (1934). It follows from those data that the gonopores in *E. testacea* are separated by 4 full rings and both are situated in inter-ring grooves. In very few specimens of *E. monostriata* the male gonopore is situated on the surface of the rings, and both gonopores are separated by 3 full rings. Equally rarely the gonopores are separated by 5 rings. In our studies we found the variation in the position of the gonopores only in *E. monostriata*.

e: variation of the structure (topography) of the ovaries and vasa deferentia. Analysis of the morphology of the reproductive system revealed significant differences between the two species.

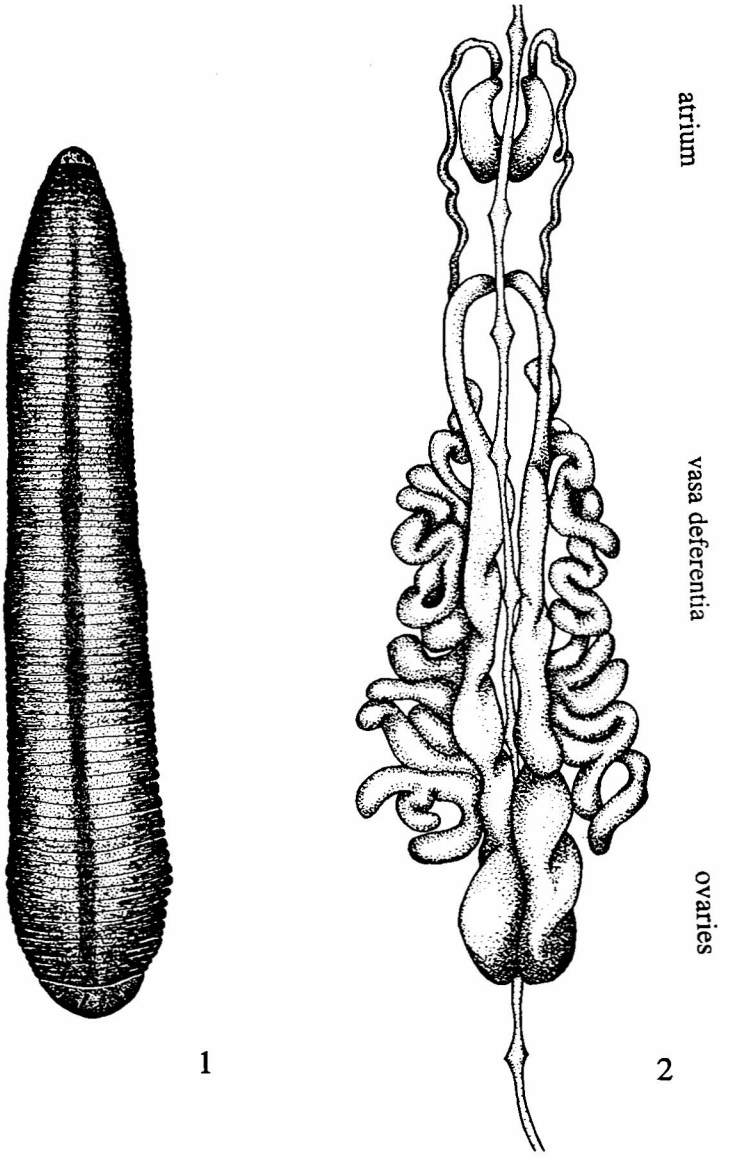
Erpobdella monostriata (LINDENFELD et PIETRUSZYŃSKI, 1890)

In 72 specimens (25.71%) the ovaries and vasa deferentia ended at the level of the same ganglion. In two (0.71%) specimens the ovaries were shorter than vasa deferentia by 1 neurosomite. Among *E. testacea* specimens of such a structure of the reproductive system were not found. The topography of reproductive organs of 206 specimens (73.58%) is presented in tab.2 and fig.5. Of the four studied groups specimens with ovaries longer than vasa deferentia by 1 neurosomite were the most numerous (61.65%, group 4). In the remaining groups the ovaries were longer by 2/3 neurosomite (18.45%, group 3), by 1/2 neurosomite (16.90% group 2) and 1/3 neurosomite (3.40%, group 1).

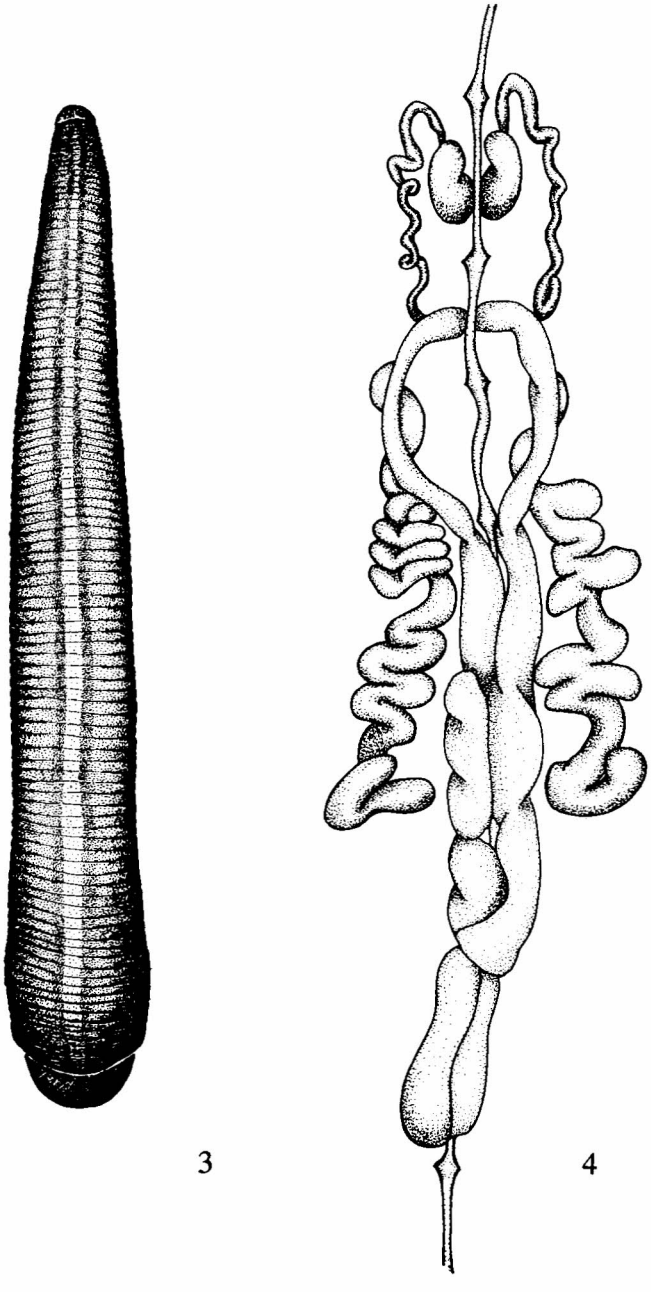
In order to find the most characteristic structure of the reproductive system, and to assess the similarity between the reproductive systems of the studied groups, cluster analysis was performed. Based on this clusters were distinguished (figs. 5, tab. 2). The most typical reproductive system is that of the group 4 - cluster III. Groups 1 and 2 form one cluster - I, and their reproductive systems should be treated as identical. This is confirmed by the fact that in *E. monostriata* specimens with vasa deferentia longer than ovaries form a majority, but the difference does not exceed one somite, with a tendency to equal length.

Erpobdella testacea (SAVIGNY, 1820)

The topography of reproductive organs in 135 specimens (100%) is presented in table 3 and figure 6. It appears that specimens with ovaries longer than vasa deferentia



1-2. *Erpobdella monostriata*: 1 - habitus, 2 - typical reproductive system, ovaries longer than vasa deferentia by 1 somite

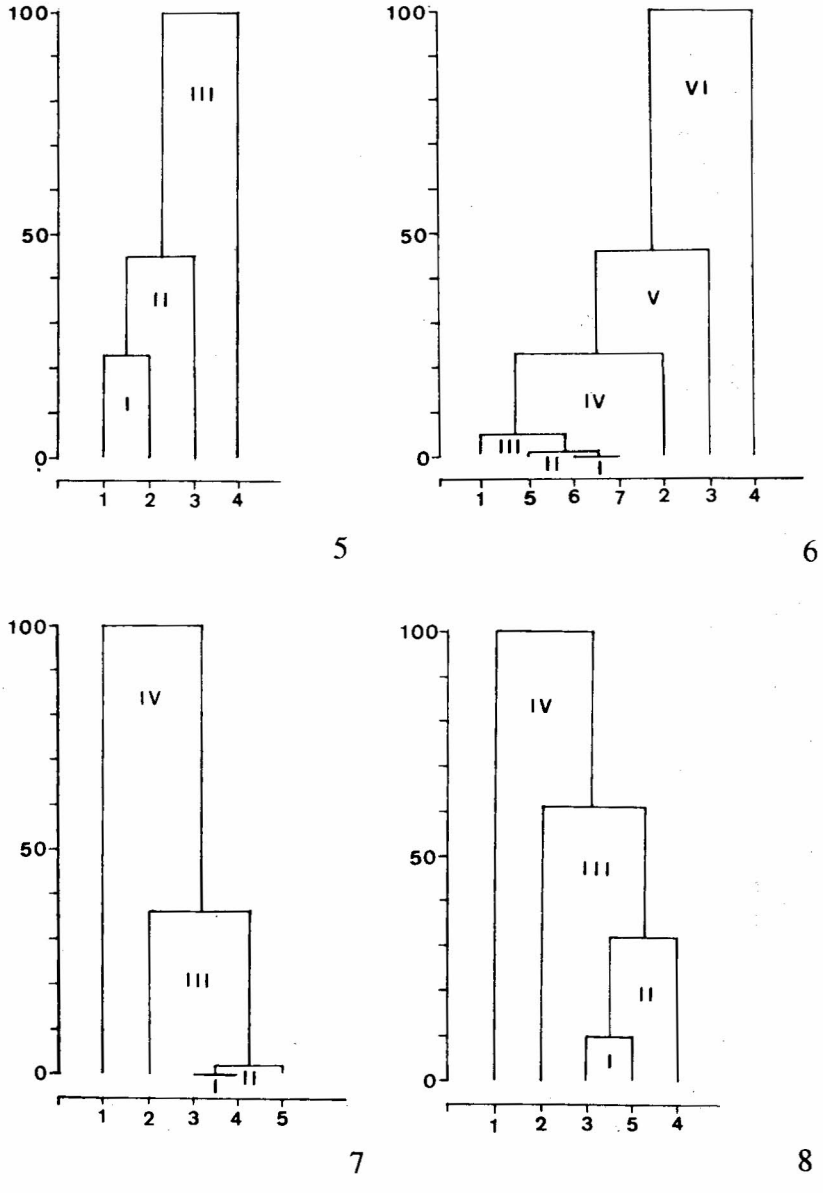


3-4. *Erpobdella testacea*: 3 - habitus, 4 - typical reproductive system, ovaries longer than vasa deferentia by 2 somites

by 2 somites are the most numerous (80.75%, group 4), the next group being specimens (10.37%, group 3) with the difference of 1.5 somite. The remaining studied groups constitute a low percentage. Like with *E. monostriata*, in order to determine the most characteristic reproductive system and the similarity between those systems in the studied groups, cluster analysis was performed (figs. 6, tab. 3). The most typical reproductive system of *E. testacea* is that of group 4 - cluster VI. The clusters resulting from the analysis I, II, III and IV (studied groups 7, 6, 5, 1 and 2) with various reproductive systems actually form an entity, the probability of the presence of *E. testacea* in the studied population being very low. Thus *E. testacea* has a reproductive system characterized by a greater difference in length of ovaries and vasa deferentia than in *E. monostriata*, amounting to 2 or 1.5 somite.

ECOLOGY: Differences were found in the frequency of occurrence and abundance in various types of water bodies, as well as in habitat preferences of the studied species (tab. 4). In order to ascertain exactly which types of water bodies are inhabited by the two species, the water bodies were subject to cluster analysis. Clusters of water bodies were thus distinguished (tab. 4, figs. 7, 8). *E. monostriata* is a typically lacustrine species (studied reservoir 1 - cluster IV), less often it lives in rivers (studied water body 2 - cluster III). Old river beds and field pools (studied reservoirs 3, 4 - cluster I) and fish ponds (studied reservoir 5 - cluster II) from statistical viewpoint are the same habitat for this species, and its occurrence there is not likely.

The occurrence of *E. testacea* in these reservoirs is different. It can be found with a high probability in all the studied water bodies, old river beds and fish ponds (studied reservoirs 3 and 5 - cluster I) are the same habitat for this species. BENNIKE (1943) classified *E. monostriata* with stenoecious lacustrine leeches, and *E. testacea* with euryoecious species. The frequency of occurrence of *E. testacea* in water bodies of the Myśliborskie Lake District was 39.3% , of *E. monostriata* only 11.4% . Water bodies abound with a variety of habitats, including muddy ones with lush vegetation, inhabited by *E. testacea*. The latter was found mainly in small reservoirs, like postglacial pools, old river beds, river bays, eutrophic lakes. In summer their water is strongly heated, and contains less oxygen than colder waters, and in spring heats sooner which is a reason for the earlier laying of cocoons. Only few lakes in the Myśliborskie Lake District create favourable conditions for *E. monostriata*. Contrary to *E. testacea* it inhabits the shallowest parts of littoral and is almost never found below 50 cm depth. As evidenced by studies in the Barlineckie and Lipie Lakes where it was among eudominants, it lives mainly in habitats where littoral is supplied with numerous springs on shores or on the bottom of the lakes. A similar situation was observed in the Lakes Ostrowieckie, Sitno, Martew and lower and mid section of the River Drawa. In all these water bodies the most abundant populations of *E. monostriata* were found near springs on a stony or gravelly-stony bottom. The water temperature there was always lower in summer and higher in winter than at localities not supplied with spring water. Based on this it could be established that annual changes in water temperature were in those parts of lakes smaller than in other sites. Systematic measurements revealed that the water temperature in springs ranged within very narrow limits: from 6.5°C do 12.1°C within a year. *E. monostriata* was a dominant species there. Water temperature in July 1986 was the



5-8. *Erpobdella monostriata, E. testacea*: 5, 6 - similarity between leech groups based on reproductive system (1-7 group number, I-VI cluster number). 7, 8 - similarity between occurrence in water reservoirs (1-5 number of water body, I-IV cluster number)

Tab. 1. Position of gonopores in *Erpobdella monostriata*

Distance between gonopores (measured by rings in clitellum)	Position of gonopores		Number of specimens	%
	male	female		
4 full rings	8/9	12/13	221	79.3
4 rings	8/9	beginning of 13th ring	40	14.4
4 1/3 rings	8/9	beginning of 13th ring	6	2.2
4.5 rings	8/9	beginning of 13th ring	6	2.2
5 rings	8/9	13/14	4	1.5
5.5 rings	8/9	half 14th ring	1	0.4
Total			278	100.0

Tab. 2. Variation of relative length of ovaries and vasa deferentia in *E. monostriata* (measured in neurosomites)

Studied group	Ovary longer than vas deferens by: [neurosomite]	Number of specimens				%	Cluster
		Lake			Total		
		Barlineckie	Lipie	Żarnowieckie			
1	1/3	6	1	0	7	3.4	I
2	1/2	7	15	12	34	16.9	
3	2/3	1	16	21	38	18.4	II
4	1	12	48	67	127	61.3	III
Total		26	80	100	206	100.0	3

Tab. 3. Variation of relative length of ovaries and vasa deferentia in *Erpobdella testacea* (measured in neurosomites)

Studied group	Ovary longer than vas deferens by: [neurosomite]	Number of specimens				%	Cluster
		Lake			Total		
		Barlickie	Lipie	Żarnowieckie			
1	1/2	2	-	-	2	1.48	III
2	1	5	-	1	6	4.44	IV
3	1.5	9	3	2	14	10.37	V
4	2	10	42	57	109	80.75	VI
5	2.5	1	1	-	2	1.48	II
6	3	1	-	-	1	0.74	I
7	4	1	-	-	1	0.74	
Total		29	46	60	135	100.00	6

Tab. 4. The occurrence of *E. monostriata* and *E. testacea* in water bodies of the Baltic Coast and Pomeranian Lake District

Number of water body	Species	Number of specimens collected			Cluster
		Baltic Coast	Pomeranian Lake District		
			Myśliborskie Lake District	Drawa basin	
1 lakes	E. monostriata E. testacea	780 167	1175 227	511 269	IV IV
2 rivers	E. monostriata E. testacea	4 146	1 116	332 71	III III
3 old river beds	E. monostriata E. testacea	absent 42	absent 39	not studied not studied	I I
4 field pools	E. monostriata E. testacea	absent 6	absent 8	absent 106	I II
5 fish ponds	E. monostriata E. testacea	4 27	10 30	12 33	II I

following: spring 8.6°C, flooded shore 9.9°C, at shore line 12.6°C, at depth of 70 cm at the bottom 16.5°C, at the surface 19.1°C. Results obtained in the Lake Lipie were very similar (AGAPOW 1982), as well as those from springs of the Lakes Martew, Ostrowieckie (AGAPOW 1988, AGAPOW, WANIAK 1987) and Żarnowieckie (BIELECKI et al. 1978).

Because of this *E. monostriata* can be regarded as a bioindicator of water quality, like many other groups of aquatic animals. Somewhat different data on habitat selection by *E. monostriata* were provided by WILKIALIS (1970). According to this author the trophic character of a lake has no significant effect on the occurrence of this species. Based on his results from lakes of the Suwalskie Lake District he concluded that the species inhabits warm waters, easily heated on sunny days. SANDNER and WILKIALIS (1972), based on their results from a few lakes of the Mazurian Lake District, reported that the species was very abundant in shallow water 0-20 cm deep and heated up to 22-24°C, on a sandy-muddy or muddy-sandy bottom.

The results of studies from lakes and rivers Drawa and Płociczna in the Myśliborskie Lake District (AGAPOW, 1982), and also Żarnowieckie Lake (BIELECKI et al. 1987) evidence its preference for shallow (up to 50 cm deep) water, but it is most abundant close to springs on a stony and gravelly-stony bottom.

In the Barlineckie Lake the seasonal occurrence of leeches was analyzed in 1985 (AGAPOW 1988, fig. 17, p. 58) at a locality where *E. monostriata* constituted over 70% leeches collected. From the beginning of August species which earlier stayed in the zone of warmer water, somewhat farther from the shore line, leave the spring region, and are replaced by *E. monostriata*. Because the spring water does not freeze, also *Helobdella stagnalis*, *Erpobdella octoculata*, *E. nigricollis* and other species winter there. In spring and summer *E. monostriata* stays at the depth of 0-50 cm.

The breeding of *E. monostriata* takes place from the beginning of June till the end of August, though it is the most intense from half of June till the end of July within the temperature range 14.6°C do 18°C. This affects the population age structure measured by body length of individuals (AGAPOW 1988, fig.18, p.62). The mean body length of preserved specimens oscillated around 15.8 mm in July samples and around 22.2 mm in March samples. As shown in the graph (AGAPOW 1988, p. 62) 59.6% specimens were within length classes from 19 to 24 mm in November, and in March the percentage increased even up to 67.3%. In summer months the percentage of adult individuals decreased to c. 25% and then gradually increased from August. This results from intense reproduction and increasing number of young in the population. It can be seen in the graph (AGAPOW 1988, fig. 18) that juvenile individuals of the length class of 7-18 mm in June constituted 65.8%, in July 77.3%, in August 61.3% and in September only 25% population. This is a strong evidence that breeding of *E. monostriata* is the most intense in June and July.

Erpobdella testacea breeds much earlier. At localities where it is the only representative of leeches, cocoon-laying was observed from the beginning of April till the end of May in large numbers, and from June their number decreased considerably (AGAPOW 1982). KLEKOWSKA (1951) and MANN (1961) maintain that under favourable

conditions *E. testacea* lays its first cocoons already in March. It was also found to behave differently from *E. monostriata* in its habitat. While individuals of *E. monostriata* are distributed under stones, branches or other submerged objects, individuals of *E. testacea* gather in root parts of plants or at leaf bases. In reservoirs in which the water level is unstable they enter the muddy bottom.

Conclusions

In our opinion studies on the variability of *E. monostriata* and *E. testacea* provide evidence sufficient for their recognition as distinct species.

Erpobdella monostriata (Lindenfeld et Pietruszyński, 1890), stat. nov.
(figs. 1, 2)

Nephelis octoculata var. *monostriata* Lindenfeld et Pietruszyński, 1890 not *Erpobdella monostriata* (Gedroyć, 1916) sensu Pawłowski, 1948.
Herpobdella octoculata var. *monostriata*: Gedroyć, 1916.
Herpobdella testacea f. *monostriata*: Pawłowski, 1936b, 1936c, Dobrowolski, 1958, Wiśniewski, 1958.
Herpobdella testacea f. *monostriata* Liskiewicz, 1934, Bennike, 1934.
Erpobdella testacea f. *monostriata*: Pawłowski, 1948
Erpobdella testacea f. *monostriata* Klekowska, 1951, Brandes (sic !): Tarwid, Dobrowolski et al., 1953, Serafińska, 1958, Mann, 1961, Kalbe, 1965, Pawłowski, 1968, Wilkialis, 1970, Sandner, Wilkialis, 1972, Agapow, 1982.

Diagnosis

Body distinctly tapered anterad. Colour light with a dark median streak. Reproductive system with vasa deferentia longer than ovaries by not more than 1 somite.

Material

It is unknown if and where type specimens are preserved; most probably they do not exist.The alcohol-preserved neotype and 20 specimens, July 1989, Barlinek, Barlineckie Lake, littoral, under stones in a spring (Pomeranian Lake District, Poland), leg. L. Agapow. Other materials: 56 specimens, July 1978, Żarnowiec, Żarnowieckie Lake (Baltic Coast, Poland), leg. A. Bielecki.

Description

Body distinctly tapered anterad. Length: neotype - 23 mm, width - 3 mm, 20 specimens c. 1.8 - 30 mm. Alcohol-preserved specimens light with a dark median streak, venter lighter than dorsum. Gonopores separated by 4 full rings. Ovaries longer than vasa deferentia by 1 somite (fig.2).

Nomenclature note. The name *Erpobdella monostriata* was regarded by Pawłowski (1968) as created by Gedroyć (1916). Later *Erpobdella monostriata* (Gedroyć, 1916)

sensu PAWŁOWSKI, 1948 was recognized as a good species, distinct from *Erpobdella monostriata* (LINDENFELD et PIETRUSZYŃSKI, 1890). The name *Erpobdella monostriata* (GEDROYĆ, 1916) sensu PAWŁOWSKI, 1948 is thus a junior homonym and should be rejected. Because *Erpobdella monostriata* (GEDROYĆ, 1916), sensu PAWŁOWSKI, 1948, has a junior synonym *Herpobdella octoculata* ssp. *vilnensis* LISKIEWICZ, 1927 (=*Erpobdella octoculata* ssp. *vilnensis* LISKIEWICZ, 1927), the name *Erpobdella vilnensis* LISKIEWICZ, 1927 is the next available and should be used for the species in question.

Erpobdella testacea (SAVIGNY, 1820)
(figs. 3, 4)

Hirudo vulgaris: O.F. MÜLLER, 1774.
Erpobdella vulgaris: DE BLAINVILLE in LAMARCK, 1818.
Nephelis testacea SAVIGNY, 1820, AUGENER, 1926, BACKHOFF, 1927, DRESCHER, 1928.
Nephelis cinerea MOQUIN-TANDON, 1826.
Nephelis octoculata: MOQUIN-TANDON, 1846.
Nephelis sexoculata SCHNEIDER, 1883
Nephelis hexoculata SELIGO, 1890.
Herpobdella octoculata: BLANCHARD, 1894, 1896, GEDROYĆ, 1916, 1926, DEMEL, 1923, 1924, MICHALSKI, GABAŃSKI and KULMATYCKI, 1936.
Herpobdella octooculata: GEDROYĆ, 1919.
Herpobdella testacea: JOHANSSON, 1910, PAWŁOWSKI, 1935a, 1936a, 1936b, GABAŃSKI, MICHALSKI, PESKA-KIENIEWICZOWA and KULMATYCKI, 1937, DOBROWOLSKI, 1958, WIŚNIEWSKI, 1958.
Erpobdella testacea: HERTER, 1936.
Erpobdella (Erpobdella) testacea: PAWŁOWSKI, 1955, WOJTAS, 1957, 1959.
Herpobdella octoculata var. *nigra* GEDROYĆ, 1916.
Herpobdella testacea Sav. *typica* LISKIEWICZ, 1927.
Herpobdella testacea Sav. m. *grisea* LISKIEWICZ, 1927.
Erpobdella testacea f. *typica*: KLEKOWSKA, 1951.
Erpobdella testacea f. *typica*: SERAFIŃSKA, 1958, MANN, 1961, KALBE, 1965, PAWŁOWSKI, 1968, WILKIALIS, 1970, SANDNER, WILKIALIS, 1972, AGAPOW, 1982.

The synonyms were established based on original descriptions excluding their identity with *E. monostriata* (LIND. et PIETR.).

DIAGNOSIS

Body distinctly oval anterad, blunt and truncate posterad. Colour dark, greyish black or grey with a brown hue, and a narrow lighter median streak. Gonopores well visible and separated by 4 full rings. Reproductive system with ovaries always longer than vasa deferentia by more than one somite.

MATERIAL

Type specimens are unknown to us, and it is unknown if and where they are preserved; probably they do not exist. The alcohol-preserved neotype and 25 specimens,

July 1989, Barlinek, Barlineckie Lake, muddy bottom, on leaves and roots of *Typha latifolia* (Pomeranian Lake District, Poland), leg. L. AGAPOW. Other materials: 50 specimens, July 1978, Łubkowo, Żarnowieckie Lake (Baltic Coast, Poland), leg. A. BIELECKI.

DESCRIPTION

Body anteriorly rounded, posteriorly blunt and truncate. Length: neotype - 19 mm, width 3.5 mm, 25 specimens 1.5-40 mm. Colour of alcohol-preserved specimens dark, greyish black or grey with a brown hue, and a light narrow median streak. Gonopores well visible and separated by full 4 rings. Ovaries longer than vasa deferentia by 2 and 1.5 somite (tab.3, fig.4).

The neotypes of *E. monostriata* and *E. testacea* are deposited at the Museum of Natural History, Wrocław University.

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