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VARIABILITY OF THE REPRODUCTIVE SYSTEM OF *PISCICOLA RESPIRANS* (TROSCHEL, 1850) (HIRUDINEA, PISCICOLIDAE)

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ZMIENNOŚĆ UKŁADU ROZRODCZEGO *PISCICOLA RESPIRANS* (TROSCHEL, 1850) (HIRUDINEA, PISCICOLIDAE)

Abstract. The studies on the reproductive system of *P. respirans*, based on 115 specimens, have revealed its considerable variability. Two main types of the system can be distinguished: 1) ovaries reaching the first pair of testes, ejaculatory ducts symmetrical, no seminal vesicles (juvenile individuals), 2) ovaries reaching the first pair of testes, ejaculatory ducts symmetrical, seminal vesicles reaching the ends of ovaries (adults individuals).

The structure of the reproductive system is correlated with the individual size and age. Because the reproductive system of *P. respirans* as described by BRUMPT (1900) and SKET (1968) based on type specimens designated by them, is found only in a small fraction (c. 4-8%) of specimens, a redescription of the species is necessary, best based on a neotype series.

INTRODUCTION

The systematics of parasitic fish leeches (Acanthobdellidae and Piscicolidae) has changed essentially during the last period; it is based on morphological (HOFFMANN 1956, LUKIN 1976, SAWYER 1986) and biometrical characters (EPSTEIN 1987, BIELECKI 1997) of the reproductive system (EPSTEIN 1968, 1969, 1973, 1987, BIELECKI 1997) and alimentary tract (BIELECKI 1997). As a result of these studies many new genera were distinguished, some species being in consequence transferred from one genus to another.

These modifications were based mainly on the characters of the reproductive system. However, many authors describing new species and *P. respirans* as

well, took into consideration the structure of the reproductive system of single or very few specimens (BRUMPT 1900, SKET 1968), which in many cases made it impossible to apply a statistical analysis.

The objective of the present study was to recognise the variability of the reproductive system of *P. respirans* based on material suitable for statistical analysis. Such a study made it possible to compare the most typical structure of the reproductive system of *P. respirans* with that system of the individual designated as type in BRUMPT'S (1900) description.

MATERIAL AND METHODS

The reproductive system was analysed in 115 specimens of *P. respirans* – an ectoparasite of salmonid fishes (Salmonidae) and rheophilous cyprinds (Cyprinidae) (BIELECKI, WITKOWSKI 1988). The leeches were collected from fish obtained with electrofishing equipment, then fixed in 2.5% formaldehyde (BIELECKI 1977, BIELECKI, WITKOWSKI 1988). For detailed data on the material see table 1.

TABLE 1
List of collecting localities, dates and hosts of *Piscicola respirans*

Locality - river	Date	Host
Pławna	27.05. 1976	trout, grayling
Nysa Kłodzka	27.05. 1976	trout, grayling
Nysa Kłodzka	28.05. 1986	trout, grayling, minnov, loach
Nysa Kłodzka	14.06. 1986	grayling
Nysa Kłodzka	13.05. 1987	trout, grayling, minnov, loach
Duna Dolna	4. 05. 1987	trout
Bystrzyca Dusznicka	13. 05. 1987	trout

The material was divided into classes depending on size of the specimens. The size ranges and number of specimens in each class are shown in table 2.

TABLE 2
Number of dissected *P. respirans* in each size class

Body length (cm)	Size class	Number of dissected spe
1.8 - 3.0	I	22
3.1 - 3.9	II	33
4.0 - 4.4	III	36
4.5 - 7.0	IV	24
Total	4	115

Selection of leeches was described by BIELECKI (1997). The dissected reproductive systems are presented in figures 1-25.

The material was statistically analysed using two variants of χ^2 test:

Comparison of hypothetical density with the empirically estimated frequency, i.e. agreement of null hypothesis, testing dependence among characters; the so-called independence test (RUSZCZYC 1970, STANLEY 1976).

RESULTS

In our study we took into consideration the variability of the male part, i. e. ejaculatory ducts and seminal vesicles, of reproductive system. The female part displayed a high stability. It was found that in *P. respirans* the ovaries always reached the first pair of testes (t_1), contacting with their anterior parts.

Symmetry or asymmetry of ejaculatory ducts was estimated:

- left and right ducts reach the same level (figs 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, tab. 3),
- right duct reaches higher than the left (figs 18, 19, 20, 21, 22),
- left duct reaches higher than the right (figs 23, 24, 25).

The seminal vesicles were divided into three categories: symmetrical, asymmetrical and atrophic or poorly developed. Within these categories, further division was based on their position relative to the ovaries,

- for symmetrical vesicles: vesicles reaching the beginning (fig. 4), half (fig. 5); 2/3 (figs 6, 7) or the end of the ovary (figs 8, 9, 10),
- for asymmetrical vesicles: vesicles reaching the end of the right (fig. 11) or left (fig. 12) ovary,
- for atrophic or poorly developed vesicles: right (fig. 13), left (fig. 14) or both vesicles (figs 16, 17) absent.

The following formula was used to calculate χ^2:

$$\chi^2 = \sum \left\{ \frac{(f - F)^2}{F} \right\}.$$

where: r – number of characters of the reproductive system (horizontal),
f – frequency of specimens,
F – expected frequency of specimens with given characters of the reproductive system (calculated on the basis of hypothesis) at the number of degrees of freedom ń = r – 1

The value of $\chi^2 = 0.248$, obtained for the estimation of dependence among the group of juvenile and adult specimens and ejaculatory ducts in *P. respirans* reveals the lack of such a dependence (tab. 4), since the critical value of χ^2 at the significance level $p = 0.05$ is 5.99 ($\chi^2 = 0.248 < 5.99$).

The value of $\chi^2 = 30.14$ obtained for the dependence among juvenile and adult specimens and all the characters of seminal vesicle (tab. 5) indicates a significant dependence even at $p < 0.001$, which means that the interdependence of characters could be accidental only in one specimen per 1000. The critical value at $p < 0.05$ is 14.07.

Since the seminal vesicle were divided into three categories, it was interesting to check which of category was the strongest dependent on the size class. For this reason the values were calculated separately for:

- vesicles absent or poorly developed ($\chi^2 = 7.09$),
- vesicles symmetrical ($\chi^2 = 3{,}31$),
- vesicles asymmetrical ($\chi^2 = 0{,}62$).

The results allow a conclusion that only the absence of seminal vesicle or their poor development display a dependence on the size of specimen, according to the size classes adopted.

TABLE 3

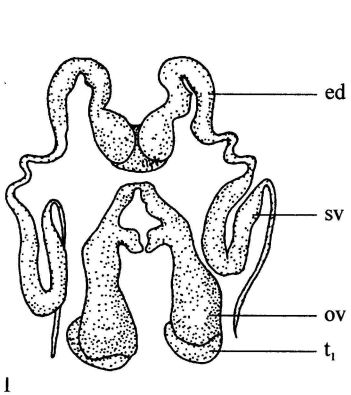
Number and percentage of juvenile and adult specimens of *P. respirans* in particular morphological categories of the reproductive system.

Specimens	Ejaculatory ducts reaching:			Seminal vesicles									Total
				Symmetrical, reaching:			Asymmetrical, reaching:			Absent			
	left and right at the same level	right above left	left above right	the beginning of ovaries	1/2 ovaries	2/3 ovaries	the end of ovaries	right to the right end of ovaries	left to the left end of ovaries	Right and left	Right	Left	
Juvenile	29 25.22	8 6.96	3 2.69	0 0	0 0	3 2.61	4 3.48	0 0	1 0.87	30 26.09	1 0.87	1 0.87	80
Adult	52 45.21	18 15.65	5 4.35	3 2.61	5 4.35	7 6.09	26 22.61	3 2.61	4 3.48	18 15.69	5 4.35	4 3.48	150

TABLE 4

Independence test $\chi^2 = 0.248$ for ejaculatory ducts of juvenile and adult specimens of *P. respirans*

Specimens		Ejaculatory ducts reaching:			Total
		Left and right reach the same level	Right above left	Left above right	
Juvenile	Number of specimens	29	8	3	40
	Hypothetical number of specimens	28.18 72.50	9.04 20.00	2.78 7.50	100
	% juvenile specimens	25.22	6.96	2.61	34.78
	χ^2	0.024	0.120	0.017	
Adult	Number of specimens	52	18	5	75
	Hypothetical number of specimens	52.82 69.33	16.96 24.00	5.22 6.67	100
	% adult specimens	45.21	15.65	4.35	65.22
	χ^2	0.013	0.065	0.009	
Juvenile and Adult	Number of specimens	81	26	8	115
	% specimens	70.43	22.61	6.96	100
	χ^2	0.037	0.185	0.026	0.248



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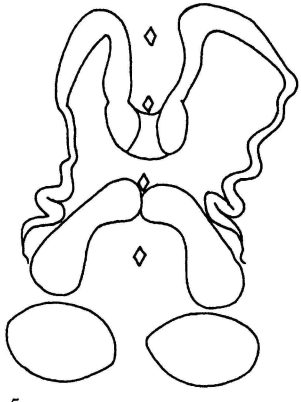

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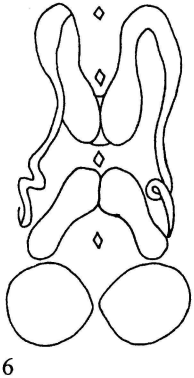

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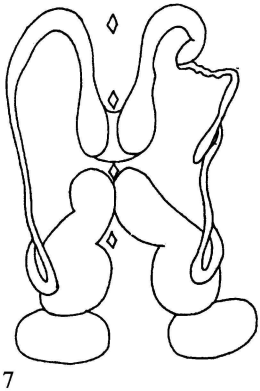

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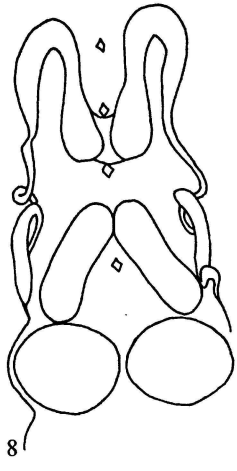

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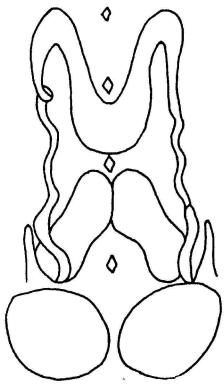
Figs 1-8. *Piscicola respirans* reproductive system. 1. according to BRUMPT, left and right ejaculatory ducts (ed) reach the same level, symmetrical seminal vesicles (sv) reaching ovaries (ov), first pair of testes (t_1). 2-3. according to SKET, right ejaculatory duct reaching higher than the left, symmetrical seminal vesicles reaching ovaries. 4. ejaculatory ducts reach the same level, symmetrical seminal vesicles reaching the beginning of ovaries. 5-8. ejaculatory ducts reaching the same level, seminal vesicles symmetrical, reaching ovaries (5), 2/3 ovaries (6, 7) or the end of ovaries (8)



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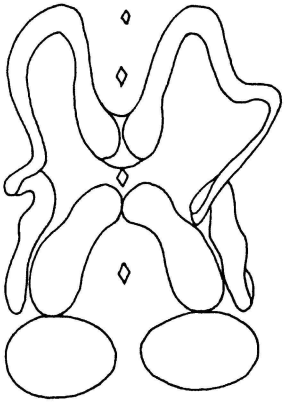

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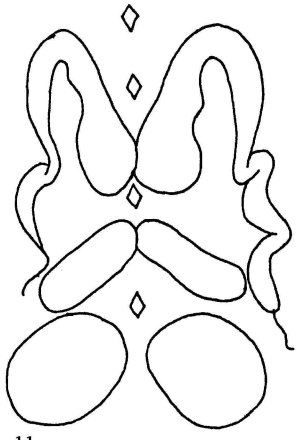

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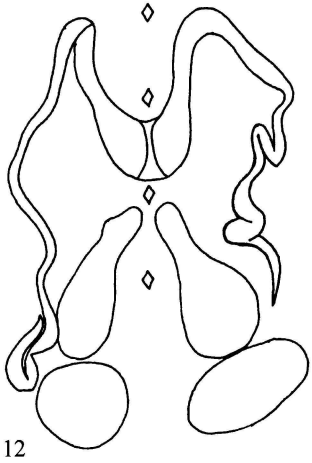

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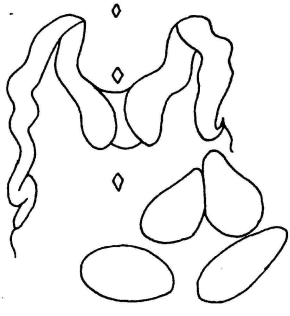

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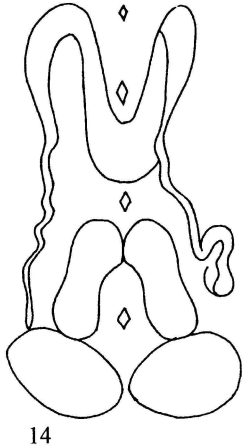

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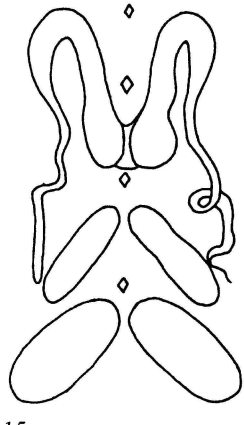

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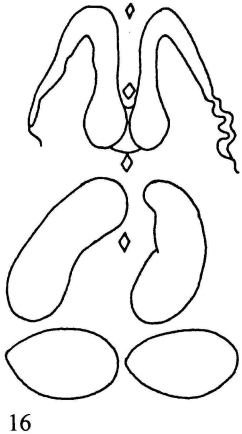

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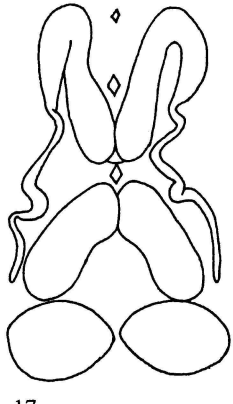

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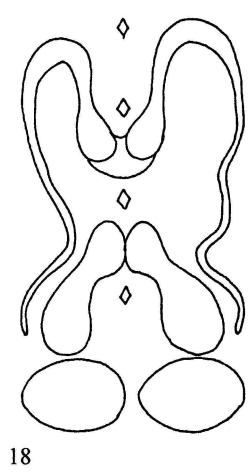
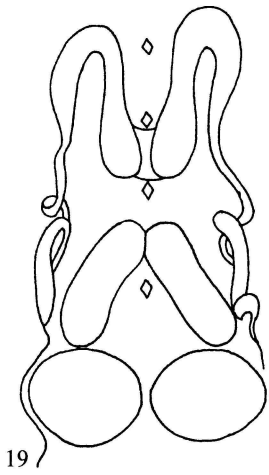
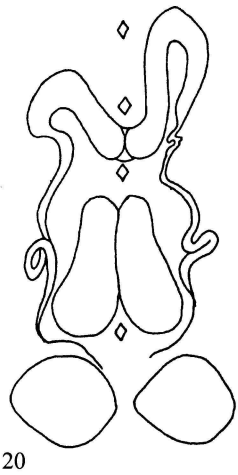
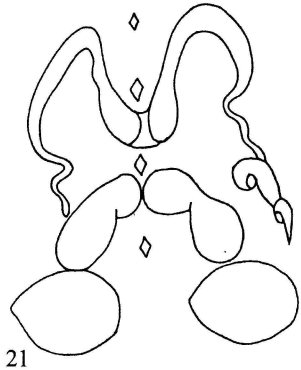
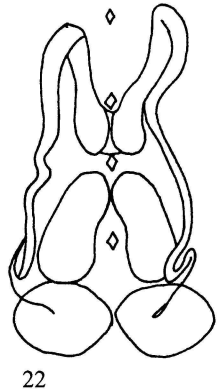
Figs 9-17. *Piscicola respirans* reproductive system, left and right ejaculatory ducts reach the same level

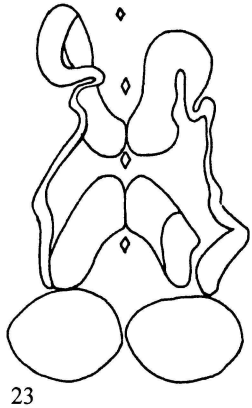


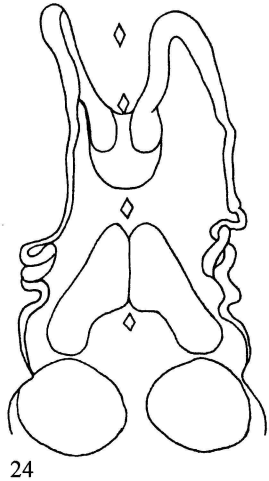


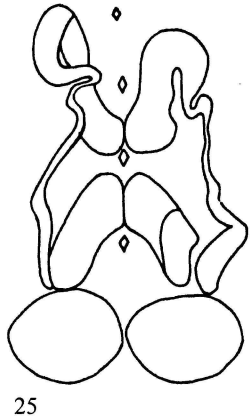












Figs 18-22. *Piscicola respirans* reproductive system, right ejaculatory duct reaches higher
Figs 23-25. *Piscicola respirans* reproductive system, left ejaculatory duct reaches higher than the right

DISCUSSION

Based on the percentage of specimens displaying particular categories of the reproductive system, the results of our study reveal that the highest proportion of specimens (28,34%) had ovary reaching the thirst pair of testes, symmetrical ejaculatory ducts reaching the same level and no seminal vesicles (tab. 4, fig. 16). The next most frequent type of the reproductive system (20.81% specimens) had the same characters, but well developed seminal vesicles reached the end of ovary (tab. 4, figs 9, 10). In the studied population the reproductive system corresponding with the description of the type specimen by BRUMPT (1900) shown in fig. 1, was found only in few adult specimens of *P. respirans* (3,48 %). The reproductive system described in one specimen by SKET (1968), in our study was observed only in 0,87 % specimens (tab. 4, fig. 20).

CONCLUSION

The reproductive system of *P. respirans* displays a variability, and two main types of this system can be distinguished:

a/ ovaries reaching the first pair of testes, symmetrical ejaculatory ducts reaching the same level, no seminal vesicles (juvenile individuals);

b/ symmetrical ejaculatory ducts reaching the same level, seminal vesicles reaching the end of ovaries (adults).

The structure of the reproductive system is correlated with the individual size, while particular types of the reproductive system in juvenile and adult specimens of *P. respirans* are not characteristic even in 45%.

The analysis of the data presented above shows that it is impossible to describe a typical reproductive system of *P. respirans* without regard of the size class and variability range.

Since the structure of the reproductive system described by BRUMPT (1900) and SKET (1968) based on their respective type specimens is found only in a small fraction of specimens (ca. 4%), it is necessary to redescribe the species, at best based on a series of specimens, and to designate a neotype.

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