Straminipilous organisms growing on herbivorous pirapitinga (*Piaractus brachypomus*) and carnivorous piranha (*Pygocentrus nattereri*) from Poland

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Abstract

We investigated the growth of straminipilous organisms on the skin, muscles and liver of herbivorous pirapitinga (*Piaractus brachypomus*) and carnivorous piranha (*Pygocentrus nattereri*) in water of three different eutrophication levels. Sixteen straminipilous organism species were found growing on the investigated body parts of both species of fish used as baits. The higher number of species was found on the baits of carnivorous species (15) when compared with the ones from the herbivorous pirapitinga (10 species). The highest number of straminipilous organisms species developed on the skin of both species of fish. The highest number of species of straminipilous organisms was observed growing in the water of the Biała river (middle eutrophication), while the lowest number occurred in the baits of vessels with water from the Dojlidy pond (low eutrophication).

Keywords: straminipilous organisms, *Piaractus brachypomus*, pirapitinga, *Pygocentrus nattereri*, red piranha.

Organismos stramenophila em crescimento na herbívora pirapitinga (*Piaractus brachypomus*) e na carnívora piranha (*Pygocentrus nattereri*) da Polônia

Resumo

Investigamos o crescimento de organismos stramenophila sobre a pele, músculos e fígado da herbívora pirapitinga (*Piaractus brachypomus*) e da carnívora piranha (*Pygocentrus nattereri*) em águas de três diferentes níveis de eutrofização. Dezesseis espécies de organismos stramenophila foram encontradas crescendo sobre as partes do corpo investigadas de ambas as espécies de peixes utilizadas como cobaias. O maior número de espécies foi encontrado em cobaias de espécies carnívoras (15), quando comparado com o da herbívora pirapitinga (10 espécies). A maioria das espécies de organismos stramenophila desenvolveu-se sobre a pele de ambas as espécies de peixes. O maior número de espécies de organismos stramenophila foi observado em crescimento nas águas do rio Biała (eutrofização do meio), enquanto o número mais baixo ocorreu em cobaias de vasos com água do lago de Dojlidy (eutrofização baixa).

Palavras-chave: organismos stramenophila, *Piaractus brachypomus*, pirapitinga, *Pygocentrus nattereri*, piranha-vermelha.

1. Introduction

In their natural environment, *Piaractus brachypomus* and *Pygocentrus nettereri* inhabit inland waters of South America (Thorson, 1976; Menni et al., 1996). In many countries, including Poland, both species are reared in amateur aquaria for their characteristic body colouration and original appearance. In aquarium conditions, they sometimes alter their behaviour, e.g. predatory piranha lose their aggressive disposition, become anxious and skittish, retaining, however, their atractive look due to their colourful skin. The aim of this study was to supply some data to extend the list of straminipilous organisms growing on chosen parts of the body of the pirapitinga and piranha specimens, used as baits. The result was to compare the composition, abundance and diversity in water from three trophically different water bodies in Poland.

2. Material and Methods

The analysis involved skin, muscles and liver dissected from a number of fish of two aquarium – reared pirapitinga and piranha. These were individuals of both sexes of herbivorous pirapitinga (*Piaractus brachypomus* Cuvier, 1818) and carnivorous, predatory red piranha (*Pygocentrus nattereri* Kner, 1858). The fishes were killed and 10 g samples of the body organs were immediately dissected and transferred to vessels.

Water samples for the experiments were collected from three different water bodies:

- River Biała, length 9.8 km, a left bank tributary of the Supraśl river flowing through Białystok City;
- Dojlidy Pond, located near Białystok City, area 34.2 ha, maximum. depth 2.85 m, southern shores border with coniferous woods and western shores with Białystok City;
- Fosa Pond, area 2.5 ha, maximum depth 1.75 m. Pond with wild ducks and breeding swans as well as crucian carp, used by anglers. The pond is surrounded by meadows with linden and elm.

Water samples for the analysis and the experiments were collected from each reservoir at a depth of 15-25 cm at a distance of 0.5 m from the bank. The water was filtered through a gauze and then poured to vessels. Nineteen parameters were determined for physical and chemical characteristics of the water using standard methods (Greenberg et al., 1995).

The following procedure was used while determining the presence of straminipilous organisms species on the investigated body organs of the fishes. Water samples (800 mL each) were placed in a 1,000 mL vessel. For each body part of each species from each water body, three vessels were collected. To every vessel were transferred 5-10 small pieces of suitable body part in accordance to the general principles of culture (Fuller and Jaworski 1987). All vessels were enclosed in Petri dishes with the bed turned upside down to prevent possible airborne contamination in the vessels with fungal spores. The vessels were stored at 15 ± 2 °C, with access to daylight resembling natural conditions and following the recommended instructions (Seymour and Fuller, 1987). The analyses of water and experiments were carried out in three parallel repetitions.

The pieces of baits from each vessel were observed every 3-4 days under a light-microscope and the presence of morphological structures (zoospores, antheridia and oogonia) of aquatic straminipilous organisms was recorded. The experiments were carried out for one month.

The straminipilous species were identified using the keys of Batko (1975), Pystina (1998) and the authors of the respective species. The systematics of straminipilous organisms was according to Dick (2001).

3. Results

Hydrochemical parameters of water used in the experiments are presented in Table 1. The most eutrophic was the water of the Fosa pond (most) and the Biała river (middle eutrophication) however, the water of the Dojlidy pond had the lowest content of ammonium nitrogen and phosphates. The highest levels of the BOD_5, COD, CO_2, chlorides, magnesium and iron concentration were found in the Fosa pond. Water from Dojlidy pond contained the lowest levels of COD, CO_2, sulphates, chlorides, magnesium and iron.

Sixteen straminipilous species were found growing on the investigated body parts of fishes (Table 2). The record of a few straminipilous species rare to the hydromycology of Poland and for fishes is worth special note, including *Olpidiopsis saprolegniae*, *Saprolegnia litoralis*, *S. salmonis*, *Pythium diclinum* (syn. *Pythium gracile* Schenk) and *P. torulosum*. The highest number of

Table 1. Chemical and physical properties of water in the three water bodies studied.

Parameters	River Biala	Dojlidy pond	Fosa pond
Temperature (°C)	17.4	15.5	16.2
pH	7.31	7.84	7.02
O_2 (mg.L^{-1})	10.04	9.64	1.84
BOD_5 (mg.L^{-1})	4.82	5.43	9.22
COD (mg.L^{-1})	9.02	7.03	15.09
CO_2 (mg.L^{-1})	15.41	13.24	22.43
Alkalinity in $CaCO_3$ (mval.L^{-1})	4.70	4.68	5.76
N-NH_3 (mg.L^{-1})	0.642	0.610	0.864
N-NO_2 (mg.L^{-1})	0.011	0.013	0.114
N-NO_3 (mg.L^{-1})	0.051	0.062	0.552
P-PO_4 (mg.L^{-1})	1.504	0.458	3.598
Sulphates (mg.L^{-1})	38.02	23.61	25.06
Chlorides (mg.L^{-1})	40.07	18.04	45.21
Total hardness (mg Ca.L^{-1})	92.16	88.56	79.27
Total hardness (mg Mg.L^{-1})	22.34	16.34	26.28
Fe (mg.L^{-1})	0.90	0.70	1.06
Dry residue (mg.L^{-1})	534.0	296.0	429.0
Dissolved solids (mg.L^{-1})	492.0	280.0	370.0
Suspended solids (mg.L^{-1})	42.0	16.0	59.0

straminipilous species developed on the skin of both species of fish. The highest number of species of straminipilous organisms was observed on baits placed in the water from the Biała river, while the lowest number occurred in the water of the Dojlidy pond. Also the higher number of species was found on baits of the carnivorous species of piranha (15) when compared with the ones of the herbivorous pirapitinga (10).

4. Discussion

In this study the highest number of straminipilous species were growing on the cornivorous piranha. A similar phenomenon we observed examining aquatic straminipilous organisms growing on avian excrements. The higher number of straminipilous organism species was found on the excrement of carnivorous birds than in the herbivorous species of mud and waterbirds (Czeczuga and Mazalska, 2000).

The highest number of species of straminipilous organisms was growing on both species of fishes in the water from river Biała, the lowest number in the water from Dojlidy pond. As is known, the water of Biała river is more eutrophic than the water of the Dojlidy pond. We observed similar phenomenon examining the straminipilous organisms growing on the eggs of acipenserid fishes (Czeczuga et al., 1995).

Only *Saprolegnia parasitica* was found on all of the investigated parts of the body of both species of fish. *Saprolegnia parasitica* causes mass death of eggs (Lartzeva, 1986; Hatai et al., 1990; Czeczuga et al., 2005), fish fry (Czeczuga and Muszyńska, 2000) and adult fish specimens (Frick and Reinhold, 1987; Hatai and Hoshiai, 1992). *Olpidiopsis saprolegniae* was first described by Braun (1856) as *Chytridium saprolegniae*, as a parasite of species of the genus *Saprolegnia*. Cornu (1872) transferred this species to the genus *Olpidiopsis*. In this study, *Olpidiopsis saprolegniae* was found growing only on the

Table 2. Straminipilous organisms recorded on six body parts of piranha and pirapitinga obtained in three different water bodies.

Taxa	*Piaractus brachypomus* Cuvier, 1818			*Pygocentrus nattereri* Kner,1858		
	Skin	**Muscles**	**Liver**	**Skin**	**Muscles**	**Liver**
Straminipila						
Hyphochytriomycetes						
Hyphochytriales						
Olpidiopsis saprolegniae Cornu	d			d		
Peronosporomycetes (Oomycetes)						
Saprolegniales						
Achlya debaryana Humphrey	-	-	-	b	-	-
Achlya dubia Coker	b	-	-	b	-	-
Achlya klebsiana Pieters	d	-	-	b	-	-
Achlya oblongata de Bary	b, f	-	-	b, f	-	-
Achlya polyandra Hildebr.	b, f	-	b, f	b, f	-	b, f
Dictyuchus sterilis Coker	-	-	-	b	-	-
Saprolegnia ferax (Gruith.) Thur.	f	b, f	-	d	b, f	-
Saprolegnia litoralis Coker	-	-	-	d	-	-
Saprolegnia monoica Pringsh.	-	-	-	f	-	-
Saprolegnia parasitica Coker	d	b	b, d, f	b, f	b, f	b, d, f
Saprolegnia salmonis Hussein et Hatai	b, f	-	-	f	-	-
Thraustotheca clavata (de Bary) Humphrey	-	-	-	b, d	-	-
Leptomitales						
Leptomitus lacteus Agardh	b	-	-	d	-	b
Pythiales						
Pythium diclinum Tokun.	-	-	-	d	-	-
Pythium torulosum Coker et P. Patt.	d	-	-	-	-	-
Total number of species	10	2	2	15	2	3
Number in water from river Biała	b – 5	b – 2	b – 2	b – 8	b – 2	b – 3
Number in water from Dojlidy pond	d – 4	d – –	d – 1	d – 5	d – –	d – 1
Number in water from Fosa pond	f – 4	f – 1	f – 2	f – 5	f – 2	f – 2

b – River Biała; d – Dojlidy Pond; f – Fosa Pond

skin of both species of fish in the water of pond Dojlidy.This straminipilous species was observed on dead specimens of the crustacean *Moina macrocopa* (Straus,1873; Czeczuga et al., 2008), and *Pallasea quadrispinosa* G.O. Sars,1847 (Czeczuga et al., 2004b), and eggs of *Gasterosteus aculeatus* (L.,1758) (Czeczuga and Muszyńska, 1999b). *Saprolegnia litoralis* was observed growing in the water from Dojlidy pond on the skin of the carnivorous piranha. It was first described by Coker (1923) as water saprotroph from North America. We observed it on the spawn of certain amphibians (Czeczuga et al., 1998) and on dead dragonflies (Czeczuga and Godlewska, 2006). This species was found on eggs of *Misgurnus fossilis* (L.,1758) (Czeczuga and Muszyńska, 1997) and two species of the North Pacific salmon *Oncorhynchus* (Czeczuga and Muszyńska, 1996). *Saprolegnia litoralis* has been reported growing also on the elvers eel, *Anguilla anguilla* (L.,1758) (Czeczuga and Muszyńska, 2000). On the skin of both species of fishes *Saprolegnia salmonis* was found growing. It was first described in Japan on the eggs of sockeye salmon, *Oncorhynchus nerka* (Walbaum,1792) (Hussein et al., 1999). We recently observed growth of this species on the eggs of lavaret (*Coregonus lavaretus,* L.,1758) in Mazury (Czeczuga et al., 2004c) and Kaszuby in Poland (Czeczuga et al., 2004a). *Saprolegnia salmonis* was found also on the eggs of *Salmo trutta* (L.,1758) (Czeczuga et al., 2005). *Pythium diclinum* is known as a parasite of aquatic algae, especially green algae (Batko, 1975). We have hitherto observed its growth on the eggs of the crucian carp *Carassius carassius* (L.,1758) (Czeczuga and Muszyńska, 1999a). It should be noted that Sati and Khulbe (1983) observed growth of *Pythium diclinum* as a parasite on the gills of a few fish species in India. This species was first described by Schenk (1859) as parasitic in algae of the genera *Spirogyra*, *Cladophora* and *Nitella* in the botanic gardens of Wűrzburg, Germany. In our study, this species of straminipilous organism was observed growing on the skin of carnivorous piranha in water from Dojlidy pond, whereas the second species of this genus, *Pythium torulosum*, was found also on the skin of herbivorous pirapitinga in the water from the Dojlidy pond. *P. torulosum* was first described by Coker and Patterson (1927) from a small stream in North Carolina (USA). It is known as a phyto-and zoosaprophyte in various types of trophic water bodies (Czeczuga and Snarska, 2001). This species was found also on certain species of dead planktonic (Czeczuga et al., 2002) and benthic crustaceans (Czeczuga et al., 1999).

A few species of *Pythium* had already been encountered in fishes (Diler, 1995; Czeczuga, 1996). *Pythium ultimum* Trow was found on the eggs of *Lepomis macrochirus* Raf.,1875 (Scott and O´ Bier, 1962) and on the sturgeon *Acipenser nudiventris* Lovetzky,1834 (Czeczuga et al., 1995), and on *Tilapia* fish (El-Sharouny and Bedran, 1995), and on eggs of *Hucho hucho* (L.,1758) salmon (Czeczuga et al., 1996). *Pythium hydnosporum* (Mont.) J. Schröt. was observed on the eggs of white fish, vendace and pike (Czeczuga and Muszyńska, 1998a; 1999b). *Pythium middletonii* Sparrow was found on the eggs of several fish species in a hatchery in Russia (Florynskaya, 1969). *Pythium pulchrum* Minden was found on eggs of *Perca fluviatilis* (L.,1758) (Czeczuga and Muszyńska, 1999b) and *Pythium rostratum* E. J. Butler on eggs of lamprey *Lampetra planeri* (Bloch,1784) (Czeczuga, 1997). In the water bodies of Japan, *Pythium monospermum* Pringsh. as a parasite of salmonid eggs often occurred (Kitancharoen and Hatai, 1998; Kitancharoen et al., 1997).

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