

Diversity of lampreys and fishes of the Upper Vistula River drainage, Poland: present state and future challenges

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Abstract. There have been some 57 lamprey and fish species recorded in the Upper Vistula River drainage (S-E Poland). Among these there are a number of species-complexes (*Carassius auratus*, *Gobio gobio*, *Cobitis taenia*) with unresolved taxonomy. Identity of some others (*Barbus waleckii*, *Romanogobio albipinnatus*, *Cottus gobio*) is questionable and needs a review. Phylogenetic relationships of another ones (*Eudontomyzon mariae*, *Lampetra planeri*, *Lampetra fluviatilis*) is also under debate. Knowledge about the distribution of many species is very scarce and needs to be filled. In the current work we briefly summarise present state of the diversity and classification of lampreys and fishes of the Upper Vistula drainage and point some urgent questions that have arose in recent years and are waiting for new solutions.

Key Words: biodiversity, evolutionary species concept, ichthyofauna, review, species-complex, taxonomy.

Streszczenie. W dorzeczu Górnej Wisły stwierdzono dotąd ok. 57 gatunków minogów i ryb. Pośród nich znajdują się pewne zespoły gatunków (*Carassius auratus*, *Gobio gobio*, *Cobitis taenia*), których klasyfikacja pozostaje niejasna. Tożsamość innych (*Barbus waleckii*, *Romanogobio albipinnatus*, *Cottus gobio*) jest niepewna i wymaga gruntownej rewizji. Jeszcze inne (*Eudontomyzon mariae*, *Lampetra planeri*, *Lampetra fluviatilis*) są przedmiotem dyskusji filogenetycznych. Wiedza na temat rozprzestrzenienia wielu gatunków jest szcążkowa i wymaga uzupełnienia. W niniejszej pracy krótko podsumowano aktualny stan wiedzy w tym zakresie, jak również wskazano na powstałe w ostatnich latach pytania, które wymagają nowych rozwiązań.

Key Words: bioróżnorodność, ewolucyjna koncepcja gatunku, ichtiofauna, przegląd, taksonomia, zespoły gatunków.

Rezumat. S-au identificat un număr de 57 specii de chișcari și pești în cursul superior al Vistulei (sud estul Poloniei). Printre acestea se numără și așa numitele complexuri de specii cu taxonomie încă neelucidată (*Carassius auratus*, *Gobio gobio*, *Cobitis taenia*). Identitatea altor câtorva este încă îndoielnică (*Barbus waleckii*, *Romanogobio albipinnatus*, *Cottus gobio*) și necesită o revizuire. Cunoștințele distribuției multor specii sunt foarte sărace în date și necesită adăugiri. În lucrarea aceasta sumarizăm stadiul actual, diversitatea și clasificarea chișcarilor și peștilor din cursul superior al Vistulei și indicăm câteva probleme urgente apărute în ultimii ani, care așteaptă soluții de rezolvare.

Cuvinte cheie: biodiversitate, concept evolutiv de specie, ichtiofaună, revizuire, complex de specie, taxonomie.

Introduction. The Vistula is the largest river draining to the Baltic Sea. Most of its catchment area belongs to the territory of Poland, and only very few tributaries are in within the borders of Slovakia and Ukraine. An about 380-kilometer uppermost stretch of the river, from its spring to the confluence with a large right-bank tributary, the San River, is known as the Upper Vistula (Dynowska & Maciejewski 1991).

Knowledge about the occurrence, distributions and taxonomy of lampreys and fishes of the Upper Vistula drainage has been developed for over a century. First valuable faunistic reviews regarding this area have been by Wałęcki (1864) and Nowicki (1882, 1889). Then, after the World War II, a significant contribution by Staff (1950) has appeared. More recently the ichthyofauna of the Upper Vistula was investigated on a

large scale by Bieniarz & Epler (1972, 1991) and Włodek & Skóra (1989). Also Backiel (1983) and Backiel & Penczak (1989) greatly contributed the knowledge about the ichthyofauna of that area. Since then numerous ichthyologists have investigated the Upper Vistula River along with most of its tributaries. This has led Witkowski & Kotusz (2008) to a conclusion that most of the Vustula River has been successfully covered by ichthyological research. Of course, this not necessary mean that all problems regarding the ichthyofauna of the Upper Vistula drainage have been solved out. Contrary, progress of the knowledge results in numerous new questions awaiting answers. In addition, one should note that although the ichthyofauna of the most of the Vistula tributaries has been well investigated indeed, the knowledge about the fish fauna of the main river still remains insufficient. It mainly due to general problems that one has to challenge when trying to investigate large rivers: deep water, wide river bed and high river discharge (Casselmann et al 1990; Backiel 1993). Additional difficulties have to faced regarding the sampling and field identification of certain taxa (e.g., lampreys) (Moser et al 2007; Drag-Kozak et al, in prep.).

Table 1

List of the lampreys and fishes known to occur in the Upper Vistula River drainage, Poland (according to the authors listed in the references).

No.	Scientific name	Common name	Remarks
Petromyzontidae			
1	<i>Eudontomyzon mariae</i>	Ukrainian brook lamprey	See remarks in the text
2	<i>Lampetra fluviatilis</i>	River lamprey	See remarks in the text
3	<i>Lampetra planeri</i>	European brook lamprey	See remarks in the text
Acipenseridae			
4	<i>Acipenser sturio</i> and/or <i>Acipenser oxyrinchus</i>	Baltic sturgeon	Extinct
Anguillidae			
5	<i>Anguilla anguilla</i>	European eel	
Cyprinidae			
6	<i>Abramis brama</i>	Common bream	
7	<i>Alburnoides bipunctatus</i>	Spirlin	
8	<i>Alburnus alburnus</i>	Bleak	
9	<i>Aspius aspius</i>	Asp	
10	<i>Ballerus ballerus</i>	Zope	
11	<i>Ballerus sapa</i>	White-eye bream	
12	<i>Barbus barbus</i>	Common barbel	
13	<i>Barbus carpathicus</i>	Spotted barbel	
14	<i>Barbus waleckii</i>	Walecki's barbel	Possible hybrid <i>B. barbus</i> x <i>B. carpathicus</i>
15	<i>Blicca bjoerkna</i>	Silver bream	
16	<i>Carassius auratus</i> complex	Godfish, silver crucian carp, Prussian carp	Including <i>C. auratus</i> and <i>C.</i> "gibelio"; non-native
17	<i>Chondrostoma nasus</i>	Nase	
18	<i>Ctenopharyngodon idella</i>	Grass carp	Non-native
19	<i>Cyprinus carpio</i>	Common carp	Non-native
20	<i>Gobio gobio</i> complex	Common gudgeon	See remarks in the text
21	<i>Hypophthalmichthys molitrix</i>	Silver carp	Non-native
22	<i>Hypophthalmichthys nobilis</i>	Bighead carp	Non-native
23	<i>Leucaspis delineatus</i>	Sunbleak	
24	<i>Leuciscus idus</i>	Ide	
25	<i>Leuciscus leuciscus</i>	Common dace	
26	<i>Pelecus cultratus</i>	Sabre	Not seen since the 19 th century
27	<i>Phoxinus phoxinus</i>	European minnow	
28	<i>Pseudorasbora parva</i>	Topmouth gudgeon	Non-native; established

Table 1. (cont.)

No.	Scientific name	Common name	Remarks
29	<i>Rhodeus amarus</i>	European bitterling	
30	<i>Romanogobio albipinnatus</i> complex	Whitefin gudgeon	
31	<i>Romanogobio kesslerii</i>	Kessler's gudgeon	
32	<i>Rutilus rutilus</i>	Roach	
33	<i>Scardinius erythrophthalmus</i>	Rudd	
34	<i>Squalius cephalus</i>	Chub	
35	<i>Tinca tinca</i>	Tench	
36	<i>Vimba vimba</i>	Vimba bream	
Salmonidae			
37	<i>Hucho hucho</i>	Danubian salmon	Non-native; established
38	<i>Salmo salar</i>	Atlantic salmon	Extinct; restitution action is ongoing
39	<i>Salmo trutta</i>	Trout	Including 3 "morphs": <i>trutta</i> (migratory sea trout), <i>fario</i> (stationary brown trout) and <i>lacustris</i> (stationary lake trout); see the text
40	<i>Thymallus thymallus</i>	European grayling	
Siluriformes			
41	<i>Silurus glanis</i>	European catfish	
Ictaluridae			
42	<i>Ameiurus melas</i>	Black bullhead	Non-native; established
43	<i>Ameiurus nebulosus</i>	Brown bullhead	Non-native; established
Lotidae			
44	<i>Lota lota</i>	Burbot	
Cottidae			
45	<i>Cottus gobio</i>	Bullhead	See remarks in the text
46	<i>Cottus poecilopus</i>	Alpine bullhead	
Gasterosteidae			
47	<i>Gasterosteus aculeatus</i>	Threespine stickleback	
48	<i>Pungitius pungitius</i>	Nine-spine stickleback	
Percidae			
49	<i>Gymnocephalus cernua</i>	Ruffe	
50	<i>Perca fluviatilis</i>	Perch	
51	<i>Sander lucioperca</i>	Sander	
Odontobutidae			
52	<i>Perccottus glenii</i>	Amur sleeper	Non-native; established
Cichlidae			
53	<i>Oreochromis niloticus</i>	Nile tilapia	Non-native
Balitoridae			
54	<i>Barbatula barbatula</i>	Stone loach	
Cobitidae			
55	<i>Cobitis taenia</i> complex		Diploid-polyploid complex
56	<i>Misgurnus fossilis</i>	Weatherfish	
57	<i>Sabanejewia baltica</i>	Baltic golden loach	See the text

Classification of the lamprey and fish fauna of Poland was established due to some fundamental books, largely the first and the second edition of "The freshwater fishes of Poland" edited by Brylińska (1986 and 2000, respectively) and "Fishes and lampreys" by Rolik & Rembiszewski (1987). These works have summarised numerous studies on particular taxa. Both books, however greatly contributing Polish ichthyology, have

become somehow out-of-date during the last decade(s). Popularisation of certain modern tools and techniques, especially of the molecular biology, have considerably changed the taxonomy of fishes (cf. Kottelat & Freyhof 2007). Also a shift from the biological to phylogenetic and evolutionary species concept has strongly affected European systematic ichthyology (Kottelat 1997; Wiley & Mayden 2000; Kottelat & Freyhof 2007).

Material and Method. In the currently presented study we shortly summarise recent discoveries and changes in the classification of some lamprey and fish taxa occurring, or thought to occur, in the Upper Vistula drainage. The questionable taxa were reconsidered in the context of newly published studies, as well as confronted with the own (field) experience of the authors. Also some new findings regarding the distribution of certain taxa were taken into account. The evolutionary species concept (Kottelat 1997; Wiley & Mayden 2000; Kottelat & Freyhof 2007) was consecutively used throughout this work. Obviously the list presented below is not exhaustive and discusses only some major issues that should be addressed in the nearest future.

Results and Discussion

Order **Petromyzontiformes**

Family **Petromyzontidae**

Eudontomyzon Regan, 1911

Occurrence of the Ukrainian brook lamprey *Eudontomyzon mariae* (Berg, 1931) in the Upper Vistula drainage was discovered by Oliva & Hensel (1962). In recent years numerous new localities of this species have been found throughout the Upper and Middle Vistula drainage (Witkowski 2001; Drag-Kozak et al, in prep.). Some authors (e.g., Rembiszewski 1967), taking into account possible confusions with other lamprey species and very scarce data on its distribution, hypothesised that *E. mariae* is much wider distributed than it has been usually presumed. On the other hand some other scientists (e.g., Marszał 2001) suggested dispersion of this species throughout the country in recent decades. Just very recently Blank et al. (2008), analysing mitochondrial DNA variation, have postulated reintegration of *E. mariae* with the *Lampetra* genus. In these context, and regarding our own observations (Drag-Kozak et al, in prep.), we strongly admit a necessity of reassessing validity of numerous identifications of "brook lamprey" populations in the Upper Vistula drainage.

Lampetra Bonnaterra, 1788

The problem of origin and phylogenetic relationships of migratory parasitic and stationary non-parasitic lampreys has been a subject of endless discussions among ichthyologists. Recent molecular studies revealed very complex relationships among European populations, usually classified into two closely related species, the river lamprey *Lampetra fluviatilis* (Linnaeus, 1758) and the European brook lamprey *Lampetra planeri* (Bloch, 1784). The study of Espanhol et al. (2007) pointed to occurrence in Europe of at least three evolutionary lineages, and to possible negation of the monophyly of *L. planeri*. However, neither Espanhol et al (2007), nor Blank et al (2008) could definitely recognised if they are two different species, or only "ecotypes" of a single species. Lasne et al. (2010) observed frequent phenomena of commune spawning of the both lampreys in France. Pereira et al (2010) revealed occurrence within *L. planeri* in Portugal of a number of independent evolutionary lineages, distinct from each other, as well as from migratory *L. fluviatilis*. Data regarding the occurrence of *L. fluviatilis* in the Upper Vistula are about one-century old (Nowicki 1889), all the more taxonomic position of *L. planeri* populations should be reinvestigated.

Family **Cyprinidae**

Barbus Cuvier et Cloquet, 1816

Traditionally three species are considered to occur in the Upper Vistula drainage: the barbel *Barbus barbus* (Linnaeus, 1758), the spotted barbel *Barbus petenyi* Heckel, 1852, and the Walecki's barbel *Barbus waleckii* Rolik, 1970. According to Kotlík et al (2002) the spotted barbel should be referred as to *Barbus carpathicus* Kotlík, Tsigenopoulos, Ráb et Berrebi (2002). Nonetheless, in numerous publications it is still called *B. petenyi*. The third barbel, *B. waleckii*, originally described as a subspecies of *Barbus cyclolepis* Heckel, 1837 has been considered a valid species by some authors (e.g., Bogutskaya et al 2002; Kottelat & Freyhof 2007). In the context of recent studies (Konopiński et al 2007) it seems a hybrid *B. barbus* x *B. carpathicus*. This point is also supported by our own observations that Walecki's barbel occurs only in the rivers where the two other barbels are present, as well as by some external morphological traits.

Carassius Nilsson, 1832

Usually two species of this genus are considered to occur in Poland: native crucian carp *Carassius carassius* (Linnaeus, 1758) and originating to Asia, invasive Prussian carp (silver crucian carp or Gibel carp), most often treated as a subspecies of the goldfish, *Carassius auratus gibelio* (Bloch, 1782) (Nowak et al 2008a). The latter is widely thought to consist in Poland solely of gynogenetic all-female stocks, with only occasional occurrence of very rare males (e.g., Rolik & Rembiszewski 1987). It is not the case and, at least in some populations, the males are much more common (Nowak & Szczerbik, unpubl.). Origin of these males is not clear (for the discussion, see: Abramenko et al 2004; Vekhov 2007; Liasko et al 2010). Recently another lineage of the Far East "goldfish", the ginbuna *Carassius langsdorfii*, has been found in Europe (Kalous et al 2007). In this context taxonomic identity of the Polish populations of the Prussian carp should be reassessed.

Gobio Cuvier, 1816

Taxonomic status of the common gudgeon *Gobio gobio* (Linnaeus, 1758) has been discussed from the 1960s to present (e.g., Rolik 1965; Nowak et al 2008a). Just very recently underestimated diversity of this genus has been revealed by molecular methods (Mendel et al 2008). Application of combined morphological and molecular methods led to a conclusion that the territory of Poland is inhabited by the *G. gobio* complex, not only *G. gobio* sensu stricto (Nowak et al 2009). Nevertheless, this issue needs more attention and more detailed studies are ongoing (Nowak & Mendel, unpubl.).

Family **Cobitidae**

Sabanejewia

Traditionally the golden loach in Poland has been identified as *Sabanejewia aurata* (de Filippi, 1863), a species with very wide range of distribution. According to Kottelat & Freyhof (2007) this name is available only for the populations from the Caspian Sea basin. Probably *Sabanejewia baltica* Witkowski, 1994 is the very species present in the Upper Vistula drainage, however presence of *Sabanejewia balcanica* (Karaman, 1922) cannot be ruled out (Kottelat & Freyhof 2007).

Family **Salmonidae**

Salmo Linnaeus, 1758

Taxonomic confusion regarding this genus was fairly said by Kottelat & Freyhof (2007) to be "a shame of European ichthyology". Native trouts in the Upper Vistula drainage were traditionally treated as a one species (*Salmo trutta* Linnaeus, 1758) with three "forms": anadromous *S. trutta* morpha *trutta*, non-migratory *S. trutta* m. *fario*, and land-locked *S. trutta* m. *lacustris*. The first one has been absent from the Upper Vistula since the built of the Włocławek Dam Reservoir in the middle course of the Vistula River and even earlier devastation of the spawning grounds in main tributaries of the Upper Vistula. The last one "form", *lacustris*, native to some lakes in northern Poland, was introduced to certain

dam reservoirs within the Upper Vistula drainage (Bieniarz & Epler 1991). Their mutual taxonomic relationships, as well as conservation status should be reassessed.

Family **Ictaluridae**

Ameiurus Rafinesque, 1820

Originally a subgenus of *Ictalurus*. For a long time only one species, the brown bullhead *Ameiurus nebulosus* (Lesueur, 1819), has been thought to occur in the territory of Poland (e.g., Rolik & Rembiszewski 1987). Irrespective, just very recently another ictalurid catfish, the black bullhead *Ameiurus melas* (Rafinesque, 1820), has been found (Nowak et al 2010a, b). Both species closely resemble each other and thus confusions are possible. It has been hypothesised that *A. melas* was introduced along with *A. nebulosus* in the end of the 19th century and remained unrecognised for over a century (Nowak et al 2010b). Therefore it seems possible that *A. melas* may be much wider distributed within the Upper Vistula drainage.

Family **Cottidae**

Cottus Linnaeus, 1758

Two species have been considered to occur in the Upper Vistula drainage: the common bullhead *Cottus gobio* Linnaeus, 1758 and the Alpine bullhead *Cottus poecilopus* Heckel, 1837. According to Kottelat & Freyhof (2007) the former species is restricted in the Baltic Sea basin to the rivers and stream of Scandinavia, Russia, Estonia and Germany. In southern part of the Baltic Sea basin a closely related species, *Cottus microstomus* Heckel, 1837, is present (Kottelat & Freyhof 2007). This issue should also be re-examined in details.

Conclusions. As it was shown above, the knowledge about the distribution and taxonomy of lampreys and fishes in the Upper Vistula drainage is not so perfect, as it ought to be. Despite the eminent work performed during the last century, a number of unresolved problems still wait for adequate solution. Therefore future investigations including modern methods (e.g., molecular biology) and well-prepared field researches are needed in order to elaborate the knowledge about the real biodiversity of the lampreys and fishes of the Upper Vistula River drainage.

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