Folia Zool. – 53(2): 215–226 (2004)

Red List of the ichthyofauna of the Czech Republic: Development and present status

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Received 3 July 2003; Accepted 15 December 2003

A b s t r a c t. Four lamprey species and 55 fish species are considered autochthonous taxa in the Czech Republic. In recent years, as a result of spontaneous migrations, the native ichthyofauna has been increased by three species *Sander volgensis, Gymnocephalus baloni, Proterorhinus marmoratus)* which, in view of their autochthonous occurrence in the Central European region, are evaluated as native. At present, according to the criteria of the IUCN (2001) version 3.1, two lamprey species and 6 fish species are evaluated as "regionally extinct". Most of these taxons are denoted as anadromous. One species has been classified in the category "Extinct in the wild". Two lamprey species and 25 fish species are considered to be endangered to various extent: one lamprey species and 10 fish species are classified as "Critically endangered"; one lamprey species and 5 fish species as "Endangered"; ten fish species as "Vulnerable". In the course of the past two centuries, attempts have been made at introducing about 30 fish species (see L u s k et al. 1998, H a n e l 2003); of these, the introduction of 11 species can be evaluated as successful. Only four non-native species have established stable and naturally reproducing populations in natural conditions (*Pseudorasbora parva, Carassius auratus, Ameiurus nebulosus, Gasterosteus aculeatus*).

Key words: native and non-native species, biodiversity, endangered species, protection, Central Europe

Introduction

Evaluation of species in light of the degree to which they are endangered and the compilation of so-called Red Lists and Red Books has had an almost fifty-year tradition (IUCN 1962). Endeavours to find a unified scale for evaluating both plant and animal biota have significantly slowed and complicated the development and evaluation of these problems. The classification systems have successively developed from general categories down to the present, fairly unequivocally defined categories and detailed determination criteria. In the past, the lists that can express the degrees of jeopardy to particular taxons inhabiting large geographic units (the World, Europe, the Palaearctic Region, etc.) were mostly based on estimations that considered concrete local items of knowledge. At present, it is generally accepted that the compilations of regional and continental red lists should be based on local, national or state Red Lists that can most precisely evaluate the status of the particular species in territories unequivocally defined in hydrological or political terms. It has been recommended to compile a national version of a Red List, using the most recent variant 3.1 of the IUCN rules (IUCN 2001) and taking into consideration their modification for the local evaluation (G ä r d e n f o r s et al. 2001).

The first attempts at evaluating the degree of jeopardy to the ichthyofauna, including the territory of the Czech Republic, were made during the existence of the former Czechoslovakia

(until 1992). Those evaluations included the ichthyofauna of Slovakia, which partly differs from that of the Czech Republic as regards species composition, population status and hydrological conditions. The first analysis of the degree of danger to the ichthyofauna of the Czech Republic (B a r u š et al. 1981) comprised 18 fish species divided into three categories: critically endangered, strongly endangered, and endangered. The Red Book of Rare and Endangered Vertebrates (B a r u š et al. 1989) is already based on the IUCN classification), available at that time, using the so-called socio-ecological index, which has contributed to the precision of the status of particular taxa. For the conditions of Czechoslovakia, additional forms of Red Lists have been published (B a r u š et al. 1988, L u s k 1989).

In the Czech Republic, the first Red List of lampreys and fishes was compiled according to the IUCN rules (1994) separately for the river networks of the different seas (L u s k et al. 1994, L u s k 1996). Expert ichthyologists have agreed that the Red List for the Czech Republic will be reviewed at five-year intervals. Therefore, the Red List version 1995 (L u s k & H a n e l 1996) was followed by the Red List version 2000 (L u s k & H a n e l 2000, L u s k et al. 2002), adhered in to the emendated evaluation system (G ä r d e n f o r s et al. 1999, IUCN 1999), which differs only slightly from the present version 3.1 (IUCN 2001).

Material and Methods

The fact that the hydrographical network of the Czech Republic (780,640 km^2) empties into three different seas (Black: 25.4%; North: 65.2%; Baltic: 9.4%), complicates to some extent the classification of the status of particular fish species (Fig. 1). The occurrence of a part of the native ichthyofauna is confined to only one or two basins. With regard to their country-wide distribution, the status of certain species differs considerably in different sea basins. Such species are classified in a single category and their status in the different basins is detailed in the commentary.

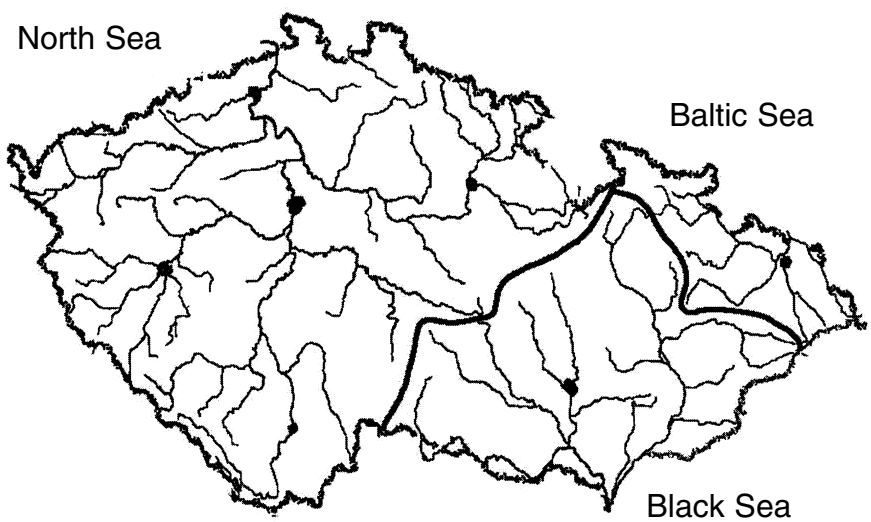

Fig. 1. Division of the territory of the Czech Republic according to the hydrographic network of the basins of the North, Baltic and Black Seas.

The present Red List is based on the Red List version 2000 (Lusk & Hanel 2000, Lusk et al. 2002), considering the most recent modification to the Red List categories of version 3.1 (IUCN 2001) as well as the recommendation to apply the Red List criteria at regional level (Gärdenfors et al. 2001). Additionally, we have considered the actual data, which alter slightly the status of some of the species (Lusk et al. 2002). All lamprey and fish species considered to be autochthonous to the ichthyofauna of the Czech Republic (Lusk et al. 2002) have been estimated and classified according to the above criteria. Each of the categories is accompanied by a commentary explaining the status of the particular species if necessary.

In applying the Red List criteria on the regional level (Gärdenfors et al. 2001) in the Czech Republic, we note that have found the following situation pertaining to the territory. Its hydrographical network belongs to three sea basins which at present are not interconnected in whatever ways (channels, canals, etc.). The fragmentation of within-basin hydrological systems has attained such a high level due to human activation that most fish and lamprey populations, contrary to the initial status, cannot exchange individuals with other populations even within one and the same drainage area. This situation can be exemplified by such species as *Chondrostoma nasus, Vimba vimba* (Lusk 1995, 1995a), and *Cobitis elongatoides* (Lusk et al. 2000). Thus, for instance, the initial continuous range of the two former species is a mosaic at present, with some of the population fragments becoming locally extinct or nearly so. A similar situation can be found in most species. Similarly, the connection with the hydrological systems of the surrounding countries, free of migration barriers, is limited to sections, just a few kilometres long, of rivers that cross their borders (the rivers Labe, Odra and Morava). That is why we have refrained from the possible use of criteria that could be employed on the regional level and have adhered, save for minor formal exceptions, to the original 3.1 version of the Red List criteria (IUCN 2001). The basic criteria A (reduction in population size), B (geographic range), C and D (population size with limit of specimens), and E (probability of becoming extinct or vanished before a concrete time limit) have been provided, in their subcriteria (A – 1,2; B – 1,2; and C – 1,2), with criteria (a to e) and numerical limits. The categories "critically endangered", "endangered", and "vulnerable" have been provided with evaluation limits expressed verbally or numerically. The result of the application of the evaluation system is expressed by codes (A, a, 1) under the particular species; for more detail see IUCN (2001)

Results and Discussion

Red List

I – EXTINCT (EX)

Petromyzon marinus Linnaeus, 1758; *Lampetra fluviatilis* Linnaeus, 1758; *Huso huso* (Linnaeus, 1758); *Acipenser sturio* Linnaeus, 1758; *Alosa alosa* (Linnaeus, 1758); diadromous form of trout *Salmo trutta* Linnaeus, 1758; *Coregonus oxyrinchus* (Linnaeus, 1758); *Rutilus pigus* (Lacépède, 1803); *Platichthys flesus* (Linnaeus, 1758).

Except for the taxon *R. pigus*, most of the above species entered our territory quite exceptionally during their anadromous migrations (Frič 1872, 1883, 1908, Flasar & Oliva 1975, Flasar & Flasarová 1976, 1981, Lohnisky 1977). The rare occurrence of *R. pigus* also date from the 19th and the first half of the 20th century, respectively (Lusk et al. 2002a).

II – EXTINCT IN THE WILD (EW)

Hucho hucho (Linnaeus, 1758)

H. hucho is a native species in the basin of the Black Sea (the rivers Morava and Dyje). At present, its local and time-limited occurrence depends on stocking material from an artificial culture. Conditions that would permit the formation of a permanent population under natural conditions are not available (L u s k 1976).

III – THREATENED

III-1 – Critically endangered (CE)

Eudontomyzon mariae (Berg, 1931); criteria: A (1-a, 2), B (2-a,b), D, E
Salmo salar Linnaeus, 1758; criteria: not determined for the present
Abramis sapa (Pallas, 1811); criteria: B (2-c, e)
Gobio kesslerii Dybowski, 1862; criteria: B (1), C (2-a)
Pelecus cultratus (Linnaeus, 1758); criteria: A (1), B (2-a, c)
Cyprinus carpio (wild form) Linnaeus, 1758; criteria: B (2-a, c), D
Sabanejewia balcanica (Karaman, 1922); criteria: B (2-a), C
Gymnocephalus baloni Holčík et Hensel, 1974; criteria: B (2-a, c), C
Gymnocephalus schraetser (Linnaeus, 1758); criteria: B (2-c, e)
Zingel zingel (Linnaeus, 1758); criteria: B (2-a, c), D
Zingel streber (Siebold, 1863); criteria: B (2-a, c), C

Starting in 1998, the drainage area of the lower reaches of the River Labe (the rivers Kamenice and Ohře) was stocked with the juveniles of *S. salar.* In the autumn of 2002, four salmon, 3+ years of age, were caught in the lower section of the River Kamenice. That would suggest a possible renewed occurrence of this species in the drainage area of the lower reaches of the River Labe (B e n d a 2003, D u š e k et al. 2003). All the remaining species mentioned above are only autochthonous for the Morava and Dyje river networks (the Danube system, the Black Sea basin). Their occurrence is considerably limited locally, which in fact tends to increase the danger threatening to their existence. *A. sapa, P. cultratus, C. carpio* (wild form), *G. baloni, G. schraetser, Z. zingel* and *Z. streber* occur in the lower stretches of the rivers Morava (in a stretch about 30 km long) and Dyje (in a stretch about 25 km long) (L u s k et al. 2002, 2002a). Their initial range consisted of a considerably longer part of the stream of the rivers Morava and Dyje (L u s k & H o l č í k 1998). The Ukrainian lamprey, *E. mariae,* was initially localised only in the Račí potok Brook in a limited extent. At present, only the remains of the population occur there, and the probability that this species may become extinct in the Czech Republic is great (K u x 1969, H a n e l & L u s k 1998). *G. kesslerii* occurs only in the River Bečva (a tributary to the River Morava) and in the section of River Morava under mouth of Bečva River. The present populations of this species are stabilised (L u s k et al. 2000a, M e r t a & L u s k 2004). *Sabanejewia balcanica* initially occurred in the River Bečva (K u x 1957), but intensive surveys in 1997–2000 did not reveal its presence there any more (L u s k et al. 2000a). Therefore the species was classified as extinct (L u s k & H a n e l 2000). In 2001, the occurrence of *Sabanejewia balcanica* was discovered in the River Vlára (the Váh drainage area, Danube basin) in the territory of the Czech Republic. The species has spread there through spontaneous migration from the lower part of the River Vlára lying in the territory of Slovakia (L u s k et al. 2002c).

III-2 – Endangered (EN)

Lampetra planeri (Bloch, 1784); criteria: A (1-a,b)
Chondrostoma nasus (Linnaeus, 1758); criteria: A (1-a,b)
Rhodeus sericeus (Bloch, 1782); criteria: A (1b)
Leucaspius delineatus (Heckel, 1843); criteria: A (1b)
Misgurnus fossilis (Linnaeus, 1758); criteria: A (1-a,b)
Cobitis elongatoides Bacescu et Mayer, 1969; criteria: A (1-a,b)

C. nasus is native only in the drainage areas of the rivers Morava and Odra. In the second half of the 20th century, the species was also stocked into the drainage area of the River Labe where it did not occur previously. In some localities, it did produce stable populations but these have not been evaluated in this review. The erection of dams on the middle sections of rivers, stream fragmentation and migration barriers, together with water pollution, have resulted in the extinction or heavy devastation of populations of *C. nasus* (L u s k 1995, L u s k et al. 2002). *R. sericeus* has become scarce, especially in the drainage areas of the rivers Labe and Odra. *L. delineatus* is native to various habitats in the flood plains of major rivers. The species could find supplementary habitats even in extensively managed fishponds. At present, a considerable number of the floodplain habitats have vanished and the intensity of fishpond management has increased. As a result, the occurrence of *L. delineatus* has become limited to several localities only, and the numbers of its populations are mostly very low.

Previously, spined loach populations were evaluated as *Cobitis taenia* in the major part of Europe, incl. the Czech Republic (L e l e k 1987, B a r u š , O l i v a et al. 1995). However, karyotype examinations carried out in the late 20th century have revealed that the territory of the Czech Republic is inhabited by populations of *Cobitis elongatoides* and by those denoted as hybrid diploid- polyploid (HDP) complexes. So far, the pure diploid *C. elongatoides* populations have been discovered in the drainage area of the River Lužnice and in the upper part of that of the River Dyje. Two variants of populations denoted as HDP complexes occur in the Czech Republic. In the drainage area of the River Labe has in they consist, on the one hand, of diploid individuals of *C. elongatoides* and, on the other, of hybrid individuals (mostly triploids 3n) whose karyotype consists of 2 n of *C. elongatoides* plus 1 n of *C. taenia.* The drainage area of the River Morava is inhabited by a HDP complex of 2 *C. elongatoides* x 1 *C. tanaitica* (R á b et al. 2000, Š l e c h t o v á et al. 2000, L u s k et al. 2000). For the sake of simplicity, we recommend to include both the pure diploid and the so-called HDP complex populations under a comprehensive name, *C. elongatoides,* for the purpose of their conservation.

III-3 – Vulnerable (VU)

Leuciscus idus (Linnaeus, 1758); criteria: A (1-a,b)
Phoxinus phoxinus (Linnaeus, 1758); criteria: A (1-a,b)
Gobio albipinnatus Lukasch, 1933; criteria: A (1-a)
Alburnoides bipunctatus (Bloch, 1782); criteria: A (1-a)
Abramis ballerus (Linnaeus, 1758); criteria: A (1-a)
Vimba vimba (Linnaeus, 1758); criteria: A (1-a)
Carassius carassius (Linnaeus, 1758); criteria: A (1-a)
Lota lota (Linnaeus, 1758); criteria: A (1-a)
Cottus gobio Linnaeus, 1758; criteria: A (1-a,b)
Cottus poecilopus Heckel, 1837; criteria: A (1-a,b)

The population status of *V. vimba* differs in different basins. In the drainage areas of Morava and Odra rivers, *V. vimba* had been among the most abundant and important fish species (J e i t t e l e s 1863, K i t t 1905). At present, the status of this species is evaluated as critically endangered in those areas, since only local remains of the initial populations occur there except for the River Bečva (L u s k et al. 1996). In the drainage areas of the rivers Labe and Vltava a considerably more favourable population status can be found, and the species is evaluated there as vulnerable.

IV – NEAR THREATENED (NT)

Thymallus thymallus (Linnaeus, 1758); *Barbus barbus* (Linnaeus, 1758); *Anguilla anguilla* (Linnaeus, 1758)*; Sander [=Stizostedion] volgensis* (Gmelin, 1788).

In the past, *T. thymallus* was among the less abundant fish species of limited occurrence. It was not until its intensive stocking into streams that *T. thymallus* has become, besides the brown trout *Salmo trutta* and *Salmo labrax*, the most numerous and economically important fish species in trout streams (L u s k et al. 1987). *A. anguilla* is native to the River Labe basin and probably also that of the Odra. In the drainage area of the River Morava (Black Sea basin) it is considered non-native and occurs there solely as the result of stocking. At present, the occurrence of eel in our waters depends solely on the import and releasing of glass eels, even though the occurrence of small eel has recently been recorded in the River Labe below Střekov, apparently connected with their natural migration from the sea (V o s t r a d o v s k ý 1994). The increasing utilisation of water energy leads to considerable devastation of individuals returning to the sea. Likewise, migration barriers hope prevented the spontaneous migration of the glass eels into the river network of the Czech Republic. Thus, the occurrence of eel will continue to depend on releasing the glass eels into rivers. *S. volgensis* occurs only in the lower stretches of the rivers Morava and Dyje. There its occurrence was not evinced until very recently (L u s k et al. 2002a). Compared to those in the past, the distribution, occurrence and population status of *B. barbus* have distinctly decreased in the course of the 20th century, above all due to the construction of dams, water pollution, and stream canalisation (L u s k 1995a, 1996a).

V – LEAST CONCERN (LC)

Salmo trutta m. *fario* Linnaeus, 1758*; Esox lucius* Linnaeus, 1758; *Rutilus rutilus* (Linnaeus, 1758); *Leuciscus leuciscus* (Linnaeus, 1758); *Leuciscus cephalus* (Linnaeus, 1758); *Scardinius erythrophthalmus* (Linnaeus, 1758); *Aspius aspius* (Linnaeus, 1758); *Tinca tinca* (Linnaeus, 1758); *Gobio gobio* (Linnaeus, 1758); *Alburnus alburnus* (Linnaeus, 1758); *Abramis bjoerkna* (Linnaeus, 1758)*; Abramis brama* (Linnaeus, 1758); *Barbatula barbatula* (Linnaeus, 1758); *Silurus glanis* Linnaeus, 1758; *Perca fluviatilis* Linnaeus, 1758; *Gymnocephalus cernuus* (Linnaeus, 1758); *Sander [=Stizostedion] lucioperca* (Linnaeus, 1758); *Proterorhinus marmoratus* (Pallas, 1814).

VI - NOT EVALUATED (NE)

Acipenser ruthenus Linnaeus, 1758

The occurrence of occasional individuals of *A. ruthenus* was reported in the lower part of the River Dyje (L u s k et al. 2002a).

The final version of this Red List is the result of our endeavours, based on our recent knowledge of the occurrence and populations changes, to classify all our native lamprey and

fish species in the newly conceived categories according to the materials of the IUCN. Naturally, the classification corresponds with the time at which the list has been compiled, and with the actual status of knowledge. In future, it may be possible to reclassify some of the species according to new data. In the cases of several rather rare species (e.g. *Gobio albipinnatus, Alburnoides bipunctatus, Leucaspius delineatus)*, enough data on their precise occurrence and population status are still not available. A similar situation, however, is the case for several other countries as well (e.g. L e l e k 1993).

Protection of species diversity

At present, the national laws of the Czech Republic protect species listed in the category of "particularly protected species" (Law no. 114/1992 and Intimation no. 395/1992). The category is divided into three groups, which contain the following lamprey and fish species (the spelling of their names agrees with that given in the law):
Critically endangered species: *Eudontomyzon mariae, Lampetra planeri, Gobio kessleri, Sabanejewia aurata, Zingel zingel, Zingel streber;*
Strongly endangered species: *Pelecus cultratus, Alburnoides bipunctatus, Cobitis taenia;*
Endangered species: *Rutilus pigus, Leuciscus idus, Phoxinus phoxinus, Abramis sapa, Cyprinus carpio* – wild form, *Misgurnus fossilis, Lota lota, Gymnocephalus schraetser, Cottus gobio, Cottus poecilopus.* The law protects these species as subjects as well as their environment.

With the EU membership the national legislation adopts the European nature conservation laws. As regards conservation of species, this pertains to Guideline no. 92/43/EES. According to Appendix II to that guideline, populations of the following species (their names spelled as in the Appendix) will be protected in the Czech Republic in selected and defined localities: *Lampetra planeri, Eudontomyzon mariae, Salmo salar, Aspius aspius, Gobio albipinnatus, Rhodeus sericeus, Cobitis taenia, Sabanejewia aurata, Misgurnus fossilis, Gymnocephalus schraetser, Zingel streber, Cottus gobio.* In addition, the following species have recently been listed in Appendix II: *Gobio kesslerii, Pelecus cultratus* , and *Gymnocephalus baloni.* For populations of special importance of these species, we are obliged to define particularly protected localities that will become parts of special areas of conservation (pSAC) of the NATURA 2000 system. Appendix II also contains *Hucho hucho*, but the conservation of this species pertains to the natural populations of this species, which do not occur in the Czech Republic. Appendix IV lists species requiring strict protection, among them *Acipenser sturio*, a species that is considered regionally extinct in the Czech Republic. Appendix V contains species that may be the objects of certain measures in connection with their management. Of the species that occur in the Czech Republic, this list contains *Thymallus thymallus, Salmo salar, Hucho hucho, Gymnocephalus schraetser,* and *Zingel zingel.*

Intraspecific diversity and its protection

In the Czech Republic, intraspecific diversity as a research topic that did not appear until the past decade (L u s k o v á et al. 1995, 1997; Š l e c h t o v á et al. 1998; L u s k et al. 2002, etc.). At present we have concrete items of knowledge of the intrapopulation and interpopulation diversity for a small number of the species only, witch has attracted fish attention to this phenomenon within a nature protection context. For a number of years,

species that are objects of intense sport fishing *(Salmo trutta, Thymallus thymallus, Aspius aspius,* etc.) have been supported by releasing stocking materials obtained by hand-stripping and rearing. As a result, these activities have essentially nullified the initial intraspecific diversity. A similar situation can be observed in the case of species that were subject to hand-stripping and subsequent releasing of reared progenies as part of their conservation measures *(C. nasus, L. lota).* At present, the greatest risk for the intraspecific diversity of native fish species in the Czech Republic is in the fishery management of natural waters, a part of which is their intervention stocking with a number of reared species. Unfortunately, effective legal means to protect intraspecific diversity is still not available. For the time being, the only means are in the education of the public and in the voluntary (i.e. unenforceable) observation of principles leading to the protection of intraspecific diversity on the part of the fishery management (Šlechta et al. 1998; Lusk et al. 2002, 2002b).

The hitherto formal attitude toward biodiversity protection, including its legal tools, is based on the concept of a species as the basic unit in the sense of the Linnaean classification. Knowledge obtained by means of genetic methods has introduced the concept of sibling species, sympatric species pairs within one species, sympatric ecotypes, hybrid complexes as well as populations themselves to be the object of protection (Utter 1981, Ryder 1986, Lindsey 1988, Avise 1989, O'Brien 1994, Mayden & Wood 1995, Smith et al. 1995, Waples 1995, Nelson 1999, Vasil'eva 2000, Bohlen & Ráb 2001). In order to secure effective legal protection of fish diversity in this sense, it is necessary to extend the specification of the object of protection and include, besides the species, additional natural developmental biological units, as indicated above. In past decades, scientists have begun concentrating their attention upon the identification of populations and population groups that show independent history (and different developmental trends), regardless of their taxonomic identity. This approach enables them discern independent developmental lines representing a maximum of genetic potential for future evolutional changes, that is, the key aspect for a long existence of a particular taxon (see Taylor 1999). This approach may play an important part in the protection of the gene pool of taxons whose status is still not quite clear.

Non-native species

At present, the native ichthyofauna of most regions is influenced by non-native, mostly exotic, species that have either been intentionally introduced into a drainage area or subsequently penetrated it from neighbouring drainage areas. Such species, non-native in most cases, have more or less negatively affected the native ichthyofauna, as indicated by a number of papers summarising these problems (e.g. Allendorf 1991, Holčík 1991, Efford et al. 1997). In the course of the 19th and 20th centuries, experiments were implemented for various reasons to enrich a native ichthyofauna by non-native or exotic fish species (Lusk et al. 1998). Records or reports are available on the introduction and release of some 30 odd species that cannot be considered to be native for the Czech Republic. In some cases, there were accidental or single experiments, most of them unsuccessful. At present, only 11 species occur in the Czech Republic on a wider scale, above all, within production rearings. Of them, only *Pseudorasbora parva* (Temminck et Schlegel, 1846)*, Carassius auratus* (Linnaeus, 1758)*, Ameiurus nebulosus* (Lesueur, 1819) and *Gasterosteus aculeatus* Linnaeus, 1758 have produced stable and viable populations in natural waters where they are capable of reproduction. An asset of introductions can only be seen if the non-

native species will assert themselves in production cultures in fishponds and/or special plants (*Oncorhynchus mykiss* (Walbaum, 1792), *Coregonus maraena* (Bloch, 1779), *Coregonus peled* (Bloch, 1779), *Ctenopharyngodon idellus* (Valenciennes, 1844), *Hypophthalmichthys molitrix* (Valenciennes, 1844), *Hypophthalmichthys nobilis* (Richardson, 1845)) including warmed waters (e.g. *Clarias gariepinus* (Burchell, 1822), *Oreochromis niloticus* (Linnaeus, 1758)). In the case that a non-native species has produced stable and numerous populations (*A. nebulosus* and *C. auratus*), its influence on the native species is unequivocally negative. In particular, *C. auratus*, showing characteristic properties of an invasive species, has had a negative influence on the native species with identical environmental requirements (L u s k et al. 1998a). It should be principally accepted that any incidental risks of an intended introduction are unpredictable. In view of the protection of the native ichthyofauna, it is necessary to reject any introductions of alien species into the Czech Republic.

A c k n o w l e d g e m e n t

The authors thank anonymous reviewers for stimulating and critical comments. The Red List is based on the results obtained from the work on grant and research projects in recent years; in particular, this pertains to projects no. A6093105 and A6045005 from the Grant Agency of the Academy of Sciences of the Czech Republic, no. S6093007, S5045111 from the Academy Sciences of the Czech Republic, and no. 206/00/0668 from the Grant Agency of the Czech Republic. We have also utilised data and results obtained by the application of the European legal norms into the legal milieu of the Czech Republic (NATURA 2000, Council Regulation no. 43/92/EEC). We are grateful to G. C o o p for improvement of the English.

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