

# The significance of non-indigenous fish species in the river Elbe

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## 1 Introduction

In Europe, the introduction of non-indigenous freshwater fish has been practised for a very long period of time. As early as the first century BC, the carp (*Cyprinus carpio*), which originates from Asia, was introduced to Italy and then cultivated in the centuries which followed. During the Renaissance, keeping freshwater fish advanced to become a widespread vogue. However, the greater part of the non-indigenous fish species introduced to Europe only arrived after 1850. Generally, three different modes of introduction can be identified:

- The natural extension of a species' habitat (Fig. 1): This may occur without man exercising any influence at all. Usually, however, human activity is involved indirectly through the development of artificial waterways, i.e. canals, between different hydrographic systems. This opens up the possibility for fish species and of course other fauna belonging to both systems to infiltrate into the respective other system and become established there.

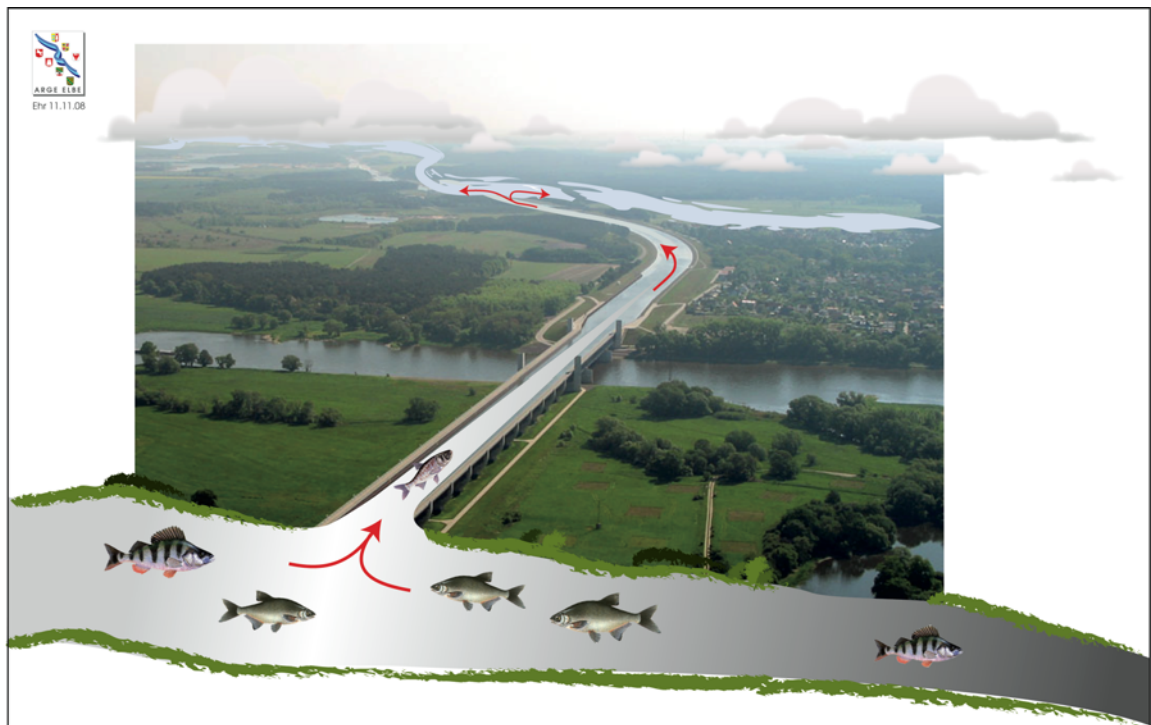


Fig. 1 The natural extension of a species' habitat

- Negligent handling of fish transports (Fig. 2): Fish species can be introduced into new habitats when they are included as bycatch amongst fish being transported for restocking. An example of this kind is represented by the stone moroko (*Pseudorasbora parva*) which may arrive with imported carp. Non-indigenous species may also be introduced via garden ponds, private aquariums and pet shops, when fish escape by some means into free waters, or indeed are deliberately set free, as often happens in the case of ‘souvenirs’ brought in from other countries.

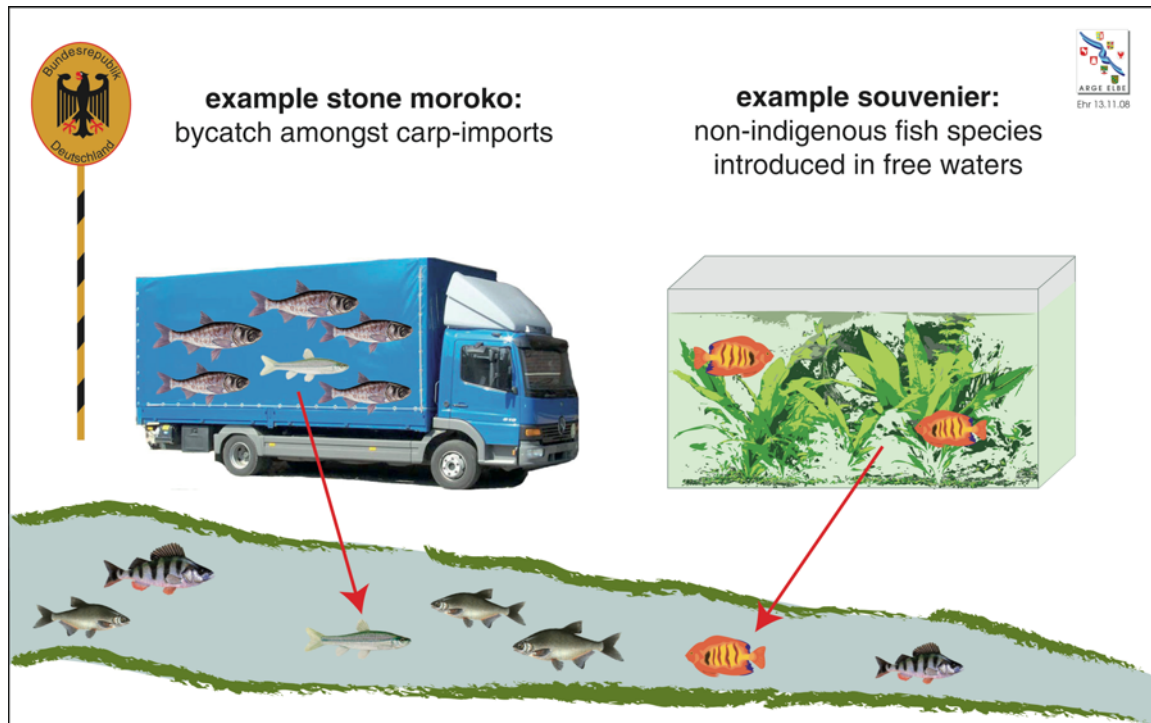


Fig. 2 Negligent handling of fish transports

- Deliberately imported fish for stocking waters (Fig. 3): Some species have been introduced as part of targeted biotope management measures, as in the case of the grass carp (*Ctenopharyngodon idella*) used as ‘biological weed removers’. Most allochthonous fish species have been brought in with a view to improving fishing yields and for angling. The most prominent example of this is given by the rainbow trout (*Oncorhynchus mykiss*) from North America. When such fish escape from angling ponds and aquaculture, this leads to a further spread of the species concerned. Other foreign species have been introduced for reasons of aesthetics, especially towards the end of the nineteenth century, when many species were imported to ‘embellish’ the country’s fauna. In Germany, a major part in this development can be attributed to Max von dem Borne, who from 1882 until his death in 1894 introduced a large number of fish species from North America, including the brown bull-head (*Ameiurus nebulosus*), for instance.

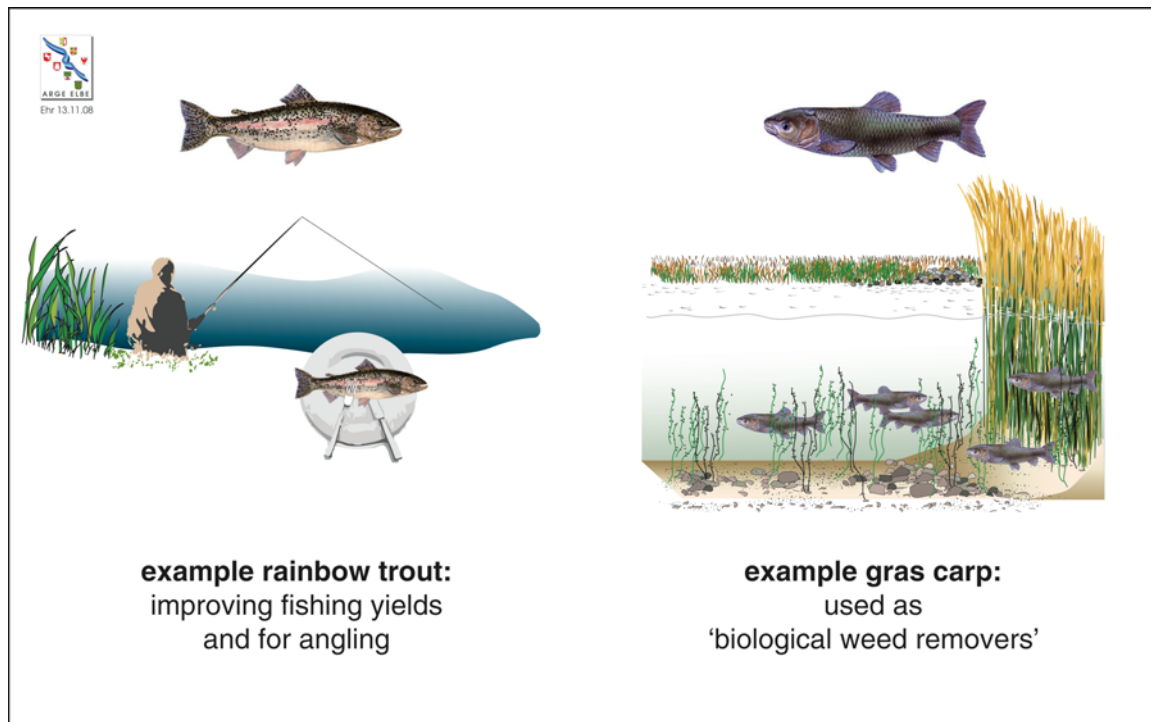


Fig. 3 Deliberately imported fish for stocking waters

In total over 130 fish species have been introduced to Europe. Depending on how the term ‘neozoon’ is to be defined, between 10 and 14 limnic and euryhaline species have currently been able to establish themselves in the river Elbe (2000 to 2008) (Fig. 4). This number accounts for between 18% and 24% of all the river Elbe’s 57 known limnic and euryhaline representatives.

## 2 Foreign fish species – a question of definition

To use the term ‘foreign fish species’ begs the question as to what exactly is meant by ‘foreign’. As this remains a matter of debate, it is unavoidable that from author to author differing criteria for classification are given. A whole range of terms is used, often synonymously, in reference to fish species: neozoa, allochthonous or introduced species, invasive, non-indigenous, non-native, translocated, alien and exotic species. Whether a fish is considered to be foreign or indigenous may depend on the one hand on the time at which it was first proven to be present; on the other hand the issue may be decided on the basis of its ability to reproduce successfully and consistently. For instance, the so-called ‘Stuttgart Theses’ (ANONYMUS 1996) define neozoon species as those which have arrived in a certain region after the year 1492 either directly or indirectly as a result of human influence and are to be found there in the wild. (1492 is seen as the point in time separating the neozoon species from the archaeozoon species.) In this case the term ‘region’ refers to a natural geographic space or its catchment area, to some extent taking political boundaries into account. A neozoon species is considered to have

established itself if it can survive over a longer period of time (at least 25 years) and/or over at least three generations.

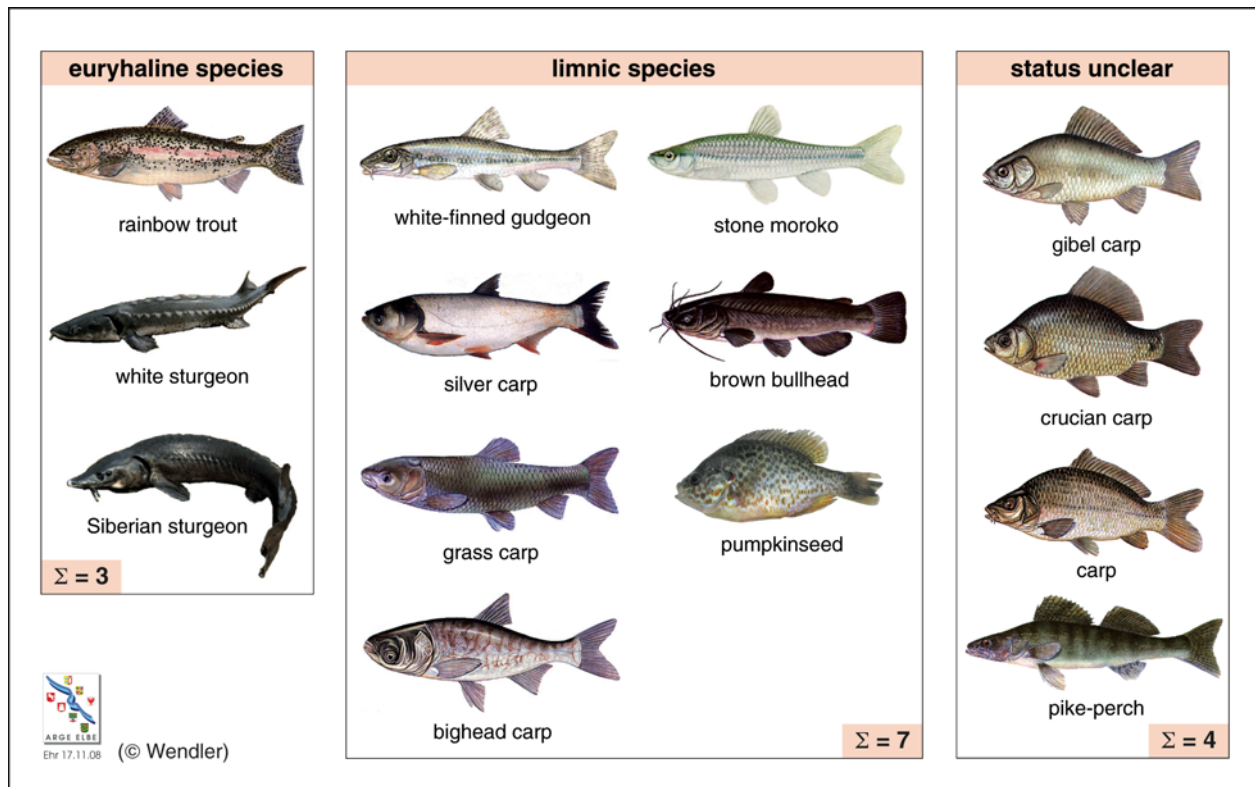


Fig. 4 Non-indigenous fish species in the river Elbe - period of time 2000-2008

Neozoa may also be classified according to a different point in time and also according to different types (NEHRING & LEUCHS 1999):

- neozoon actuale: A neozoon according to a narrow definition: One which has been introduced to a certain region since the year 982 (the first year in which American organisms were introduced to Europe following Eric the Red's transatlantic voyage) either directly or indirectly as a result of human intervention, and which has lived there in the wild for at least three generations. Examples: *Cordylophora caspia*, a type of polyp, and the stone moroko (*Pseudorasbora parva*).
- neozoon incertum: A species for which uncertainty prevails in respect of the degree of human intervention and/or the current breeding population's degree of establishment. Examples: *Orconectes limosus* (a species of crayfish) and brook trout (*Salvelinus fontinalis*).
- neozoon simulatum: A species which has appeared after the year 982 without any apparent connection with human activity and which, possibly, continues to spread (natural extension of habitat). Examples: the common goose barnacle (*Lepas anatifera*) and estuarine shrimp (*Palaemon longirostris*).

The above remarks show that it can be difficult to distinguish between neozoa and non-neozoa (archaeozoa) amongst the fish (and other) species currently present in the river Elbe. The difficulty is exacerbated by the fact that little information is available in respect of the species populating the river for periods prior to 1850. Only those species can definitely be classified as neozoa for which reliable records exist to show that they have only recently appeared in the Elbe system. Examples of such species are the silver carp (*Hypophthalmichthys molitrix*), grass carp (*Ctenopharyngodon idella*), bighead carp (*Hypophthalmichthys nobilis*) and brown bullhead (*Ameiurus nebulosus*).

### 3 Foreign fish species currently present in the river Elbe

As a practical rule of thumb, the Wassergütestelle Elbe (Elbe river water quality authority) has drawn a chronological line at the end of the 19<sup>th</sup> century to distinguish between neozoa and non-neozoa. There were two principle reasons which led to this decision: On the one hand the spectrum of fish species occurring in the river Elbe is relatively well documented in old records from the second half of the nineteenth century, and on the other hand it is possible to determine with a considerable degree of confidence which species have established themselves since that point in time, especially those introduced on account of human activities.

According to this convention, the following euryhaline (salt tolerant, migratory fish) species may be considered to be neozoa: white sturgeon (*Acipenser transmontanus*), Siberian sturgeon (*Acipenser baeri*) and rainbow trout (*Oncorhynchus mykiss*). These species account for one in five of the 15 euryhaline species currently known to inhabit the course of the Elbe.

The limnic, i.e. freshwater fish are as follows: white-finned gudgeon (*Gobio albipinnatus*) silver carp (*Hypophthalmichthys molitrix*), grass carp (*Ctenopharyngodon idella*), bighead carp (*Hypophthalmichthys nobilis*), stone moroko (*Pseudorasbora parva*), pumpkinseed (*Lepomis gibbosus*) and brown bullhead (*Ameiurus nebulosus*). These species represent approximately one sixth of the 42 limnic species at present known to exist in the river Elbe.

According to the chronological divide defined by the Wassergütestelle Elbe, the four limnic fish species gibel carp (*Carassius auratus gibelio*), crucian carp (*Carassius carassius*), carp (*Cyprinus carpio*) and pike-perch (*Sander lucioperca*) are not to be classified as neozoa for the river Elbe. This definition is, however, open to discussion. Other authors tend rather to include these species with the neozoa. Should this be taken as the basis for assessing the fish stocks in the Elbe, then

the neozoa would account for rather less than one third of the currently known 42 limnic species.

#### 4 Assessment

As a preliminary summary the following may be said of the neozoan piscine species in the river Elbe:

- The process of defining the term 'piscine neozoon' has not yet reached its conclusion. At present, it is determined by the various criteria used by different authors to arrive at a classification.
- On the basis of the approach adopted by the Wassergütestelle Elbe, the proportion of neozoan species within the entire spectrum of the euryhaline and limnic species groups lies between 18% and 24%. They have established themselves to varying degrees throughout the course of the river Elbe. Some species are present in numbers capable of sustainable breeding, as in the case of the brown bullhead, whereas only occasional individual white sturgeon are to be found.
- From the point of view of their numbers and the total fish weight involved, the currently occurring foreign fish species play only a minor role both in the individual hydromorphological sections of the Elbe as well as in its various piscine regions (the proportion is less than 1%). However, certain neozoan species occur more frequently in local concentrations.
- Also in a locally restricted context, some neozoa such as the brown bullhead (*Ameiurus nebulosus*) appear to be competing for living space with indigenous species, e.g. gudgeon. This cannot, however, be applied to the entire course of the river Elbe.
- The appearance of further invasive species which are capable of establishing themselves permanently is to be reckoned with. Neither administrative regulatory instruments nor targeted measures for control are likely to be able to prevent this.
- To date, neozoa have not brought about any fundamental restructuring of the piscine faunal distribution in the river Elbe.

## 5 References

- ANONYMUS (1996) „Stuttgarter Thesen“ zur Neozoen-Thematik. – In: GEBHARDT, H., R. KINZELBACH & S. SCHMIDT-FISCHER (Hrsg.), Gebietsfremde Tierarten. Ecomed. Landsberg. S. 311-312
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