Part IV: Identification and assessments of sites – fish, mammals and birds

Chapter 9

Survey of NATURA 2000 fish species in the German North and Baltic Seas

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Abstract

Due to their limited salinity tolerance, the occurrence of freshwater Annex II-fish species such as asp (*Aspius aspius*), spined loach (*Cobitis taenia*), bullhead (*Cottus gobio*), weatherfish (*Misgurnus fossilis*), bitterling (*Rhodeus amarus*), and ziege (*Pelecus cultratus*) was found to be restricted to freshwater and oligohaline-mesohaline habitats (i.e., areas with relatively low salinities), especially in the coastal waters of the German Baltic areas.

Mainly anadromous Annex II-fish species such as sturgeon (*Acipencer* spec.), North Sea houting (*Coregonus oxyrinchus*), river lamprey (*Lampetra fluviatilis*), sea lamprey (*Petromyzon marinus*), allis shad (*Alosa alosa*), and twaite shad (*Alosa fallax*) were expected to occur in the German parts of the North Sea and Baltic Sea. However, *Acipenser sturio*, a species of sturgeon, is considered extinct as a reproductive species in the North Sea region, and the sturgeon species last recorded in individual catches in the Baltic Sea in the 1990s is *A. oxyrinchus*.

At present, the North Sea houting is very rare in the North Sea, while the Baltic houting population (*Coregonus maraena*) is not protected under the Habitats Directive.

Since 1978, a total of 178 records of lampreys have been obtained in the German North Sea areas. Most of the lamprey records (mainly river lampreys) were located in nearshore areas, especially between

Helgoland Island and the mouth of the Elbe and Weser estuaries. Recently, 81 individuals of river lamprey and 4 individuals of sea lamprey were recorded in German Baltic waters from 2000 to 2004.

Today the main distribution range of allis shad is restricted to the Atlantic coasts of France and Portugal. The record of allis shad in the *Strelasund* in 1998 was the only specimen of this species caught in German Baltic waters during the last 20 years. Therefore, the species is expected to occur only accidentally in the German waters of the North and Baltic Seas.

In contrast, within the German coastal waters (12-nautical mile zone) of the North Sea, there were high-density areas of twaite shad. In total, 6,052 individuals of twaite shad have been caught in the *German Bight* (*Deutsche Bucht*) since 1978. Since 1995, however, the catch effort and the percentage of stations with twaite shad records have increased and, in general, there have been more records of this species in the German coastal waters than in the German Exclusive Economic Zone (EEZ).

From May 2003 until November 2004, 38 individuals of twaite shad were found at 14 different locations in the German EEZ of the Baltic Sea, northeast of the Rügen Island, as well as in the *Pommeranian Bay* (*Pommersche Bucht*) and the *Szczecin Lagoon* (*Stettiner Haff*) and its adjacent waters. Fifty percent (50%) of the total twaite shad records originated from the *Szczecin Lagoon* and adjacent waters. All of them were adult individuals. In the *Odra Bank* (*Oderbank*) and in the coastal waters of the Usedom Island, only juvenile individuals of age group 0 were caught; this amounted to 19% of the total number of records. Thirty-one percent (31%) of all individuals of twaite shad (mainly adults) were recorded from the potential Site of Community Interest (pSCI) *Western Rønne Bank* (*Westliche Rönnebank*) and adjacent waters. Given the recent records from the German Baltic waters, it is assumed that, after about 50 years of decline, the Baltic population of twaite shad has been increasing since the middle of the 1990s.

The observed status of the populations of Annex II-fish species in the German waters of the Baltic Sea and North Sea indicate that the study of their distribution and the trends in their population development must be continued on the basis of an international cooperation, especially with the new EU Member States of the southern Baltic.

1 Introduction

In order to fulfil the requirements of the European Directive on the conservation of natural habitats and of wild fauna and flora (the "Habitats Directive" 92/43/EEC of 21 May 1992), it is necessary to investigate the occurrence and distribution – within the EEZ of Germany in the North- and Baltic Seas – of fish species listed in Annex II of the Directive. These listed species require the identification and designation of Special Areas of Conservation (SACs). In general, there is little knowledge on the importance of European marine and brackish waters as habitat for Annex II-fish species (Elliott and Hemingway 2002).

In 2002, the Federal Research Centre for Fisheries (BFAFi) and the Carl von Ossietzky University (ICBM) were commissioned by the Federal Agency for Nature Conservation (BfN) for a research and development project. The project's goal was to assess whether areas of high abundance of Annex II-fish species in the German EEZ can be identified or not. The ICBM could only analyse the distribution of twaite shad in the German North Sea because there was sufficient database for geo-statistical methods only for this species in this area (Stelzenmüller and Zauke 2003, Stelzenmüller et al. 2004). However, Kloppmann et al. (2003) demonstrated that there was an incomplete picture and database of the distribution of all Annex II-fish species in the German EEZ. In order to produce a sufficient dataset, the German Oceanographic Museum (DMM) and the University of Rostock (IfB) conducted investigations in 2003 in the Baltic Sea, especially in the *Pommeranian Bay* and adjacent waters. The aim of the study was to develop and test more specialised data enquiry and sampling strategies to find out if additional records of Annex II-fish species can be produced. The first results of this continuing study were published by Thiel et al. (2004a, 2004b, 2005).

2 Relevant Annex II-fish species and important aspects of their status

Only a few of the Annex II-fish species are expected to occur in the German parts of the North Sea and Baltic Sea (figure 1). These are mainly anadromous species (i.e., migrating from sea to freshwater to spawn) such as sturgeon, North Sea houting, river lamprey, sea lamprey, allis shad, and twaite shad. Moreover, some freshwater fish species listed in Annex II of the Habitats Directive may occur in the German Baltic Sea, especially in its eastern parts and nearshore areas with lowered salinities. Such species

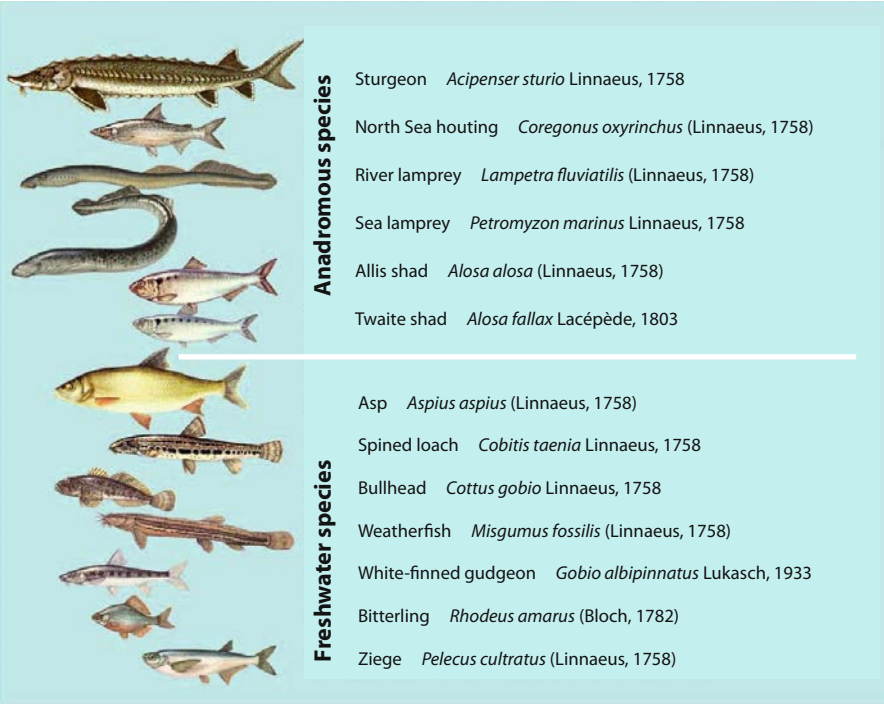


Figure 1. Relevant Annex II-fish species in the German North- and Baltic Seas

are asp, spined loach, bullhead, weatherfish, white-finned gudgeon, bitterling and ziege (figure 1).

Anadromous sturgeon populations were known from the North- and Baltic Seas and from most of the larger rivers draining into these marine waters (Freyhof 2002). According to Debus (1995), the extinction of these sturgeon populations during the last century was caused mainly by overfishing, pollution, river regulation, and damming in the North- and Baltic Sea areas (figure 2).

After 1950, sturgeons were only caught occasionally in the North- and Baltic Seas. *Acipenser sturio* (last caught in 1993) is considered extinct in Germany as a reproductive sturgeon species and is now reduced to a relict population in the French Gironde River (Kirschbaum and Gessner 2002). Recent research shows that the sturgeon species last recorded in individual catches in the Baltic in the 1990s was the Atlantic sturgeon *Acipenser oxyrinchus* Mitchill, 1815, a species still comparatively abundant along the northeastern coast of the United States (Ludwig et al. 2002).

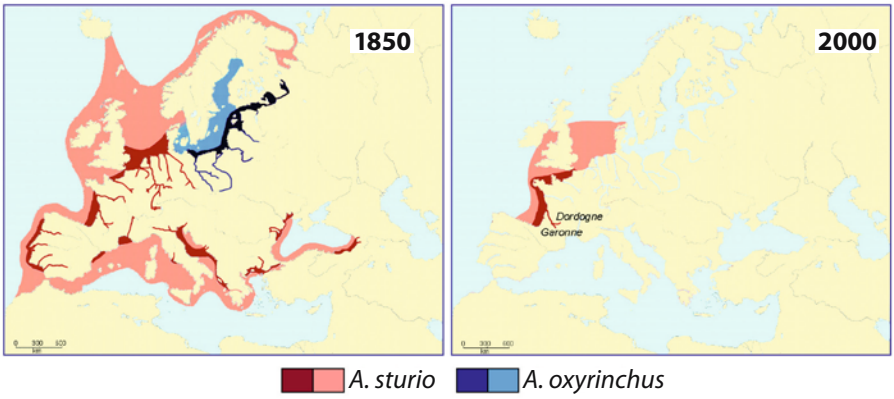


Figure 2. Distribution of European sturgeon (*A. sturio*) and Atlantic sturgeon (*A. oxyrinchus*) in Europe around 1850 (left) and 2000 (right)

Archaeological and genetic studies have shown that about one thousand years ago, in the Baltic, *A. oxyrinchus* replaced *A. sturio*, which until then had been the dominant native species. Because of this historic presence of *A. oxyrinchus* in the Baltic Sea, the re-introduction of this species would be justified and in line with respective legal guidelines.

The houting was a frequent anadromous fish in the coastal areas of the North Sea, especially in the Wadden Sea and in the large German North Sea estuaries (Vorberg and Breckling 1999). Nowadays, the houting is very rare in the North Sea. Reasons why it vanished from the German North Sea areas are probably the same as for the extinction of sturgeons (Freyhof 2002). However, the Baltic houting population was not protected under the Habitats Directive until now.

Both the river lamprey and sea lamprey occur in marine and brackish waters of the German North Sea and Baltic Sea region (Diercking and Wehrmann 1991, Gaumert and Kämmereit 1993, Spratte and Hartmann 1998, Winkler et al. 2002). It is known that river lampreys live predominantly in coastal areas, especially near estuaries (Hardisty 1986), while sea lampreys are also found in the open sea up to several hundred kilometres away from the coast (Lelek 1973). When mature, the lampreys migrate upstream the rivers. Spawning takes place only in freshwater, mostly far upstream. Historically, lampreys were mainly caught during their spawning migrations (Sterner 1918, Imam et al. 1958). Generally, lamprey populations have decreased in Germany since the mid-1950s (e.g., Imam et al. 1958, Wilkens and Köhler 1977, Möller 1984). It is assumed

that pollution of estuaries and the building of weirs and dams prevented lampreys from reaching their original spawning grounds (Lelek 1987).

Historically, allis shad populations occurred along the eastern Atlantic coasts from Norway to Morocco and into the western Mediterranean Sea, extending along the coasts of Portugal, Spain, France, British Isles, Belgium, Holland and Germany (Baglinière et al. 2003). In Germany, allis shad was an economically important species, especially in the basin of the River Rhine, prior to the beginning of the 20th century. Fishing has been invoked as one of the primary factors involved in the reduction of the Rhine population of allis shad (de Groot 1989). According to Bartl and Troschel (1997), massive overfishing during the beginning and heavy pollution in the middle of the 20th century may be the reasons why allis shad vanished from the River Rhine. Although the last specimen from the River Rhine was caught in 1963 (Bartl and Troschel 1997), the species disappeared even earlier from other German rivers draining into the North Sea and Baltic Sea basins (e.g., Duncker 1935–1939, Freyhof 2002) due to poor water quality and building of weirs (Lelek 1987). The number of recorded allis shad, however, has increased in the River Rhine since 1978 (Grimm 1993, Freyhof 2002).

In contrast, the subspecies *A. fallax fallax* of twaite shad is distributed in the Baltic Sea and along the entire Atlantic sea coast, including the North Sea (e.g., Saemundsson 1949, Kartas 1981, Taverny 1991, Sabatié 1993, Aprahamian et al. 2003). However, the correct nomenclature for the twaite shad population(s) in the Atlantic and the Baltic Sea has not yet been finally determined. Winkler et al. (2000) evaluated the distribution status of twaite shad within the framework of their checklist of fish species in the Baltic Sea. The authors described the distribution status of *A. fallax fallax* in the Baltic Sea as "present" for Denmark, "common" for Poland and Lithuania, and as "very rare" for Russia, Finland, Latvia and Germany. Generally, the twaite shad, which was very common in a number of Baltic and other European waters about a hundred years ago, has declined substantially throughout Europe (Reshetnikov et al. 1997). This decline has been attributed to pollution, overfishing, and migratory route obstructions (Whitehead 1985). Around 1990 there were only a few rivers left with healthy populations of twaite shad, like the Garonne–Dordogne river system in France and the Elbe River (North Sea) in Germany (Quignard and Douchment 1991).

Due to their limited salinity tolerance, the occurrence of freshwater Annex II-fish species is restricted to freshwater and oligohaline-mesohaline habitats of the German North Sea and Baltic Sea regions (e.g.,

Thiel et al. 1995, Thiel and Potter 2001, Thiel 2003). Details of their status will not be discussed here. General information about their distribution and habitat requirements in the German North- and Baltic Sea basins are presented in Diercking and Wehrmann (1991), Gaumert and Kämmereit (1993), Spratte and Hartmann (1998), Fricke (2000), Freyhof (2002), and Winkler et al. (2002).

3 Distribution of Annex II-fish species in German waters of the North Sea

In May and August 2002, the BFAFi carried out a study to describe the present distribution of the ichthyofauna including Annex II-fish species in the German parts of the North Sea. During that study, 61 beam trawl hauls were performed in four study areas. Furthermore, an analysis of the historical distribution of the relevant fish species in the whole German EEZ was carried out using data from the BFAFi research fishing campaigns from 1978 to the present. During this period, 3,629 hauls were performed with different trawls, and they were analysed for the occurrence of Annex II-fish species (Kloppmann et al. 2003).

The data analysis showed no concentration areas (high abundances) for any of the Annex II-fish species (i.e., twaite shad and lamprey species) in the German EEZ. There have been no records of sturgeon, North Sea houting, allis shad or of any freshwater Annex II-fish species in the German EEZ since 1981 (Kloppmann et al. 2003). The sturgeon is considered extinct as a reproductive species in the North Sea region (Kirschbaum and Gessner 2002). The same is true for the houting; only a small population has survived in the River Vida (Denmark) where the species was rediscovered in 1982. A restitution programme, based on transferred fishes from the River Vida to the River Treene, the River Elbe basin, and to the lower River Rhine in Germany, has been running since the end of the 1980s (Jäger 1999). However, none of these stocking projects has resulted in a self-sustainable population independent of stocking. Recent findings show that the relict stocks of houting from the North Sea basin are identical to the houtings living in the southern Baltic and belong to the species *Coregonus maraena*. The original North Sea houting (*Coregonus oxyrinchus*) is a globally extinct species (Freyhof and Schöter 2005).

Today the main distribution range of allis shad is restricted to the Atlantic coasts of France and Portugal (Baglinière et al. 2003) and it is possible that those individuals found in the River Rhine are only vagrants from the large French populations (Freyhof 2002). Therefore, the species

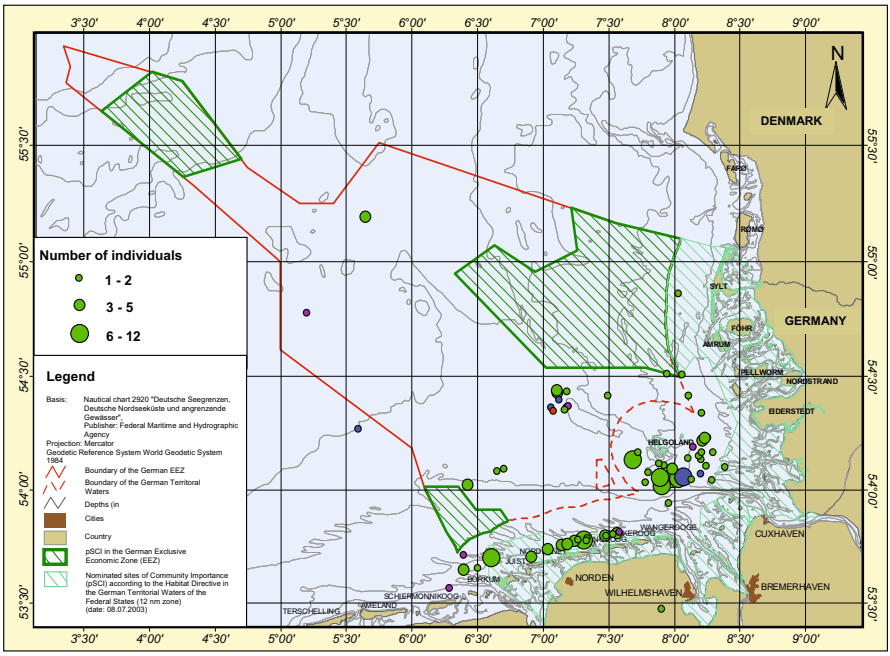


Figure 3. Distribution of lamprey catches (*L. fluviatilis* and *P. marinus*) from BFAFi in the North Sea from 1978 until 2002 according to Kloppmann et al. (2003). Purple: first quarter; red: second quarter; blue: third quarter; green: fourth quarter

is expected to occur only accidentally in the German waters of the North- and Baltic Seas.

Since 1978, 178 records of lampreys have been obtained in the German North Sea. Around 80% originated from approximately 1995 onwards (Kloppmann et al. 2003). Most of the lamprey records (mainly river lampreys) were located in nearshore areas, especially between Helgoland and the mouth of the Elbe and Weser estuaries (figure 3).

Furthermore, most of these records were obtained between July and September, which could be attributed to nearshore concentrations of river lampreys due to their spawning migration. Thiel and Salewski (2003) estimated that the anadromous spawning migration of river lampreys into the Elbe Estuary proceeds in autumn. A spring spawning migration of river lampreys was not observed. In contrast, sea lampreys migrated for spawning mainly during spring (Thiel and Salewski 2003). However, only 10 individuals of sea lampreys in the Elbe Estuary were recorded from 1989–1995 (Thiel and Salewski 2003). In comparison, 2,217 river lampreys were caught in the same area during the same period. This indicates

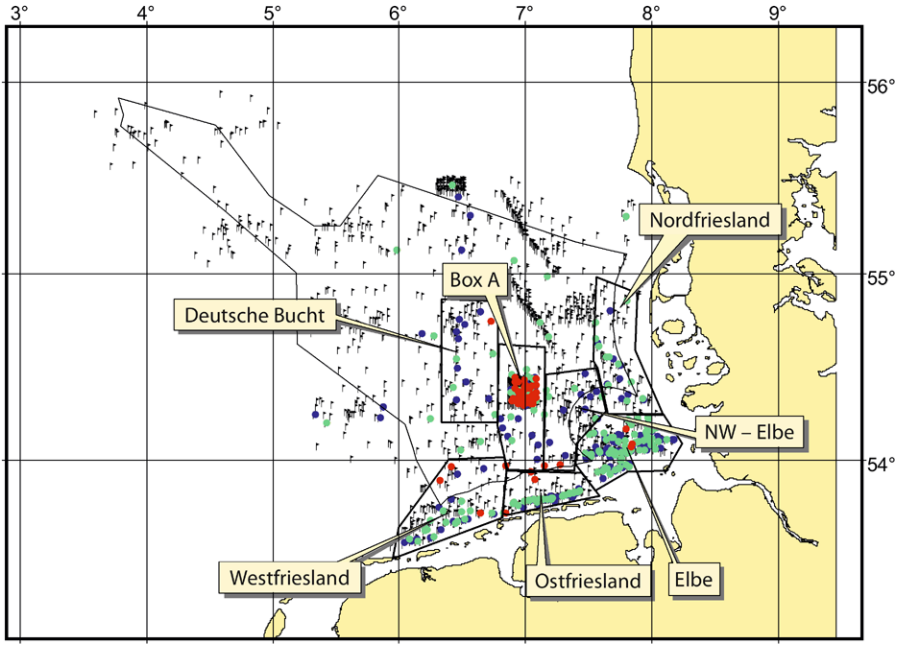


Figure 4. Distribution of all hauls and twaite shad catches from BFAFi from 1978 until 2002 according to Kloppmann et al. (2003). Flags represent individual hauls. Framed boxes: defined areas for evaluation of the spatial effort/catch proportion. Blue: first quarter; red: third quarter; green: fourth quarter. No records of twaite shads occurred in the second quarter

remarkable differences in the population densities of both lamprey species. Sea lampreys have never been very abundant in the southern North Sea region, e.g., in the Elbe Estuary (Kluge 1904, Bauch 1958).

Within the German coastal waters (12-nautical mile zone), there were high-density areas of twaite shad. In total, 6,052 individuals of twaite shad have been caught in the *German Bight* since 1978 (figure 4). Figure 4 demonstrates that apart from the 12-nautical mile zone, there were also several twaite shad records in the German EEZ. Since the spatial effort/catch proportion differs between the framed areas, then their records of twaite shad are not alike or comparable. For example, the effort within the areas "Box A" and "Elbe" was higher than in the remaining areas (Kloppmann et al. 2003).

Stelzenmüller and Zauke (2003) focused their study on the distribution of twaite shad. They analysed catch data from 1986–2001 provided by the BFAFi. The data analysis was performed with geo-statistical methods

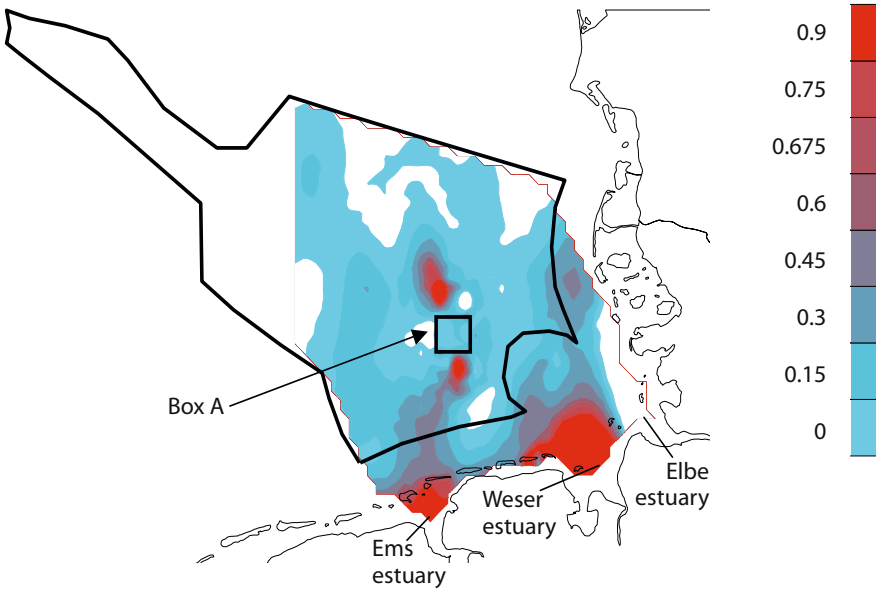
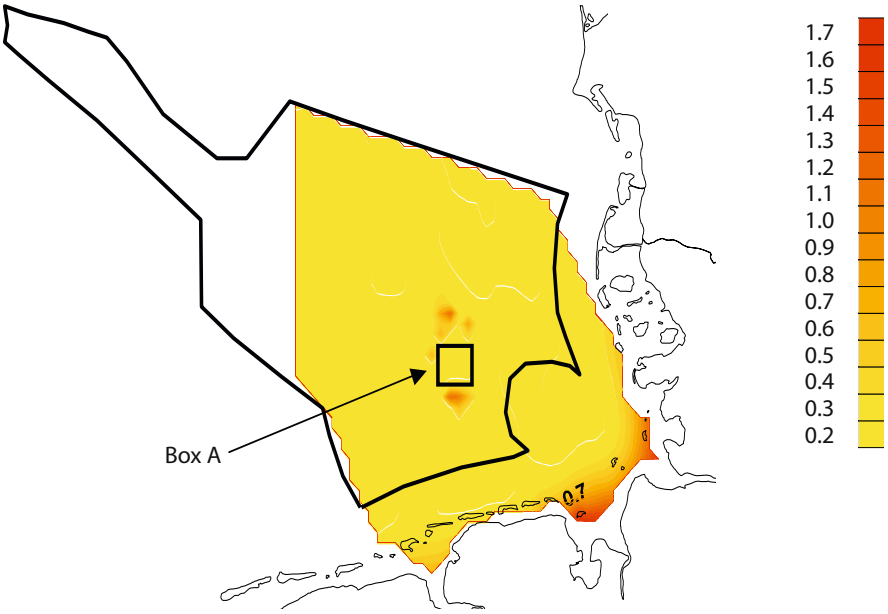


Figure 5. Above: Calculated probability (indicator kriging) to catch at least one twaite shad within the EEZ and coastal waters between 1987 and 2001 according to Stelzenmüller and Zauke (2003), identifying proven concentration areas in the Ems and Weser estuaries. Below: relative measure of uncertainty of the estimate using indicator kriging



and modelling programs in order to identify possible concentrations of twaite shad within the German North Sea. The data evaluation showed that in 166 out of 1,310 sampled stations (12.67%) at least one individual twaite shad was caught. Since 1995, however, the catch effort and the percentage of stations with twaite shad records increased and in general, there were more records of this species in the German coastal waters than in the German EEZ. The analysis indicates that the population of twaite shad has increased in the study area since 1997. The spatial modelling of the distribution patterns of twaite shad and the smoothing of the patterns using indicator kriging[1] indicate the importance of the coastal waters for this species (figure 5). Figure 5 also illustrates the relative measure of uncertainty of the estimation using indicator kriging and shows that the higher occurrences around the area "Box A" cannot be verified (for further details see Stelzenmüller and Zauke 2003).

The increased uncertainty within the outer parts of the Weser and Elbe estuaries (see figure 5) is caused by the geometry of the investigation area; therefore, the former has no influence on the interpretation of the results (Stelzenmüller and Zauke 2003). In particular, the tidally influenced outer parts of the Ems, Weser, and Elbe estuaries show clear aggregations of twaite shads (figure 5). Within these areas, the probability of catching a specimen of twaite shad is approximately 90%, whereas there were no aggregation areas in the EEZ (Stelzenmüller and Zauke 2003). Stelzenmüller et al. (2004) confirmed the importance of the Weser and Elbe estuaries as areas with the highest probabilities of catching twaite shad, while within the German EEZ of the North Sea, no such areas could be discerned. Spawning populations of twaite shad exist in the estuaries of Elbe and Weser (e.g., Hass 1965, Möller and Dieckwisch 1991, Scheffel and Schirmer 1991, Thiel et al. 1996, Gerkens and Thiel 2001). Actual spawning activities have not yet been observed in the estuaries of Ems and Eider, although adult individuals were caught in the River Eider (Vorberg and Breckling 1999) and high abundance of small juveniles occur in the Wadden Sea close to the mouth of the Eider Estuary during summer (Breckling et al. 1994). Freshwater Annex II-fish species were not found within the German EEZ and coastal waters of the North Sea. However, asp, spined loach, bitterling and white-finned gudgeon were caught, for instance, in the Elbe Estuary (Thiel et al. 1995, Thiel and Bos 1998, Jankowski 2001, Thiel and Potter 2001, Schubert 2004). From these

[1] Kriging: a form of statistical modelling that interpolates data from a known set of sample points to a continuous surface (spatial distribution).

species, only the asp occurred frequently in oligohaline-mesohaline water bodies.

In conclusion, with the available data, no concentration areas for Annex II-fish species could be shown for the EEZ; however, for the twaite shad such concentrations are evident in the Wadden Sea, particularly in the outer areas of the Ems, Elbe and Weser estuaries. This species also occurs in the EEZ and its population seems to be increasing. Sea and river lampreys exist throughout the North Sea, but catches are too low to conduct significant geo-statistical analysis for spatial distribution patterns. It is, however, much more likely to catch a river lamprey than a sea lamprey in the North Sea.

4 Occurrence of Annex II-fish species in German waters of the Baltic Sea

In June 2002, the BFAFi performed in total 38 hauls using otter trawls (Kloppmann et al. 2003). In the Baltic Sea, due to the stony bottom, just one study area was sampled with 7 hauls adjacent to the actual area. The other 31 hauls were carried out in areas outside potential SACs. The historical dataset used for the analysis of the occurrence of Annex II-fish species was from 1991 and this was based on data resulting from 2,979 hauls taken with trawls. Some additional data originating from studies in the *Pommeranian Bay* and from hydro-acoustic surveys were available from 1978. The results of the recent field work and historical data analysis showed that there were no areas of high concentration of Annex II-fish species within the German EEZ of the Baltic Sea as well (Kloppmann et al. 2003). Within this area, 2 individuals of twaite shad were found as well as one individual each of sea lamprey and of houting (Kloppmann et al. 2003). However, it is of note that the monitoring techniques used (e.g., seasonal sampling regime, mesh size in cod end) were not fully appropriate to verify the occurrence of all life history stages of Annex II-fish species. Furthermore, in areas with rocky bottom or stony reefs, no catches were carried out due to problems with operating the trawls. The results indicate a lack of data for most of the Annex II-fish species in the German EEZ and show the urgent need to develop and employ alternative research methods in order to get more detailed data on the occurrence and distribution of Annex II-fish species within the German EEZ.

In order to remedy this gap in knowledge, in 2003 the German Oceanographic Museum (DMM) and the University of Rostock (IfB) started a study in order to test more specialised data enquiries from

existing sources and to develop new sampling strategies for Annex II-fish species in the Baltic Sea, with special attention to the *Pommeranian Bay* and adjacent waters (Thiel et al. 2004a, 2004b, 2005). From August 2003 to August 2004, the first results of this study were obtained based on the analysis of relevant ichthyological collections and the compilation of recent catch records from fisheries research, and commercial and recreational fishery in the German parts of the Baltic Sea. Furthermore, catch data from research hauls in the Baltic Sea region between the Islands of Rügen, Usedom, and Bornholm were evaluated by DMM and IfB using special equipment.

In order to obtain information regarding the historical occurrence of Annex II-fish species, the ichthyological collections of 17 institutions were analysed, including those of the Museum of Natural History of the Humboldt University in Berlin, Zoological Institute and Museum of the University of Hamburg, Museum of Natural History Stuttgart, Zoological Museum of the Christian Albrechts University in Kiel, Biology Department of the University of Rostock, German Oceanographic Museum in Stralsund, and the Zoological Institute and Museum of the Ernst Moritz Arndt University Greifswald.

The analysis of these collections resulted in 1,435 spatially and temporally different records of Annex II-fish species, including *A. oxyrinchus* and *C. maraena* from 1822–1999. Apart from white-finned gudgeon, historical records of all of the relevant Annex II-fish species were identified in the Baltic Sea region (Thiel et al. 2004a, 2004b, 2005). About 32% of the recorded individuals date from the 19th century, and 65% from the 20th century. Most records obtained were for twaite shad (384 records), houting (234 records), and river lamprey (219 records). Thiel et al. (2004b) found that the oldest records date back to 1822, which were 2 Atlantic sturgeons (caught in the *Greifswald Lagoon* (*Greifswalder Bodden*) and close to Hiddensee Island), 1 bullhead from the same lagoon, and 1 weatherfish originating from waters around the city of Barth. The record of allis shad in the *Strelasund* in 1998 was the only specimen of *A. alosa* caught in German Baltic waters during the last 20 years (Winkler et al. 2002, Thiel 2003).

About 6 freshwater Annex II-fish species were recorded within the coastal waters of the German Baltic areas. These species are asp, spined loach, ziege, bullhead, bitterling and weatherfish. Most records were obtained from the *Greifswald Lagoon* and *Szczecin Lagoon* and its adjacent waters in the period from 1822 to 1999 (figure 6). Only two freshwater species, namely asp and spined loach, were estimated with high number of records, especially in the *Greifswald Lagoon* and *Szczecin Lagoon*. The

spined loach was also found in the *Schlei Fjord*, River Trave system and Warnow River (figure 6). Schaarschmidt and Lemcke (2004) recorded asps also from the Darss-Zingst Estuary, whereas Winkler et al. (2002) excluded the presence of asp in that estuary. Recently, Lorenz (2001) reported asp and spined loach presence in shallow habitats of the *Szczecin Lagoon* as well. Winkler et al. (2002) also estimated the presence of spined loach in the Darss-Zingst Estuary.

Apart from freshwater habitats, the occurrence of the freshwater Annex II-fish species was mainly restricted to oligohaline-mesohaline coastal lagoons and estuaries. However, the ziege was also recorded in coastal waters east of the Rügen Island (figure 6). Nowadays, this species is known as a rare visitor to German coastal waters and lagoons east of Rügen Island (Spieß and Waterstraat 1989, Winkler 1989). Schaarschmidt and Lemcke (2004) also found historical records of this species for coastal waters west of the island.

The white-finned gudgeon has not been observed in German Baltic waters yet, although there exists a population of this species in the river system of the *Odra* (Rolik 1965, Blachuta et al. 1994, Freyhof et al. 2000). According to Naseka and Freyhof (2004), the white-finned gudgeon of the *Odra* was recently classified as *Romanogobio belingi* (Slastenenko, 1934); however, the white-finned gudgeon is still listed as *Gobio albipinnatus* (Lukasch, 1933) in the Annex II of the Habitats Directive.

From 1822–1999, the highest records of river and sea lampreys were obtained from the waters around the Rügen Island, the *Szczecin Lagoon* with adjacent waters, from the mouth of the Warnow River, the *Mecklenburg Bay* (*Mecklenburger Bucht*) and from the *Kiel Bight* (*Kieler Bucht*) (figure 7). This indicates the importance of these waters as habitat for lampreys at that time. Important lamprey stocks also existed east of these areas. From 1900–1920, more than 30 tons of river lampreys were caught annually in the *Gdańsk Bay* (*Danziger Bucht*), the *Vistula Lagoon* (*Frisches Haff*), and the *Curonian Lagoon* (*Kurisches Haff*) (Anonymus 1900–1920).

Twaite shad was also an important commercial species in some areas of the southern Baltic, especially during the last quarter of the nineteenth- and the first half of the twentieth century (Thiel et al. 2004a). The mean annual twaite shad catch from 1891 to 1960 amounted to 87 tons for the entire southern Baltic Sea. The annual catches of this species in this area declined sharply in the 1950s so that twaite shad was only occasionally caught in the Baltic Sea region until the mid-1990s (Thiel et al. 2004a).

The present occurrence of Annex II-fish species in the Baltic Sea region was investigated via a research fishery with otter trawls and shrimp trawls.

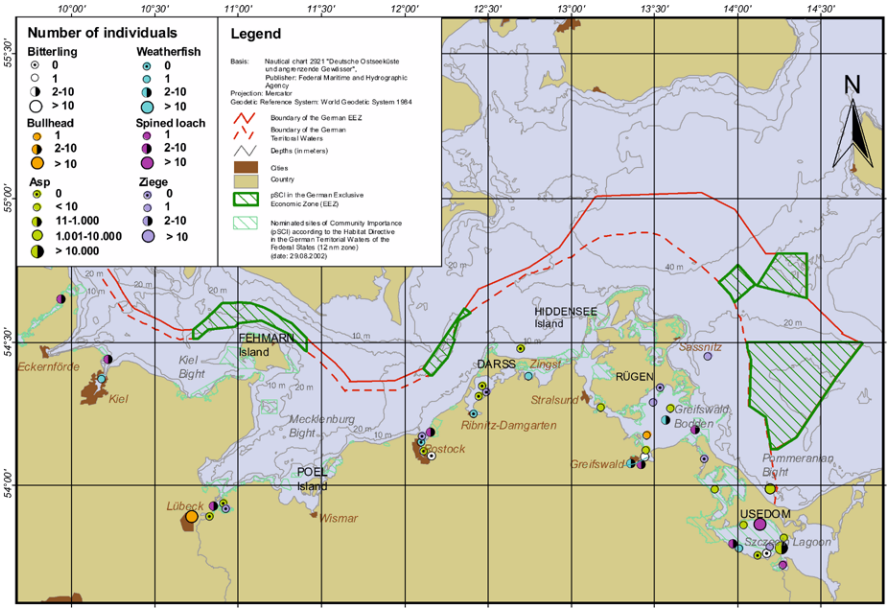


Figure 6. Distribution of historical records of freshwater Annex II-fish species in German Baltic waters from 1822–1999

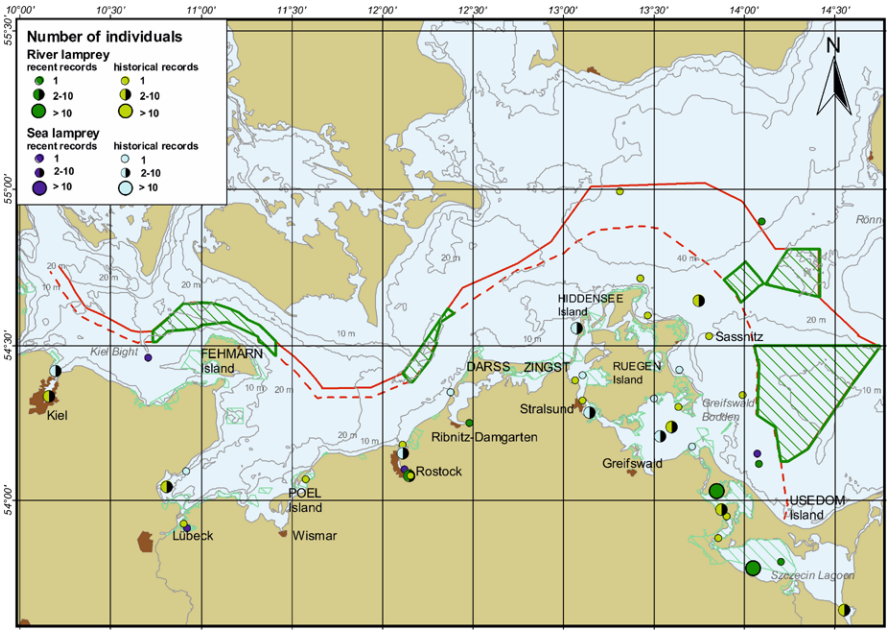


Figure 7. Distribution of recent records (since 2000) and historical records (1822–1999) of river and sea lampreys in German Baltic waters (legend in figure 6)

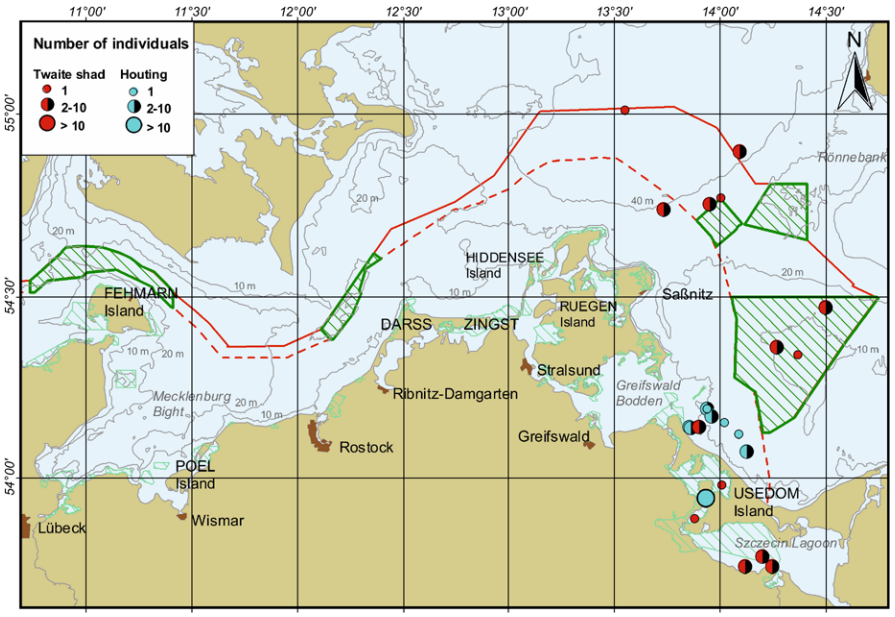


Figure 8. Distribution of recent records of twaite shad and houting in German Baltic waters from May 2003 until November 2004 (legend in figure 6)

Fish sampling with otter trawls was carried out in 3 investigation areas between the Islands of Rügen, Usedom, and Bornholm in the EEZ and in the coastal waters off Usedom Island. The sampling took place in autumn 2003 and in the spring, summer, and autumn of 2004. A total of 108 hauls were done (Thiel et al. 2004b, 2005). In order to ensure that commercial and recreational fishermen communicate actual catch records of Annex II-fish species, an information sheet containing drawings with the most important identifying characteristics of the relevant species was developed. This information sheet was distributed to a selected group of reliable people along the Baltic coast of Germany. Furthermore, a catch award was announced for those fishermen who communicate verified and accurate catches of Annex II-fish species. Additionally, new catch records of the relevant fish species were contributed by fisheries research institutes (Böttcher and Gröhsler, pers. comm. 2004).

A total of 162 individuals of Annex II-fish species were recorded in German Baltic waters from 2000–2004 (Thiel et al. 2004a, Thiel et al. 2004b): river lamprey (81 individuals), sea lamprey (4 individuals), houting (38 individuals), twaite shad (38 individuals) and *Alosa* sp. (1 individual). These records were obtained from 36 different localities, although 64%

of these spatial records originated from northeast of Rügen Island, the *Pommeranian Bay*, and the *Szczecin Lagoon* and adjacent waters (figures 7 and 8). Eighty-four percent (84%) of the river lamprey individual records originated from the *Szczecin Lagoon* and its adjacent waters (figure 7), demonstrating the importance of these bodies of water for the spawning migrations of this species. In comparison, only 4 single individuals of sea lamprey were caught at 4 different locations in German Baltic waters. Nowadays, no actual reproduction of sea lamprey in the German Baltic Sea area is known (Spratte and Hartmann 1998, Winkler et al. 2002). Historically, the sea lamprey may have spawned in the River Trave system (Duncker 1935–1939). No regular annual spawning of river lamprey occurs at all spawning sites in the German Baltic Sea region (Winkler et al. 1999). Additionally, these spawning populations are very small, comprising only of 20 to 100 individuals (Winkler et al. 2002).

Most of the spatial records of houting (80%) were obtained from the coastal waters off the Usedom Island (figure 8), indicating a nearshore distribution of this species in the *Pommeranian Bay*. Spawning concentrations occur in the *Szczecin Lagoon* and adjacent waters (figure 8). Kottelat (1997) associated the anadromous houting stocks of the German Baltic waters with *Coregonus maraena* (Bloch, 1779) from Lake Madü in Poland. According to Freyhof and Schöter (2005), the houtings from the Rivers Ems, Elbe, Treene, Schlei, Peene, and from the *Schlei Fjord* and the *Vänern* also belong to the same species. Although the population has stabilised during the last 10 years (Winkler et al. 2002), and restitution programmes have been underway, (for example, in the River Trave and in the *Schlei Fjord* using *C. maraena* from the *Szczecin Lagoon* and adjacent waters since 1992) the species is very close to disappearing from several German Baltic waters (Freyhof 2002). However, the main Baltic distribution area of houting is the *Szczecin Lagoon* and adjacent waters (Schulz 2001). A stocking programme was running there from 1996 to 2002, and it has resumed since 2005.

From May 2003 until November 2004, twaite shads were found at 14 different localities in the German EEZ northeast of the Rügen Island, as well as in the *Pommeranian Bay* and the *Szczecin Lagoon* and its adjacent waters (figure 8). With a total of 38 individuals, this species contributed 23% of all recent records of Annex II-fish species. All 19 records of twaite shad (50%) from the *Szczecin Lagoon* and adjacent waters were adult individuals, and dated from May to July (Thiel et al. 2004a, 2005). In the *Odra Bank* and in the coastal waters off the Usedom Island, only juvenile individuals of age group 0 were caught amounting to 19% of the total number of records. Thirty-one percent (31%) of all individuals of twaite

shad (mainly adults) were recorded from the *Western Rønne Bank* and adjacent waters.

Given the recent records from the German Baltic waters, it is assumed that the Baltic population of twaite shad has been increasing since the middle of the 1990s, after about 50 years of decline. Migration of greater numbers of twaite shads from the North Sea into the Baltic Sea has not been observed yet. On the other hand, the species has also been observed more frequently in the Polish, Lithuanian, and Estonian waters of the southern Baltic Sea since the mid-1990s. Therefore, the source of the population increase could be the eastern twaite shad stock of the *Curonian Lagoon* (Thiel et al. 2004a).

5 Conclusions

The status and population trends of Annex II-fish species (especially the population increase of twaite shad) reported here indicate that it is important to investigate the future population dynamics of such fish species in German waters of the Baltic Sea and North Sea. In particular, the study of the distribution of twaite shad and river lamprey, the most important Annex II-fish species in the German waters, needs to be continued. An international cooperation with the new EU Member States of the southern Baltic should be initiated to estimate the overall status of the Annex II-fish species for the southern Baltic. The importance of the *Szczecin Lagoon* (Baltic Sea) and of the Ems and Eider estuaries (North Sea) as spawning and nursery habitats of twaite shad needs further investigation to allow a more robust evaluation of the EEZ and the coastal waters of Germany as habitat for this species.

New methods (e.g., underwater video techniques, SCUBA diving) should be employed to get more accurate data on the occurrence of lampreys in stony reef habitats. Clearly further investigations regarding the systematics of migratory Coregonids (houtings) in the North- and Baltic Seas are necessary to clarify the status of some of the Habitats Directive's Annex II-fish species populations.

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