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Fisheries management in the Szczecin Lagoon

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Abstract

The Szczecin Lagoon is divided into a German and a Polish part that are managed independently. Fishery in Poland and Germany is regulated by laws containing regulations of closed season, minimum catching size, spawning and fish protection areas as well as regulations for the use of fishing gear. Both countries collect regularly data of their landed fish but an exchange of data besides the scientific level does not exist. The three mostly caught species are roach, bream and perch. Other important target species are pikeperch and Baltic whitefish. Neither Poland nor Germany undertakes the attempt of aquaculture in the lagoon. Environmental conditions are the main reason. However, in Germany Baltic whitefish is restocked, as are various fish species in Poland. In addition, scientific research of the cultivation of zebra mussels for water quality improvement takes place on the German side. Communication and cooperation between the two countries is low. A cross-border workshop organized within AQUAFIMA has shown that on both sides the demand for the implementation of a common cross-border and sustainable fishery and aquaculture management does exist.

1 Introduction

1.1 Szczecin Lagoon

The Szczecin Lagoon (Stettiner or Oder Haff in German, Zalew Szczeciński in Polish) is about 687 km² and consists of two shallow and tidal-free basins: in the west the German Kleines Haff ("Small Lagoon") with 277 km² and in the east the Polish Wielki Zalew ("Large Lagoon") with 419 km² (60 % of the total area). The water volume of the Kleines Haff is 1 km³. The Wielki Zalew has a water volume of 1.6 km³. The mean water depth in the Szczecin Lagoon is 3.8 m. The catchment area of the Szczecin Lagoon is 129,591 km². 91.5 % of the total inflow takes place via the river Oder/Odra having a flow of 17 km³ per year. The other tributaries are the river Peene (0.76 km³/a), the Uecker (0.186 km³) and the Zarow (0.144 km³) as well as Gowienica, Wołczenica and Świniec. This large supply of freshwater results in an estuarine character of the lagoon. Through the high nutrients loads of the tributary waters the lagoon is highly eutrophic. The compensation depth or the limit of algal growth is between 0.4 m and 0.8 m. Therefore, the macrophytes grow basically along the shoreline (Schulz 2013).

The Szczecin Lagoon is nearly separated from the Baltic Sea by the islands of Usedom/Uznam and Wolin. 70 % of the water discharge to the Baltic happens through the 16 km long and 10.5 m deep Świna and the Piast Canal. The remnant discharge takes place via Peenestrom and Dziwna (15 % each) (Stavenhagen 2006). The residence time of the water masses in the Szczecin Lagoon is between 35 and 75 days (Löser & Sekścińska 2005). There is an alternation of inflow and outflow events in the lagoon, especially during winter and spring. Exchange of water masses depends on differences in the water level in the lagoon, river Oder and Baltic Sea as well as wind direction and wind force. The high freshwater discharge and rather small exchange with the Baltic Sea lead to a low salinity in the Szczecin Lagoon. Besides seasonal changes of the salinity, with higher values during winter and lower

in summer, a spatial gradient of salinity can be observed as well. The salinity decreases from North to South because of the freshwater inflow from the tributaries, mainly the river Odra/Oder. Depending on exchange with the Baltic Sea and freshwater inflow the annual salinity in the Szczecin Lagoon fluctuates: the long-term winter salinity average is 2.4 psu, in summer the salinity is 0.8 psu (Löser & Sekścińska 2005). The Szczecin Lagoon is a highly variable ecosystem controlled by physical factors, such as salinity, water exchange, temperature, ice cover, and wind force and direction. The number and distribution of marine species varies with the brackish water supply from the Baltic Sea. Significant changes in the ecosystem may affect fish reproduction, which is essential for economically important species (Schulz 2013, Stavenhagen 2006).

Figure 1: Landscape of the coastal area of the Szczecin Lagoon (source: Nardine Stybel/ EUCC-D 2011)

1.2 Description of cross-border area

Since the end of the Second World War, the Szczecin Lagoon forms the border between Germany and Poland. After the reunification of Germany the Szczecin Lagoon was part of the 489 km long German section of the EU external border. The sea border there has a length of 22 km and as mentioned before divides the lagoon into the Kleines Haff and the Wielki Zalew. It runs nearly in north-south direction from the Baltic Sea, west from Świnoujście to the southern shore of the Neuwarper/ Nowowarpnieńskie Lake (Mały Rocznik Statystyczny Polski 2012).

On 1st May 2004 Poland became a member of the EU. Thus, the border changed from an external border to an EU-border. With Poland joining the Schengen area in 2007, the border between Poland and Germany became an open border which simplifies the economic exchange and the travel between both countries (Löser & Sekścińska 2005).

2 Fishery

2.1 Ecological aspects

The three most important target species in Germany and Poland based on data from 1995 to 2011 are roach *Rutilus rutilus*, bream *Abramis brama* and perch *Perca fluviatilis*. Nearly 90 % of the total catches in tonnes per year (t/a) belong to these three species. Due to their retail price other economically important species are pikeperch *Sander lucioperca* and whitefish *Coregonus maraena*. In the Wielki Zalew the catch yield is higher than in the Kleines Haff. Because of the larger area of this side of the lagoon, the productivity and the fishery intensity are higher. The annual average (from

1995 to 2011) shows that Poland caught 2310.8 t/a, whereas Germany caught 465.7 t/a. The average yield per area unit for Germany and Poland in this period was 16.8 kg/ha and 55.15 kg/ha, respectively (Figure 2). Besides the difference in the surface area, better food availability, spawning conditions and hydrographical characteristics, like water depth, shoreline and tributaries, result in better conditions for fish stocks of the Wielki Zalew.

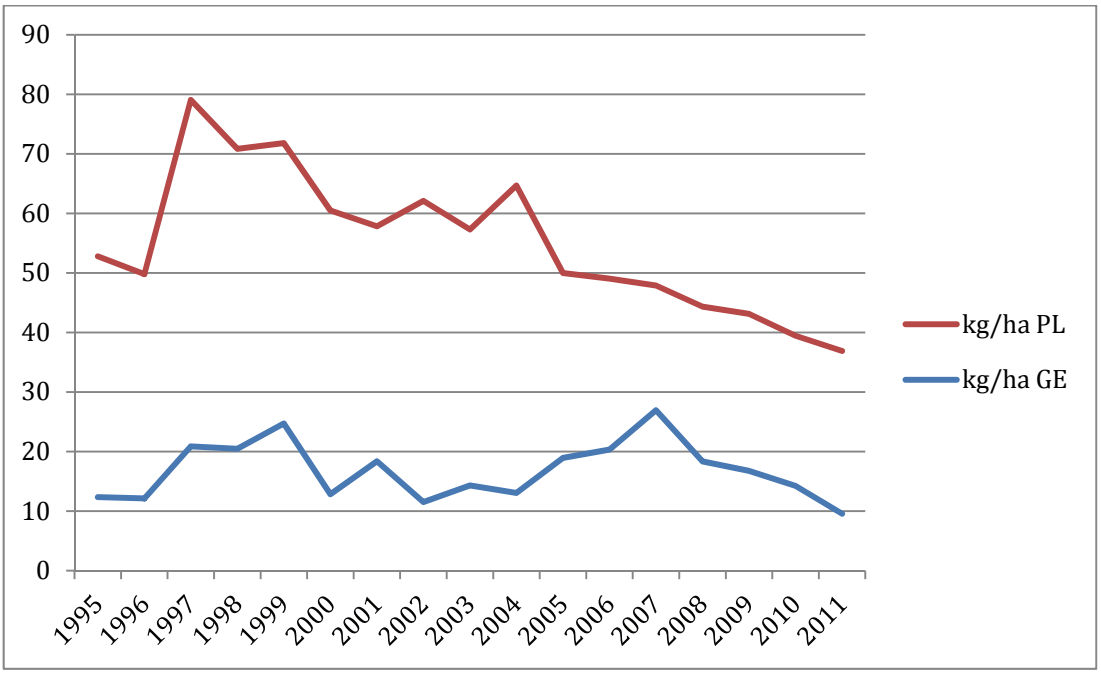

Figure 2: Catch yield (kg/ha) in the Kleines Haff and Wielki Zalew (data from 1995-2011)

Schulz (2013) points out that a reduced catch does not indicate a decreasing stock. Other factors, such as number of fishermen, price level, commercial outlet or climatic changes, i.e. less ice drift, warmer water, can also have impacts on the fishing intensity. Reliable data for these assumptions are missing as the sizes of the current fish populations in the Szczecin Lagoon are unknown.

In Poland, a drastic reduction of the yearly catch from 1999 to 2011 took place: it was reduced by half. For 2004 the small peak is due to the fact that the number of fishermen was decreasing and catching quotas were introduced. In Germany, the yearly catches from 1995 to 2011 are nearly constant with annual variations. The total yearly catch per fishermen must have increased as the total number of fishermen in the Kleines Haff decreased (LALLF 2013a).

Table 1: Minimum landing size in Germany and Poland (after: §4, KüFVO M-V and Zarządzenie Nr 1 OIRM w Szczecinie z dnia 25 maja 2011 r., respectively)

Fish species	Germany	Poland
roach *Rutilus rutilus*		20 cm
bream *Abramis brama*		40 cm
perch *Perca fluviatilis*	20 cm	17 cm
pikeperch *Sander lucioperca*, [syn. *Stizostedion lucioperca*]	40 cm	45 cm
whitefish *Coregonus maraena*	40 cm	40 cm
trout *Salmo trutta*	45 cm	50 cm
eel *Anguilla anguilla*	50 cm	50 cm
pike *Esox lucius*	50 cm	45 cm
salmon *Salmo salar*	60 cm	60 cm

There are big differences between Poland and Germany in the minimum landing size (from mouth to the end of the tail fin) of some target fish species (Table 1). In Germany, there is no minimum size for roach and bream which are the most fished species in the German part of the lagoon. But the German authorities and research institutes assume that the stock is sufficiently large. More important are the differences in minimum landing sizes for perch and pikeperch, fish species with a high economic value and they should be adjusted. Polish fishermen can catch perch smaller than 20 cm because the stock is larger in the Polish part of the lagoon than in the Kleines Haff, where the minimum landing size for perch is 20 cm. Thus, in Germany the species is given a chance for one more spawning event than in Poland. The Polish fishermen refer to a compensation effect and do not see any reasons to raise their minimum landing size for perch. The minimum landing size for pikeperch is five centimeters smaller in Germany than in Poland (40 cm and 45 cm, respectively). A rise in the minimum catching size would lead to an extreme economic loss. Both countries have their reasons for the minimum landing size and see no reason for an adjustment.

Figure 3: Typical fishing boat of the Szczecin Lagoon (Mönkebude) (source: EUCC-D/IKZM Oder 2005)

Poland and Germany have defined closed seasons, when fishing of certain species in the whole respective part of the Lagoon is banned (Table 2). The closed seasons for most of the fish species are quite similar, so that they are well protected in the lagoon during these periods. The largest differences exist in the closed season for eel and whitefish. As a result of completely different eel management programs in both countries, the closed season for eel fishing in Germany is in winter (1st December to 28th February), whereas in Poland it is during summer (15th June to 15th July). Whitefish has no closed season in Germany, so the time for fishing of this species there is two month longer than in Poland. But the stock of whitefish in the German part of the Szczecin Lagoon is decreasing, so the state authority of Mecklenburg-Vorpommern is planning to reintroduce a closed season in the new coastal fisheries decree probably for the season 2014.

Table 2: Closed seasons for fishing of different fish species in Germany and Poland (after: § 5 KüFVO M-V, 2006; Zarządzenie Nr 1 OIRM w Szczecinie z dnia 25 maja 2011 r., respectively.)

Fish species	Germany	Poland
eel	1st December – 28th February	15th June – 15th July
pike	1st March – 30th April	1st March – 5th May
salmon	15th September – 14th December	25th September – 15th November
trout	15th September – 14th December	25th September – 15th November
whitefish	none	20th October – 15th December
pikeperch	23th April – 22th May	4 to 6 weeks between 5th April – 25th May*

*) the exact dates are announced each year by RSFI (OIRM) in Szczecin

In addition to closed seasons fish and spawning protection areas exist. In these areas fishery is prohibited temporarily or permanently (Figure 4). There are two *fish protection areas* in Germany: in the "Usedomer Kehle" fishing is banned all-year around and at the river Zarow fishing is prohibited from 1st August to 28th February. In *spawning protection areas* fishing is prohibited between 1st April and 31st May. In Germany there are four spawning protection areas: Göschenbrinksfläche, Anklamer Fähre, Borkenhagen and Lake Usedom (§11 & §12, KüFVO M-V). By announcement fishing can also be forbidden in overwintering areas. On the Polish side there is a vast number of areas which are closed for fishing during periods indicated in the regulations issued by RSFI. Permanently closed areas are e.g. in the vicinity of some estuaries, Lake Wicko Male and adjacent areas in the Lake Wicko Wielkie (part of the Wolinski National Park). Furthermore, there is a time restriction for using specific types of gear.

Figure 4: Overview about spawning and fish protection areas of the German part of the Szczecin Lagoon, clockwise: Świnoujście, Międzyzdroje, Wolin, Stepnica, and Ueckermümde (based on Stavenhagen 2006)

Moreover, there are technical restrictions, such as mesh size, net length, and number of gear, that regulate the sustainable use of the fish resource. Table 3 shows the minimum mesh size for different fish species in the Baltic Sea from Germany and Poland. It shows that the minimum mesh sizes in Poland are sometimes significantly smaller than in Germany. That means that they catch fishes which are passing through the meshes in Germany. On the other side, Germany has no minimum mesh size

for bream and roach which are the most caught species in the Szczecin Lagoon. Furthermore, there is no minimum mesh size for whitefish in Germany. Fishes that are smaller than the minimum landing size must be returned to the sea. Such a return can be dangerous for some species, especially for whitefish.

Table 3: Minimum mesh size in Germany and Poland (§ 15, KüFVO M-V; Zarządzenie Nr 4 Okręgowego Inspektora Rybołówstwa Morskiego w Szczecinie z dnia 20 października 2004 r) * this mesh size is applied in set gillnets used for fishing perch and roach, other set gillnets must have a mesh side not shorter than 50 mm; ** that is a minimum mesh size (again mesh side) allowed in fyke nets with a selective screen used on the Polish side of the Lagoon

Fish species	Germany	Polish internal waters
perch	70 mm	30 mm*
cod	110 mm	
pike	100 mm	
herring	32 mm	
salmon	157 mm	
trout	120 mm	
flatfish	120 mm	
pikeperch	90 mm	
fyke nets and eel baskets	25 mm	10 mm**
bream		
whitefish		
rainbow trout		
roach		30 mm*

The space between the fishing gear and the length of nets in the German part of the lagoon is restricted by the "Küstenfischereiverordnung MV" (inshore fisheries regulation of Mecklenburg-Western Pomerania - KüFVO M-V). Per person a maximum of 100 m gillnet, eight eel baskets and 100 hooks on the long line is permitted.

In Poland, a greater quantity of fishing gear types can be used. These are different kinds of seines, set longlines, set gillnets and trammel nets, and traps (only fyke nets) (Zarządzenie Nr 1 OIRM w Szczecinie z dnia 25 maja 2011 r.), gillnets and fyke nets are the most commonly used in the Wielki Zalew.

2.2 Economic aspects

The fishery district in the German Part of the Szczecin Lagoon reaches from the Polish border to the train bridge Zecherin, including Lake Warpe and Lake Usedom, as well as the lower Uecker to the Ueckermünde Bridge, from the lower Zarow to the Grambin Bridge and from the lower Peene to the train bridge Anklam. The important landing ports are in Ueckermünde, Mönkebude, Altwarp, Kamminke and the town of Usedom (Schabelon 2007). In the Wielki Zalew seven landing ports for fish exist. Figure 5 shows the landing ports Lubin (Lübin), Wolin (Wollin), Stepnica (Stepenitz), Trzebież (Ziegenort), Nowe Warpno (Neuwarp), Świnoujście-Karsibór (Swinemünde-Kaseburg), Świnoujście-Przytór (Swinemünde-Pritter) and the number of fishing boats registered for these ports.

In Germany 80 fishermen are involved in the AQUAFIMA case study area. A fisherman owns the boat and normally other family members can use it as well. 34 of the fishermen are full time (professional) fishermen, 9 are non-commercial and additionally there are 37 hobby fishermen. After Schulz (2013) the German fishermen think that the intensity of fishery is reasonable (stock situation, expense) and that the lagoon cannot withstand more fishermen and/or more fishing gear. In Poland there is another system: ship owners own one or several ships and numerous fishermen use them.

There are 126 ship owners (2012) and 370 full time fishermen (2007) in the Polish part of the lagoon. On average 2.9 fishermen share a boat in Poland. In addition, 290 persons (mostly family members) work on land for the fishery and depend on it. Data on part time fishermen are not available in Poland.

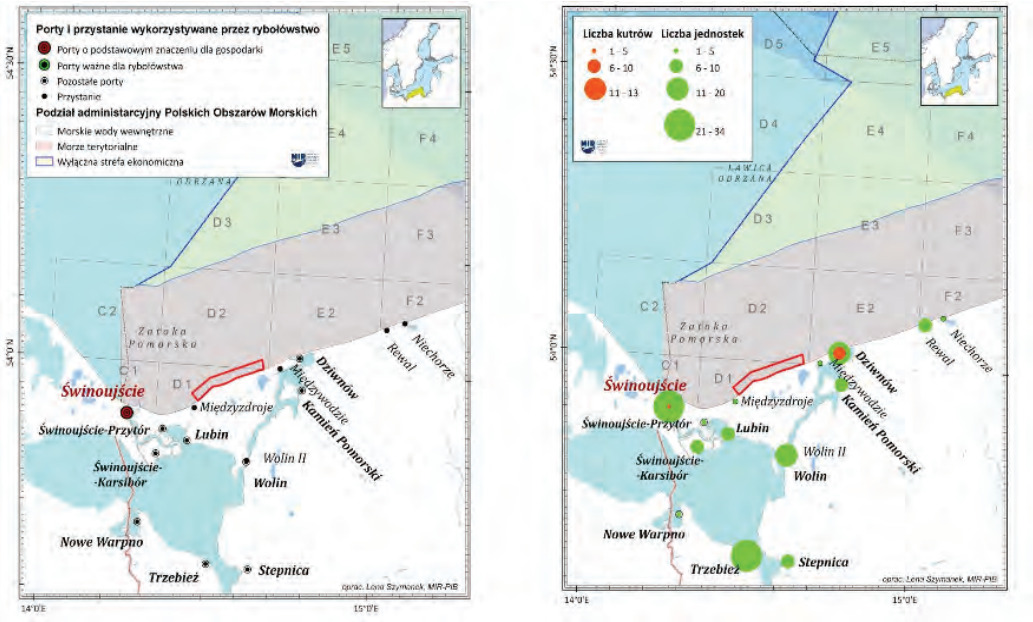

Figure 5: Landing ports in the Polish part of the Szczecin Lagoon; left: fishing harbours and seaports, right: numbers of boats (source: NMFRI)

Similar problems occur in both countries: fishermen are overaged and the next generation is not interested in being a fisherman. Reasons are hard work, less profit and high maintenance costs as well as decreased fish stocks. In Germany there are also problems or restrictions by the employer's liability insurance association that prevent people from being a fisherman. The lack of the next generation of fishermen will lead to a disappearance of the traditional fishery in coastal areas of the Baltic Sea. Moreover, a loss of jobs on land which depend on the fisheries industry is to be feared.

The technical and area restrictions (fisheries rules) are controlled by the local authorities. The German fishermen have to fill out a form of all monthly catches for the state fish landing statistic. Every vessel needs its own form that shows the result of the monthly fishing activity at the latest five day after the new month has started. Violation of the rule is an offense, and can lead to a fine (§ 24 &§ 25, KüFVO M-V). The actually fishing effort like the hours at sea is not controlled in Germany.

In Poland the fishing effort is controlled. The numbers of fishing gear of a given type cannot exceed a certain level set by RSFI, e.g. for fyke nets the upper limit is 1883 and for set gillnets 3591 (Zarządzenie Nr 1/2008 OIRM w Szczecinie z dnia 15 kwietnia 2008 r.)

The fishing areas depend on the experience of the fishermen, but there are no specific fishing areas which could be named in Germany. The fishermen mostly try to catch their fishes close to their homeport because of the high fuel costs. Another common fishery area is the coastal zone up to three meter water depth. In Poland there are no special places, but the best-known fishing areas around the case study area are Lake Dąbie, Roztoka Odrzańska, Szczecin Lagoon, Lake Wicko, River Old Świna, River Dziwna, Kamień Lagoon, Lake Nowe Warpno.

Besides technical, spatial and temporal restrictions resulting from the rules for fishermen, a socio-economical problem exists. The professional fishery is expensive and the average yearly yield is low. In addition to annual costs for the vessel, fuel, berth for the ship, insurance and spare parts which cost

a minimum of 10 % up to 25 % of the original boat price the fishermen have to pay a yearly fee to use their fishing gear.

Example Kleines Haff (German part of the Szczecin Lagoon)

The maximum length of bottom-set gillnets allowed in the area is 65,000 m according to the "Küstenfischereiverordnung MV" (inshore fisheries regulation of Mecklenburg-Western Pomerania). In reality, however, 66,200 m of gillnets have been licensed in 2013. Considering the length of 100 m of bottom-set nets permitted per recreational fisherman, i.e. 3.7 km of nets, and an estimated 1.0 km of net length permitted for each of the 9 non-commercial fishermen, in theory only about 1.5 to 1.6 km remain for each of the 34 professional fishermen. This value varies, since not every professional fisherman has applied for his/her historically calculated net length due to the fact that every metre of bottom-set net requires a fee of 0.02 EUR per calendar year to be paid. In addition, 3,000 eel traps are permitted in the lagoon, while only 1,206 have been licensed in 2013 (and 1,112 in 2012), for each of which an annual fee of 0.50 EUR needs to be paid.

Some fishermen operate stationary pound net close to the shore. As their historically allocated positions are not used throughout the year, however, an average number of 20 chamber traps can be estimated to be in part-time use.

Active fishing gear, for example trawls, are prohibited in the German part of the Szczecin Lagoon.

The 34 professional fishermen have 56 vessels in use, while the 9 non-commercial fishermen use 10 boats. Vessel lengths can be seen in Figure 6.

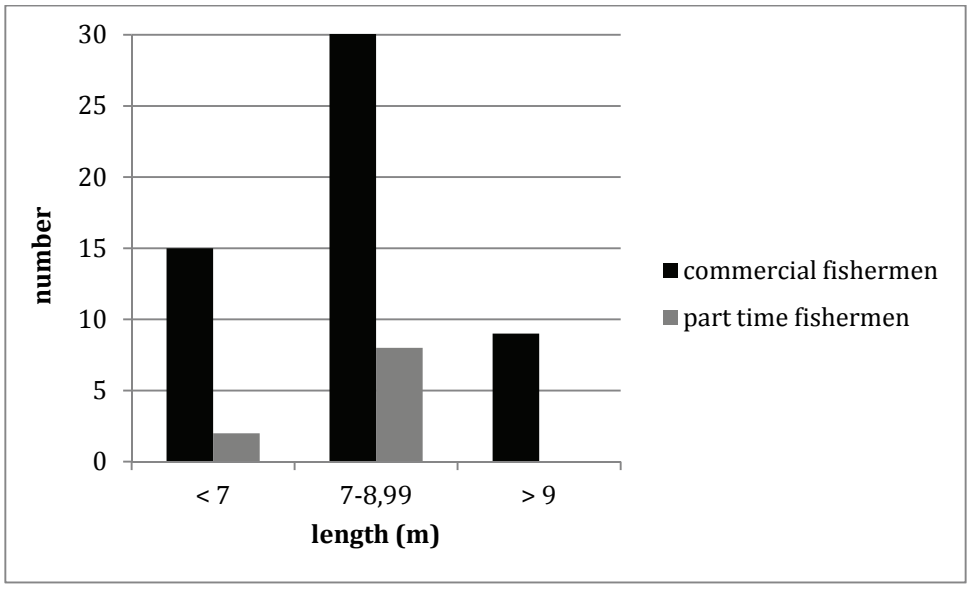

Figure 6: Number and length of fishing boats in the German part of the Szczecin Lagoon

After four years of steadily declining catches, greater catches were finally obtained again in 2012, resulting in a mean annual yield of 17.4 kg/ha. It is assumed that a predominant part of the 472 t of the total catch in 2012 were caught by professional fishermen (Figure 7). This corresponds to a mean annual catch of 11 t per fishing enterprise and a mean daily catch of approximately 50 to 60 kg.

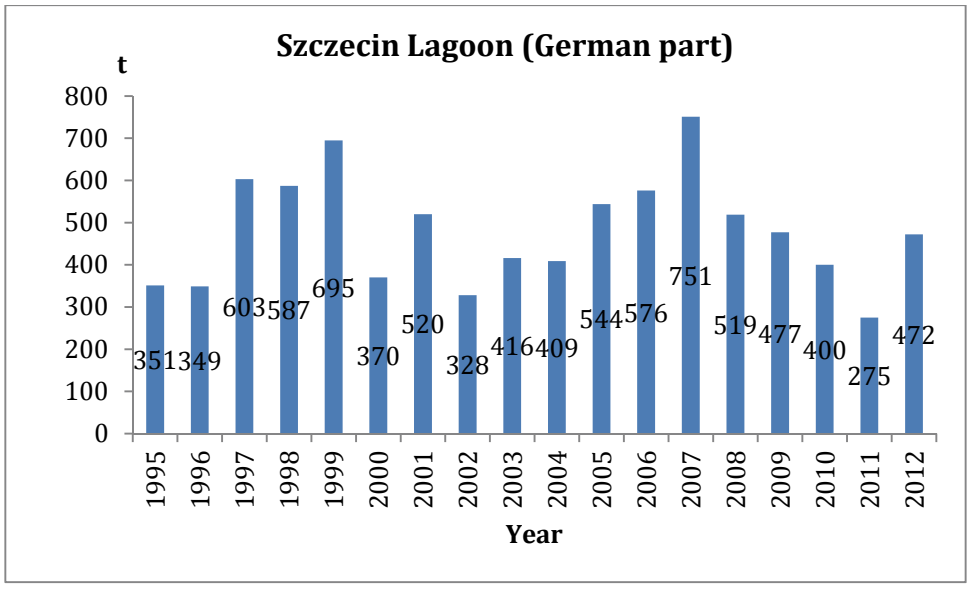

Figure 7: Total catch (t) in the Szczecin Lagoon, 1995-2012.

According to the report "Testnetzbetrieb Küstenfischerei – Spezialauswertung Mecklenburg-Vorpommern für das Jahr 2010 mit Vergleichen zu 2008 und 2009" and based on catch yields, the following mean profits for professional fisheries in the Little Szczecin Lagoon can be derived (Table 4):

Table 4: Mean profits of professional fisheries in the Little Szczecin Lagoon

Year	Mean profits in EUR
2008	12,730
2009	7,857
2010	18,481

Assuming that a skilled German worker has an average net annual income of 20,000 EUR, it becomes apparent that the profitability of fishing enterprises is highly critical and that in fact their existence cannot be secured from catch revenues alone. Obviously there are enormous differences amongst the enterprises as well as alternative income opportunities that, however, cannot be evaluated.

The profit situation also depends on the fishing vessels: According to the fisheries control office in Ueckermünde, responsible for recording the fish catches in the Kleines Haff, vessels with a length of 7 to 9 m gained a profit of 16,939 EUR in 2010, while fishing boats longer than 9 m earned 20,177 EUR in the same year.

The Federal Office of Agriculture and Food BLE published the landing statistic for whole Germany and for the individual states. In Mecklenburg-Vorpommern the State Office for Agriculture, Food Security and Fisheries (LALLF) published a landing statistic for the individual fisheries district (Table 5). The European Fisheries Fund (EFF, 2007) mentioned that the economic situation of the Baltic fish businesses are tense because of the few target species and the temporal and spatial fishing restrictions.

Table 5: Landing statistic based on data from BLE and LALLF-MV in 2012

	Landing quantitative in t	Share in landing quantitative Total % (Germany/MV)	Yield 1000 €	Share in Yield Total %. (Germany/MV)
Mecklenburg-Vorpommern	-	-	-	-
Kleine Hochsee- und Küstenfischerei	19,485.6	27.4	12,503.8	10.4
Szczecin Lagoon (German Part)	472.3	2.4	303.1	2.4

2.3 Fishing areas and gear

Gillnets and fyke nets are passive catching methods which are sustainable (e.g. minor damage of the sea floor). In Germany passive fishing is the traditional catching method. In the German part of the Szczecin Lagoon a total number of 65,000 m gillnets, 3,000 eel baskets and 20,000 hooks (§ 14 KüFVO M-V) are permitted. Figures 8 and 9 show the sites of fyke nets in the Szczecin Lagoon based on data from 2002 and 2011.

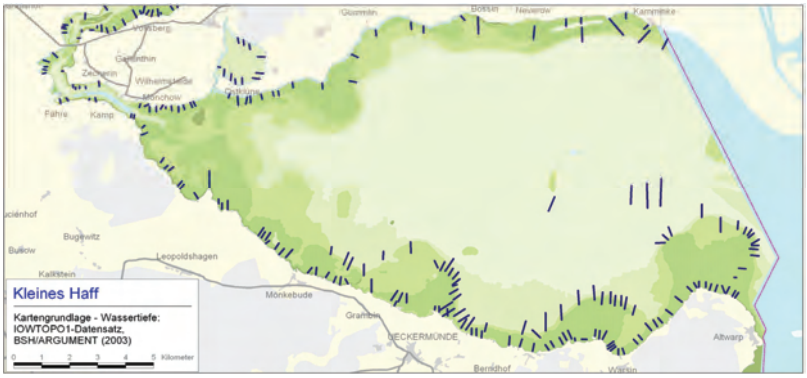

Figure 8: Fyke net sites in the German Part of the Szczecin Lagoon in 2002 (Schabelon, 2007)

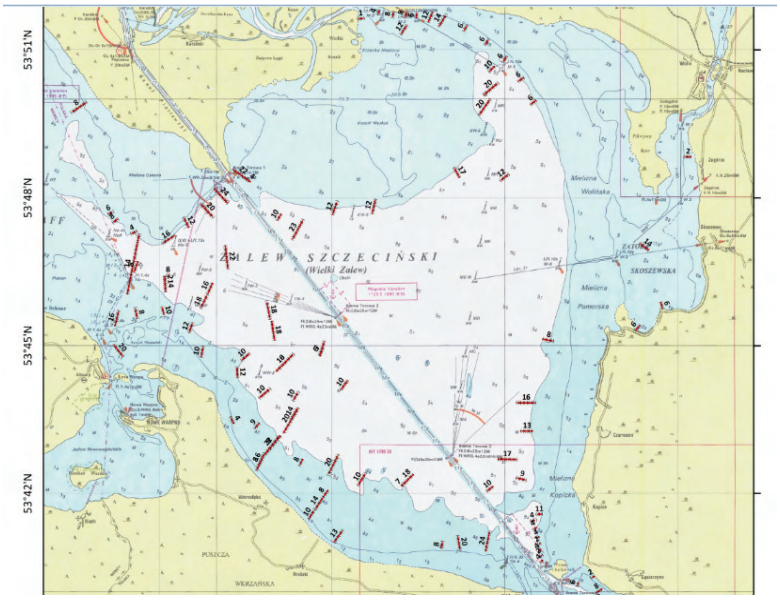

Figure 9: Fyke net sites in the Polish Part of the Szczecin Lagoon in 2011; numbers of maximum allowed fyke nets on given sites are indicated (source: NMFRI)

In Poland the fishery administration (in the case of the Szczecin Lagoon, the Regional Marine Fisheries Inspector in Szczecin) decides on request of the fishermen or the ship owner how many fishing gears are allowed to be used on the boat. In 2011 a EU program aimed at supporting small scale fisheries started. Most ship owners gave up their licenses to use active gear, deleting them from the register of fishing vessels for at least five years. This has led to an increase in the use of passive fishing gear since 2012.

3 Aquaculture

3.1 Description of aquaculture in the region

There is currently no aquaculture activity in the Szczecin Lagoon. The University of Greifswald has installed a first research cultivation plant for zebra mussels (*Dreissena polymorpha*) in the Lake Usedom. The aim is to analyze how effectively zebra mussels can be used to improve water quality. Due to their filtering ability they are able to clean the water improving its transparency. Information about this scientific idea is given by Stybel et al. (2009) and Schernewski et al. (2012).

In Poland commercial (private owned) and experimental, mostly academically based aquaculture facilities (coast-based or in the catchment area of the lagoon - Department of Aquaculture of the West Pomeranian Technological University) exist. Furthermore, there are restocking facilities in the catchment area run by the PZW (Polish Angling Association) and facilities of the university outside the study area – at Lake Miedwie – for restocking whitefish.

Schulz (2013) mentioned that environmental conditions may prohibit aquaculture in the Baltic Sea. The risk for the ecosystem and the environment is too high, especially when fish cage cultivation would be realised. Possible unforeseeable consequences are e.g. eutrophication and oxygen depletion. Even mussel aquaculture affects different biotic factors as well as physico-chemical and socio-economic aspects (Stybel 2013). Schulz (2013) suggests that the integrated multi-trophic aquaculture (IMTA), the common cultivation of fish, mussel and underwater plants, could be a sustainable way to produce aquatic species without environmental risks.

3.2 Importance of stocking and restocking

In the German part of the lagoon stocking has environmental as well as commercial purposes, e.g. up to 400.000 juveniles and 1 million larvae of Baltic whitefish are stocked annually. Moreover, Baltic sturgeon is stocked in the River Oder and its tributaries with access to the lagoon. If funding from EU would be available stocking of other endangered species could be carried out.

In Poland, a large amount of different fish species are restocked (Table 6). Poland releases fry, larvae and young fish in the lower Odra. This has mainly commercial reasons as the high level of restocking in Poland creates new jobs in the restocking facilities located in the catchment area. Moreover, many anglers are involved in stocking activities. The Polish Angler Association (PZW) is an important producer of stocking material. In 2009, the PZW has stocked 30 fish species of different age groups in quantities of 1,600 t. In addition, the PZW bought 301 million young fishes and larvae of different species. The money source (PLN 32.8 millions = € 7.63 millions annually) is the anglers' contributions.

Experiences in restocking Baltic whitefish have shown that stocking can compensate the natural loss of egg and larvae that occurs during their early development. But to stabilize and increase the wild spawning stock and the natural recruitment, a long term stocking and a sustainable management are required. As whitefish is an economically important species, this should be realized on both sides of the lagoon including a common season closed for whitefish fishing. Currently such closed season functions just on the Polish side (20th October – 15th December).

Table 6: Mean annual values of restocking material in the Lower Odra (source: PZW data 2006-2011, except* 2011 only, ** 2009 only)

Fish species	Restocking material
commercial purpose:	
eel (*Anguilla anguilla*)	20 kg + 560,000* (fry)
pike (*Esox lucius*)	900,000 (hatch)
pikeperch (*Sander lucioperca*)	100,000 (summer fry)
tench (*Tinca tinca*)	ca. 200 kg
common dace (*Leuciscus leuciscus*)	50,000 (autumn fry)
ide (*L. idus*)	70,000 (autumn fry)
asp (*L. aspius*)	50,000 (autumn fry)
wels catfish (*Silurus glanis*)	2,000 (autumn fry)
burbot (*Lota lota*)	3,000,000 (hatch)
sea trout (*Salmon trutta trutta*)	50,000 + 10,000* (smolts)
atlantic salmon (*Salmon salar*)	10,000 (smolts)+13,252*(smolts)+110,500*(fry)
whitefish (*Coregonus maraena*)	950,000 (1,200,000**) (hatch)
Environmental preservation	
atlantic sturgeon (*Acipenser oxyrhinhus*)	186 (1+fry, > 17 cm
vimba (*Vimba vimba*)	23,000 (autumn fry) + 556,800*

3.3 Future Plans and scientific initiatives

There are no future plans for aquaculture development in the lagoon. But stocking and restocking of different fish species will be important in future. If funding would be available the stocking of endangered species (besides Atlantic sturgeon) could be carried out in future. Depending on the outcome of the first scientific research plant in the Lake Usedom further cultivation of zebra mussels could be implemented in the lagoon to improve water quality and to strengthen the regional attractiveness. Further scientific research on stock development has been carried out by the Fishery Institute Rostock on the German side (Institut für Fischerei Rostock, Landesforschungsanstalt für Landwirtschaft und Fischerei MV (LFA MV)) and by three institutions in Poland: National Marine Fisheries Research Institute, Faculty of Food Technology and Fisheries of the West Pomeranian Technological University and Department of General Zoology of the Szczecin University. A study on the fisheries in the Szczecin Lagoon and its significance for functioning of the coastal communes was recently completed by Malkowska (2009). Further research in the field of fish migrations, breeding of valuable fish species and the efficiency of stocking is undertaken by the PZW.

4 Management aspects

4.1 Management of fishery

For fishing in both countries a fishing license is obligatory. In Germany, a new fisherman applies for a license without time limitation. The permit is issued after passing a fishing license examination. The fishing permit is issued by the upper Fisheries Department. Fishermen can lose their license just by gross violation, but in the first instance they have to pay a fee up to € 75,000 (§ 25, KüFVO M-V). In Poland the ship owners are required to possess a fishing license issued by the ministry responsible for fisheries and a special fishing permit for each vessel. For this permit they have to apply annually to the Regional Sea Fisheries Inspector in Szczecin. The contrary implementation of rules may lead to a suspension and/or denying issuing a special fishing permit for the next period.

4.2 Responsibilities for fishery in the Szczecin Lagoon

There are a lot of institutions and authorities in both countries which are responsible for fishery on different levels in the case study area. They are listed in the Annex.

4.3 Legal aspects

The legal aspects are presented in Table 1 of the Annex. The most important laws for the German part of the case study area are the State Fisheries Act Mecklenburg-Vorpommern and the Coastal Fisheries Decree Mecklenburg-Vorpommern (KüFVO M-V). This will be renewed in 2014 with little changes for the case study area, such as the reintroduction of a closed season for whitefish. The Fisheries Act, the Act of Fishing Market and Financial Support for Fisheries and the Act on Support of Sustainable Development of Fishing Sector using European Fisheries Fund are the basic laws regulating fisheries in Poland. The Regional Sea Fisheries Inspector in Szczecin represents fisheries administration on the Wielki Zalew and adjacent water bodies.

5 Area based management

5.1 Definition and regional status

Based on Neal (2007) the area-based-management for fisheries aims to conserve and rebuild fish (and mussel) stocks in its natural borders through developing a regionalized regulatory structure that takes into account local biological and economic factors. This includes measures of control to smaller, more local and responsive political bodies, thus creating more effective and long-lasting conservation of the resource. This is supported by fishermen, scientists, environmental groups and the local government that are working together. Prerequisites for a successful area-based management of fishery resources are: effective exclusion of other parties, science-based ecological information, habitat protection for the local fish. Following this definition an area-based fishery management is not fully developed in the Szczecin Lagoon. There are single aspects that are realized: closed seasons, protected areas for spawning and nursery, regional regulations addressing the kind and numbers of fishing gears. As the Szczecin Lagoon is a cross-border area these regulations should be similar for both sides. To ensure a more sustainable and future oriented development of the traditional fishery sector of the lagoon a cross-border management body should be implemented. This could form the basis for regular communication and a common development of regional, cross-border regulations.

5.2 SWOT-Analysis of the management of fishery and aquaculture in the Szczecin Lagoon

Strengths	Weaknesses	Opportunities	Threats
• Long-term documentation of the yearly catch per fish species and country (data: 1995-2011) • legal definition of minimum catch size • legal definition of closed season, fish and spawning protection areas • legal definition of permanently and temporally restricted areas for fishing • Regulation of mesh size, number of fishing gear per person, allowed fishing gear • Poland: definition of catch quotas • use of passive fishing gear: gillnets, longlines, fyke nets • knowing of landing ports and fleet size • EU: Common Fisheries policy • Poland: control of fishing effort->EU-regulation • federal authorities design state fishing laws • federal authorities control the quality of landed fish, monitor the national quotas • Germany: KüFVO M-V- Specific state law for the Baltic Sea Region • national and/or federal funding to support fishermen • commercial stocking support natural fish stock and local catch quotas • as the consequences of aquaculture in the Baltic Sea are unknown, aquaculture is not operated there • Federal research institutes collect data and do research on various topics of fishery, biology, marine ecology etc. • Germany: state research institute studies on ecological, sustainable and competitive aquaculture • research on mussel cultivation, fish migrations • marketing through production organizations	• sensitive ecosystem: changes of salinity, water exchange, temperature, ice cover, wind, wind direction influenced reproduction • impact of cormorants • unknown how large the individual fish species stock is • differences between PL and DE in minimum landing size of perch and pikeperch • eel management plan shows completely different closed seasons • Germany: no control of fishing effort • Germany: no catching quotas for the Szczecin Lagoon • complex system of contact partners/ authorities on different levels • complex system of EU-laws, federal and national laws • only members of producer organization can benefit from the EU support system • only for gross violation loss of license • no cross-border institutions and management bodies • less communication between the countries • no sustainable stocking of whitefish in Germany (result of whitefish stocking in Poland expected: 2014/2015) • no next generation of fishermen, disappearing of traditional Baltic sea fishery • poor economic status of fishermen	• lesser ice cover increase the possibility of mussel farming • research on *Dreissena polymorpha* • research approach: IMTA Integrated multi-trophic Aquaculture • try to design the stocking/restocking more sustainable • generous funding enable stocking of endangered species • whitefish: reintroduction of closed season • with the support of EU-funding creation of a common sustainable management • strengthening cooperation between both countries	• changes of environmental conditions could lead to changes in fish species, fish stock, biodiversity etc. • decrease in stocks • further growth of the cormorant population • possible fishing ban in nature conservation areas, gillnets a risk for seabird and sturgeon • collapse of fishing industry as the next generation of fishermen is missing • EU-funding policy: no funding for a common sustainable management

5.3 Cross-border cooperation and exchange

In February 2013, EUCC-Germany organized in the framework of the two projects ARTWEI and AQUAFIMA a cross-border workshop in Ueckermuende (German part of the Szczecin Lagoon) with the topic „Fishery aspects at the Szczecin Lagoon“. 50 participants from Germany and Poland exchanged their knowledge and experiences of all kind of fishery management. Main issues were the current status of fish species and populations, stocking and restocking measures as well as possibilities for water quality improvement and linkages to the fishery. Participants came from research institutions, fishery authorities and fishermen associations. The discussions supported with simultaneous translation have shown that there is a high demand for regular communication and cross-border exchange of information. Especially stocking and restocking events and measures as well as closed seasons should be discussed regularly and coordinated in a cross-border way to stabilize the stocks. This would help to ensure a sustainable use on both sides of the lagoon in future. The idea of the cultivation of zebra mussels as a tool for water quality improvement was also introduced to the fishery sector. A bilingual questionnaire about pros and cons of zebra mussel cultivation was filled by the participants. The results will help to understand local interests by the fishery sector. More information of the workshop and the presentations can be found under: http://www.eucc-d.de/workshop-aktuelle-fischereiaspekte-im-stettiner-haff.html

Figure 10: Impressions of the cross-border fishery workshop in the framework of ARTWEI and AQUAFIMA (source: EUCC-Germany)

6 Lessons learned and outlook

The improvement of the fishery management in the Szczecin Lagoon may lead to stabilization of economically important stocks and to strengthen the fishery tradition of Germany and Poland. The reintroduction of a closed season for whitefish in Germany is therefore an important prerequisite. The further research on mussel cultivation in the lagoon as a tool for water quality improvement can help to develop best-practice approaches to be implemented in a larger scale with high effectiveness. The fishery sector should be involved in further discussion processes, especially to find compromises in spatial planning, e.g. of mussel cultivation plants. The farming of zebra mussels could be a potential source of income in the future once they become more commercially important.

A further aspect of research could be the integrated multi-trophic aquaculture combining algae, mussels and fish. Fish aquaculture is negatively perceived in both countries because of environmental problems and will not be implemented in medium term.

On a long term basis the fishery has to be in line with other uses, such as nature conservation; but another seasonal or spatial prohibition could be economical unfavorable for fishermen.

The creation of a joint fishery management body in the Szczecin Lagoon would strengthen the relationship between Poland and Germany and will simplify the cooperation and communication between the individual authorities, research institutions and fishermen.

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Zarządzenie Nr 1 Okręgowego Inspektora Rybołówstwa Morskiego w Szczecinie z dnia 15 kwietnia 2008 r. zmieniające zarządzenie w sprawie szczegółowego sposobu wykonywania rybołówstwa morskiego na morskich wodach wewnętrznych. (Dz. Urz. Woj. Zachodniopomorskiego Nr 44, poz. 941)

Zarządzenie Nr 1 Okręgowego Inspektora Rybołówstwa Morskiego w Szczecinie z dnia 25 maja 2011 r. w sprawie określenia wymiarów i okresów ochronnych organizmów morskich (Dz. Urz. Woj. Zachodniopomorskiego Nr 682, poz. 1210)

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ANNEX

1. Fisheries related laws and regulations

Germany

State fisheries Act Mecklenburg-Vorpommern:

lallf.de/fileadmin/media/PDF/fischer/3_Gesetze/MV_2005_FG_2013__2_.pdf

Inshore fisheries regulation of Mecklenburg-Western Pomerania – KüFVO MV of 28 November 2006:
www.landesrecht-mv.de/jportal/portal/page/bsmvprod.psml?showdoccase=1&doc.id=jlr-K%C3%BCFischVMV2006pP1&doc.part=X&doc.origin=bs

Poland

National laws regulating fisheries:

Fisheries Act: *www.bip.oirm.szczecin.pl/ustawy/ustawa_o_rybolowstwie_20061220.pdf*

Act on fishing market and financial support for fisheries:
www.bip.oirm.szczecin.pl/ustawy/ustawa_o_rynku.pdf

Act on support of sustainable development of fishing sector using European Fisheries Fund:
www.bip.oirm.szczecin.pl/ustawy/ustawa_o_wspieraniu_sektora_rybackiego.pdf

Current regional law regulating fisheries in the Szczecin Lagoon:

Zarządzenie Nr 4 Okręgowego Inspektora Rybołówstwa Morskiego w Szczecinie z dnia 20 października 2004 r. w sprawie szczegółowego sposobu wykonywania rybołówstwa morskiego na morskich wodach wewnętrznych (Dz. Urz. Woj. Zachodniopomorskiego Nr 82, poz. 1437)

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Zarządzenie Nr 1 Okręgowego Inspektora Rybołówstwa Morskiego w Szczecinie z dnia 25 maja 2011 r. w sprawie określenia wymiarów i okresów ochronnych organizmów morskich (Dz. Urz. Woj. Zachodniopomorskiego Nr 682, poz. 1210)

2. Important contacts for fisheries management in the Szczecin Lagoon

Germany

Institut für Fischerei der LFA

Carsten Kühn
Fischerweg 408
18069 Rostock

Poland

Uniwersytet Szczeciński/
Szczecin University:

Professor Józef Domagała
Dr Agnieszka Malkowska

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie
Wydział Nauk o Żywności i rybołówstwa/
West Pomeranian University of Technology in Szczecin
Faculty of food science and fishery

Professor Krzysztof Formicki
Dr Jacek Sadowski
Professor Wawrzyniec Wawrzyniak
(www.zut.edu.pl/index.php?id=6980)

Morski Instytut Rybacki –
Państwowy Instytut Badawczy/ National Marine Fisheries Research Institute

Dr Wojciech Pelczarski
Dr Iwona Psuty

Responsibilities for fisheries management of the Szczecin Lagoon

General Directorate of Fisheries			
• Common fisheries policy (CFP) - refers to all fishing activities, the farming of aquatic resources as well as the processing and commercialization of fishery products • Priorities of the CFP are conservation and management of marine resources, fisheries relations to and agreements with non-member states and international organizations, structural measures and the common market organization for fishery and aquaculture products (European Commission) • VO (EG) Nr. 88/98; geändert durch die VO (EG) Nr. 1520/98; geändert durch die VO (EG) Nr. 812/2004 • VO (EG) Nr. 27/2005 • VO(EG) Nr. 2371/2			
Germany	Function and linked laws	Poland	Function and linked laws
Federal Ministry of Food, Agriculture and Consumer Protection (Bundesministerium Ernährung, Landwirtschaft und für Verbraucherschutz (BMELV)) Wilhelmstr. 54, 10117 Berlin Tel: +49-30/2006-0 Rochusstr. 1, 53123 Bonn Tel: +49-228/529-0	➢ fisheries policy ➢ preventive consumer protection, quality management as well as environmentally and animal friendly production ➢ Marine Fisheries Act (SeeFischG) ➢ Marine Fisheries Decree (SeefiV) ➢ Fisheries Act for the State of Mecklenburg-Vorpommern (FischG)	Ministry of Agriculture and Rural Development (Ministerstwo Rolnictwa i Rozwoju Wsi; Departament Rybołówstwa) ul. Wspólna 30, 00-930 Warszawa Tel: +48 22/6231471	➢ development of: sea and coastal fishery ➢ inland fishery and aquaculture ➢ fisheries market regulation ➢ participation of Poland in the preparation of European Common law regarding food security, fishery etc. ➢ Fisheries Act (USTAWA O RYBOŁÓWSTWIE Dziennik Ustaw Nr 62z 2004 r., poz. 574, z późn. zmianami) ➢ Act on support of sustainable development of fishing sector using European Fisheries Fund (Uwaga od redakcji: Późniejsze zmiany do ustawy odnoszą się do przepisów pominiętych
Federal Office of Agriculture and Food (Bundesamt für Landwirtschaft und Ernährung) Haubachstr. 86, 22765 Hamburg	➢ implementation of the common fish market regulation ➢ management and monitoring of the national quotas ➢ creation of a list of fish species trade names ➢ operated three fishery protection vessels and three fishery research boats in behalf of the BMELV	Agency for Restructuring and Modernization of Agriculture (Agencja Restrukturyzacji i Modernizacji Rolnictwa) (ARiMR) Al. Jana Pawla II 70, 00-175 Warszawa Tel.: +4800380084	➢ processing the funding of fisheries ➢ implementation of instruments co-financed from the European Union budget and provides aid from national funds (ARiMA) ➢ Act on fishing market and financial support for fisheries

			(USTAWA z dnia 22 stycznia 2004 r. o organizacji rynku rybnego i pomocy finansowej w gospodarce rybnej - art.8 (Dziennik Ustaw Nr 34, poz. 291, z późn. zmianami)
State Ministry of Agriculture, Environment and Consumer Protection Mecklenburg-Vorpommern (Landesministerium für Landwirtschaft, Umwelt und Verbrauchersicherheit Mecklenburg-Vorpommern), Department 5 Dr. Dayen, Referat 560 Gerhard Martin Paulshöher Weg 1, 19061 Schwerin	➢ legislative and administrative tasks in the field of fisheries in the state of Mecklenburg-Vorpommern ➢ Inshore fisheries regulation of Mecklenburg-Western Pomerania (KüFVO M-V)	Regional Sea Fisheries Inspector in Szczecin (Okręgowy Inspektor Rybołówstwa Morskiego w Szczecinie, OIRM) ul. Starzyńskiego 8, 70-506 Szczecin Tel.: +48-91-4322550	➢ management of fish stocks in Polish Marine Areas west of the meridian 15°23'14"(including the Szczecin Lagoon as a part of marine internal waters) ➢ Ensure the inspection and control ➢ monitoring of the fish landing ➢ special fishing permits
State Office for Agriculture, Food Security and Fisheries Mecklenburg-Vorpommern (Landesamt für Landwirtschaft, Lebensmittelsicherheit und Fischerei Mecklenburg-Vorpommern) Tierfelder Straße 18, 18059 Rostock Abteilung Fischerei Am Bahnhof 1, 18119 Rostock	➢ fishing licenses ➢ local decisions-maker: fisheries supervisor Fischereiaufseher/ Fischereimeister)	Sea Fisheries Inspectors in Świnoujście, Szczecin, Trzebież, Wolin, (Inspektorzy Rybołwstwa Morskiego w Świnoujściu, Szczecinie, Trzebieży, Wolinie,) (IRM) Inspektor Rybołówstwa Morskiego w Świnoujściu, ul. Duńska 17 72-600 Świnoujście, Tel/Fax: +48 91/8889988 Inspektor Rybołówstwa Morskiego w Szczecinie ul. Starzyńskiego 8, 70-506 Szczecin Tel.:+48 91/4322551 Inspektor Rybołówstwa Morskiego w Wolinie ul. Niedamira 22, 72-510 Wolin Tel.: +48 91/32624 66 Inspektor Rybołówstwa Morskiego w Trzebieży ul. Portowa 5B, 72-020 Trzebież Szcz. Tel: +48 91/ 3128700	➢ realization of inspection and control in the Szczecin Lagoon

State Offices for Agriculture and the Environment Altentreptow (Staatliche Ämter für Landwirtschaft und Umwelt Altentreptow) Brunnenstraße 6, 17087 Altentreptow Postfach 1569, 17081 Altentreptow Tel: 0049 3961/261245	➢ This fishery authority has only competences in inland fishers and aquaculture ➢ Implementation and monitoring of inland fisheries regulation ➢ Represent the interests of fisheries in inland		
Johann Heinrich von Thünen-Institute Federal Research Institute for Rural Areas, Forestry and Fisheries, Institute of Baltic Sea Fisheries (Johann Heinrich von Thünen-Institut Bundesforschungsinstitut für Ländliche Räume, Wald und Fischerei, Institut für Ostseefischerei) Alter Hafen Süd 2, 18069 Rostock Tel: +49 381/8116101	➢ provide the scientific basis for sustainable utilization of fisheries resources in the Baltic Sea ➢ study the population dynamics of the important fish species in the Baltic Sea ➢ collection of biological data for international databases	National Marine Fisheries Research Institute (Morski Instytut Rybacki – Państwowy Instytut Badawczy) ul. Kołłątaja 1, 81-332 Gdynia Tel: +48 58/62017-28	➢ Under the supervision of the Ministry of Agriculture and Rural Development ➢ Research areas are fisheries biology, fisheries oceanography and marine ecology, fisheries process engineering and fisheries ➢ Responsible for the collection of economic data on sea fisheries
State Research Institute for Agriculture and Fisheries Mecklenburg-Vorpommern, Institute of Fisheries (Landesforschungsanstalt für Landwirtschaft und Fischerei Mecklenburg-Vorpommern, Institut für Fischerei) Fischerweg 408, 18069 Rostock Tel: +49 381/811-0	➢ studies on the design of an ecologically sustainable and competitive aquaculture ➢ fish farming in fresh and brackish water ➢ technological process optimization in fresh and brackish water ➢ Studies on the preservation and improvement of fishing profitability of inland and coastal waters as a basis for a sustainable and ecologically-oriented fishing management ➢ fishery biological and socio-economic aspects ➢ technical and technological aspects	Polish Angling Association (Polski Związek Wędkarski) Hard 42, 00-831 Warsaw Tel: +48 226208966 Protection Team and water development (Zespół Ochrony i Zagospodarowania Wód) Tel: +48 226205088	➢ Largest producer of stocking material ➢ The scientific PAA Research: Funded research papers in the field of fish fauna of rivers; the study of fish migration, the development of biotechnology breeding of valuable fish species, the study of factors affecting the efficiency of stocking.
National Association of boats and coastal fishing Mecklenburg-Vorpommern (Landesverband der Kutter- und Küstenfischer Mecklenburg-Vorpommern e.V.)	➢ represents the interests of fisheries ➢ distribution of fish quotas among individual companies		

Hafenstraße 12f, 18546 Sassnitz Tel: 0049 38392/66486			
National Angling Association Mecklenburg-Vorpommern e.V. (Landesanglerverband Mecklenburg-Vorpommern e.V.) Siedlung 18a, 19065 Görslow	➢ Legally recognized Association for Nature Conservation ➢ Interest representation for the preservation and protection of possibilities and conditions for the exercise of expertly and cherish friendly fishing ➢ Hege of the fish population	Fishermen's Association of the Szczecin and Kamień Lagoon, and Lake Dąbie (Zrzeszenie Rybaków Zalewów Szczecińskiego, Kamieńskiego i Jeziora Dąbie) ul. Kopernika 8, 72-020 Trzebież	
Producer organization fishing cooperative „Haffküste" Ueckermünde (Fischereigenossenschaft e.G. „Haffküste" Ueckermünde Producer organization "Usedom Fisch" e.G. (Erzeugerorganisation Usedom Fisch e. G.)	➢ measures for the rational use of fish resources ➢ Improvement of sales conditions, for example Implementation of fisheries plans ➢ Membership is essential to receive funds from the EU for the final and temporary closure ➢ Producer organizations serve producers (whether they catch fish and / or cultivate) and allow them a cooperation of management of their resources from an economic and ecological point. ➢ Create an annual work program (marketing strategy)	Local Fisheries Group "Szczecin Lagoon" (Lokalna Grupa Rybacka „Zalew Szczeciński) ul. Dworcowa 4, 72-602 Świnoujście	