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Bycatch as a potential threat to harbour porpoises (*Phocoena phocoena* L.) in Polish Baltic Waters

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WORKING PAPER

Bycatch as a potential threat to harbour porpoises (*Phocoena phocoena* L.) in Polish Baltic waters.

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ABSTRACT

Sixty two verified reports obtained in the years 1990-1999 on the bycatch, strandings and sightings of harbour porpoises in the Polish Baltic were analysed in this study. Puck Bay was the place where in relative terms the highest number of reports (22) was noted. Forty five (72.6%) reports referred to specimens from bycatch, 10 (16.1%) were individuals observed at sea, and 7 (11.3%) - stranded. 42.2% of the bycatch occurred in the fishing grounds of Puck Bay. Forty carcasses of harbour porpoises were obtained for further analysis. Most of the bycatch took place from December to April with maximum in March. In the rest of the year there were 1-3 bycaches reported per month with no cases of bycatch in June. Taking into account data on fishing effort collected for the study area it appears as by far the greatest threat to harbour porpoises is posed by nets used for salmonids. Among all the bycaught animals, most (40.0%) perished in salmon semi-drift nets. A considerable part of the harbour porpoises perished in bottom set nets laid out for cod (33.3%) while only a single bycatch was reported from herring trawl nets. To assess the danger from different fishing gear and to determine the areas where the threats are the highest, the method of obtaining data *in situ* was used. In the course of boat inspections various types of fishing gear were identified and geographical positions of 1069 nets were marked. The majority (92%) consisted of semi-drift nets for sea trout and salmon. Relatively low numbers of bycatch were reported from bottom set nets, which density in the area was, in the autumn months, over 20 times less than that of surface salmon nets. The density and distribution of both types of nets in the surveyed area is comparable during autumn and winter seasons, when the majority of bycatches in bottom set nets were reported..

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INTRODUCTION

The harbour porpoise (*Phocoena phocoena*) is the only species of *Cetacea* inhabiting the Baltic Sea (Japha 1908, Aquayo 1978, Kowalski and Pucek 1984). Nowadays harbour porpoise is a species subject to stringent protection in Poland according to international (ASCOBANS - Agreement on the Conservation of Small Cetaceans on the Baltic and North Seas and HELCOM - Helsinki Commission[1]) and domestic regulations such as Ordinance of the Minister of Environmental Protection, Natural Resources and Forestry of 6 January 1995 (*Journal of Laws* 1995 no 13, item 61); it also features in Poland's *Red Data Book* (G³owaciñski ed. 1992).
In the past the harbour porpoise was regularly hunted in the Baltic (Ropelewski 1952). In the eighteenth and nineteenth centuries porpoise hunters formed their own guilds. They were especially prosperous in Denmark, where the configuration of bays and straits made it possible to entrap the animals in the shallows and cut off their route of escape with nets (Kinze 1995). The inhabitants of the southern coast of the Baltic were also involved in the hunting of harbour porpoises. In a privilege dated 17 July 1378, in which Winrych von Klipprode, Grand Master of the Teutonic Order, granted municipal rights to the town of Hel (on the Gulf of Gdañsk), there is a reference of its inhabitants being required to pay a yearly tax on the harbour porpoises caught by each of the fishing boats (Ropelewski 1952).

Harbour porpoise was still considered abundant in the Baltic at the beginning of the twentieth century. Although few records are given, harbour porpoise was considered as a regular visitor of coastal waters of Latvia (Greve 1910, Schweder 1909), Estonia (Greve 1910), and inhabited coastal waters as far east as the Gulf of Finland (Koschinski 2002 after Tomilin 1957) and Gulf of Bothnia (Koschinski 2002 after Levander 1905). Braun (1905) states that beginning from early spring harbour porpoises were being found in salmon nets used by small boats in the Gdañsk Bay region /Baltijsk/.

In the same period in Poland harbour porpoises were regarded as pests, harmful to fish stocks and damaging nets (Ropelewski 1954). In the early 1920s a bounty scheme was introduced and fishermen were given 2, and later 5 zlotys per dead individual of harbour porpoises. Nevertheless there is no evidence on direct catch of harbour porpoises at that time, but it is clear that many animals drowned in fishing nets. Fishing statistics from the Gulf of Gdañsk area demonstrate that hundreds of animals were bycaught each year until the end of 1930s (Ropelewski 1952). It transpires that the population of these mammals was very high indeed. Based on an interview with J. Budzisz, the oldest fisherman from town of Hel, we know that harbour porpoises were bycaught quite often in the Gulf of Gdañsk still during World War II. He remembers that up to 6 animals were bycaught in salmon nets during a one-day fishing trip on the fishing ground east of Hel. As from the late 1940s harbour porpoise relative abundance has declined reasonably for unknown reasons in Polish waters (Ropelewski 1952, Pucek and Raczyñski 1983, Skóra et al. 1988) as well as in other areas in the Baltic regions, including Swedish (Koschinski 2002 after Berggren and Arrhenius 1995), Danish (Clausen and Andersen 1988) and Finnish (Koschinski 2002 after Määttänen 1990) waters. The bycatch of porpoises in Poland became very rare as well as sightings and strandings. First scientifically documented observation after the 1940s come from Gdañsk area, where one specimen was stranded in 1950 after a few years with no reports at all . (Ropelewski 1954).

The first abundance survey of porpoise population in the Baltic was conducted in 1995 in the south-western part of the sea (excluding Polish territorial waters). The estimated abundance for the area surveyed was 599 (CV=0.57) (Berggren 1995). Visual and passive acoustic surveys conducted in Polish waters in 2001 have confirmed scarcity of harbour porpoise in the surveyed area. Despite large effort, the survey has resulted in unsufficient data for calculation of abundance estimates (Berggren et al. 2002). In view of the latest genetic and morphological studies, suggestive of the separation of the Baltic harbour porpoises population (Tiedemann et al. 1996, Andersen et al. 1997, Borjesson & Berggren 1997, Huggenberger et al. 2002), such a small stock is unsustainable given the increasing threats in its natural habitat.
The aim of this study is to present recent observations of harbour porpoises in the Polish Baltic, to compare those to historical information, and to evaluate the dangers posed to them by fishing activities.

MATERIAL AND METHODS

The material consists of data collected in the years 1990-1999, as well as historical data. The reports on the observation of harbour porpoises were gathered in as a result of a widespread information campaign on the subject of harbour porpoises and Baltic dolphins, involving a yearly distribution of leaflets directly to fishermen, maritime offices, and tourist centres situated on the Polish coast. All the dead harbour porpoises – whether caught in nets or found on the shore - were brought to the Hel Marine Station of Gdañsk University, where they were measured, weighed, and afterwards subjected to autopsy including tissue sampling for further biological, parasitological and toxicological research. The material analysed originates exclusively from Polish maritime areas.

In order to assess the relative degree of danger from different fishing gear, as well as to determine the highest threats areas , we used direct *in situ* data collection. Information was collected on the number, distribution, and types of nets actually laid in fishing grounds, for comparison with the occurrence of bycatch of the animals in question. For the conduct of boat inspections the Gulf of Gdañsk area was chosen. The above method is considered the most effective in the case of small-boat coastal fishery, which is practised in this area.

The location of nets was established by means of the satellite navigation system (DGPS) connected to a computer, into which detailed information on the type of fishing gear encountered was being fed. In this way a database emerged, which allowed for a prompt establishment of the prevalent type of gear, as well as mapping its distribution. This information provides a basis for an assessment of the reasons behind the bycatch of harbour porpoises in the area.

The reference area for the data assembled was the Puck Bay, characterised by the highest reported amount of the bycatch. The cruises were conducted in the years 1998 and 1999. Two periods were chosen for the survey with typical seasonal distribution of nets in this area. In the first year of research the inspections were carried out in the autumn – between September 16 and 20, and on November 16 on a salmon fishery. Meteorological conditions rendered it impossible to continue the research in the autumn months. In 1999 12 local inspections of the distribution of fishing gear were conducted in the summer months, between May 26 and September 3 when there is no effort in salmon fishery in the area.

RESULTS

In total 62 verified reports were obtained on the bycatch, strandings or sightings of harbour porpoises in the Polish Baltic. In view of its small area the Puck Bay was the place where in relative terms the highest number of reports (22) was noted. The number of reports on harbour porpoises in Polish coastal waters has increased in recent decades from an average of 1 individual per year in the period 1950-1989 to 6.2 in the period 1990-99 (Fig. 1). The reports concerned bycatch, sightings and strandings.

Of the 62 reports collected, 45 (72.6%) referred to dead specimens from fishing bycatches, 10 (16.1%) harbour porpoises were observed at sea, and 7 (11.3%) were found dead on the shore (Fig. 2). Only once (on 26 December 1993) fishermen succeeded in saving a harbour porpoise which had become entangled in salmon nets. A large proportion of the bycatch (19 cases, i.e. 42.2 %) occurred in the fishing areas of Puck Bay.

For purposes of research 40 dead harbour porpoises were obtained from the bycatch. The length of the specimens examined varied from 111cm to 167cm, and the weight from 20.8kg to 67.0kg (Table 1). The length of the largest stranded animal (180 cm) was given approximately by a person who found the uncomplete carcass on the beach.

[1] HELCOM Recommendation 17/2

Most of the bycatches took place from December to April with maximum (11 individuals) in March. In other seasons 1-3 bycaches were reported per month, except in June when no bycatch occurred (Fig. 3).

Of all the dead animals found in the nets, most (40 %) perished in drift nets used for fishing salmonids – sea trout (*Salmo trutta*), salmon (*Salmo salar*) and rainbow trout (*Onchorynchus mykiss*) (Table 2). This type of nets is used differently in the Gulf of Gdañsk (including Puck Bay) and in the open sea. Both are drifting surface nets, with a mesh size (lumen) of 157mm. In the Gulf they are set single (35-70m long) with one end anchored (so called "semi-drift nets"). In the open sea they are laid out in sets of up to several kilometres in length. Bycatch in salmon nets was reported only from Puck Bay and coastal waters of the Gulf of Gdañsk in artisanal fishery.

Set nets are also dangerous for these animals.They are laid out on the sea bed, and anchored at both sides. A considerable part of the harbour porpoises perished in cod nets (33.3%) and flounder and pike-perch nets (15.5%). Harbour porpoises rarely get entangled in trawl nets. In this study, only one harbour porpoise got entangled in herring trawl net (Table 2).

During boat inspections various types of fishing gear were identified and 1069 geographical positions registered where fishing had occurred. Most of these (988) consisted of semi drift surface nets for salmonids (Table 3).

Both in 1998 and 1999, when net survey was conducted, no bycatches of harbour porpoises in salmon nets were recorded, and the relatively high number of reports involved exclusively bottom cod set nets (5 thereof 3 in Puck Bay). In comparison, the density of cod nets in the study area was, in the autumn months, over 20 times less than that of surface nets (Table 3).

DISCUSSION

According to an abundance estimate based on a survey in 1994, the waters of Kattegat are inhabited by 36,046 (CV=0.34) harbour porpoises and Danish and German Bights by some 6,000 harbour porpoises - 5,262 (CV=0.25) in Great Belt and 588 (CV=0.48) in Little Belt and Kiel Bight (Hammond et al. 2002). The total abundance for the North Sea and adjacent waters (except the Baltic Sea) was 341,366 (CV 0.14). A survey conducted in 1995, covering the German and Swedish waters of the Baltic proper within a currently known distribution range of porpoises, resulted in an abundance estimate of 599 (CV=0.57)individuals (Berggren 1995). Thus, the available estimates from the Baltic (although limited in scope and coverage) indicate extremely low density of harbour porpoises as compared to the nearby areas. Despite the high numbers in the North Sea and adjacent waters (Hammond *et al*. 2002), the harbour porpoise has been recognized as a species for which EU Member States are required to take protective action in EU waters (Annex II and IV, Council Directive 92/43/EEC).

This extremely small estimated harbour porpoises population in the Baltic deserves particular attention (both in terms of the research results and protective activities), since according to recent findings (Tiedemann *et al*. 1996) it appears to be a remnant of a genetically separate population. Conducting research into the structure of this population is greatly hampered because of the difficulties in obtaining sufficient and representative material.

It is likely that the distribution of Baltic harbour porpoises is mostly confined to the south-western part of the sea, while in the north-eastern region of the Baltic their presence has been sporadically recorded (Pilats 1994).

Judging from the number of reports, the present abundance of harbour porpoises at the Polish coast, appears to be considerably lower than in the years prior to 1939, when fishing statistics were maintained. Nevertheless, as the above research indicates, during 1990-1999 the number of reported bycatches, strandings and sightings of harbour porpoises increased in comparison with the period between 1950s and

1980s. This, however, might be a result not necessarily of an increased frequency of harbour porpoises in this area, but also of a campaign to disseminate information about these animals with a view to obtain reports of their occurrence.

The coastal waters of the Gulf of Gdañsk might have been inhabited by abundant population of porpoises, a fact that is attested by statistics from the 1920s and 1930s (Table 4). The fishing centres situated on Poland's tiny pre-war coastline (Fig. 5) yielded several times as many harbour porpoises each year as can now be observed, bycaught and stranded in the area of the entire Polish Baltic (Skóra *et al*. 1988).

It is a curious fact that at present harbour porpoises are being most frequently observed during winter and springtime. So far it has been assumed that most animals are found in the period April - July. Material collected in the years 1946-1965 (16 specimens), data on the migrations of harbour porpoises in Danish waters, as well as reports – then more frequent – of these animals occurring in the period April - July, made Wo³k (1969) inclined to conclude that harbour porpoises are characterised by a constant seasonal migration pattern. Ropelewski (1957) on the other hand attributes seasonality in the frequency of harbour porpoises bycatch directly to the concurrent season for catching salmon. This conclusion now seems to warranted, although it was made on the basis of a very modest data (9 reports). Thanks to the accessibility and application of more reliable fishing techniques the fishing season now extends over the whole year, and the phenomenon of migration – assuming it exists – is somewhat easier to assess. These animals seem to appear in our waters on a seasonal basis, although two periods can be distinguished when at least the young ones visit coastal Polish Baltic in higher numbers: these are the cool period between December and April, and the warm summer period between July and September (Fig. 3). The undesirable outcome of these visits is their bycatch (and high mortality), especially in winter and spring seasons.

Of the known human induced mortality factors bycatch in fishing gear seems most important. Environmental intoxication and accumulation of harmful substances in the tissues of these mammals does not seem to be a significant source of mortality in the Baltic: the analysis of intoxication by heavy metals (mercury, cadmium, lead, silver, zinc, copper and manganese) in the liver, kidneys, muscles, lungs and heart shows that the degree of their accumulation in the tissues of harbour porpoises of the North Sea and Baltic is comparable to the results obtained from other areas of the Atlantic (Szefer *et al*. 1994, Szefer *et al*. 1995).

However, the possibility of a detrimental effect of accumulation of PCB- and DDT-type compounds on the reproductiveness of harbour porpoises, as has been the case with the Baltic seals (Olsson 1992), should not be excluded. Such research, however, has not been conducted in the Polish Baltic. Due to the young age of the harbour porpoises in the bycatch, and hence the nature of the material available, it was impossible to assess the reproductive capacity of sexually mature individuals.

The preliminary research seems to indicate that the Puck Bay, the main area of the harbour porpoise bycatch, constitutes a feeding ground of young, not yet sexually mature harbour porpoises, principally 0-2 years of age (Fig. 6) (Kuklik, Lockyer, unpubl. data). This area, like those that surround it, may also be a breeding ground, a hypothesis which seems to be corroborated by pregnant and lactating females finding in the bycatch, as well as a young specimen which was being milk-fed.

Age may be the factor that plays the crucial role in individuals being caught up in fishing nets, as the young may not as yet have developed the skills of acoustic orientation and the avoidance of such obstacles (Kinze 1990). A similarly young make-up of harbour porpoises trapped in fishing nets is also recorded in the German (Kock and Benke 1995) and the Swedish parts of the Baltic (Berggren 1994) as well as in Icelandic waters (Víkingsson *et al*. this volume). Also in those regions set nets appear to be the most dangerous fishing gear.

The conclusion emerging from the above observations is that the Puck Bay is safer for marine mammals in the summer months, because of the ten times smaller number of nets, for instance when the fishing of salmonids is suspended in order to protect the spawning migration of sea trout (Fig.3).

Apparently there are no significant threats to the food base of harbour porpoises in Polish waters.. The resources constituting the main components of their diet, namely herring (*Clupea harrengus*), sprat (*Sprattus sprattus*) and gobies (Gobidae) (Malinga *et al*. 1997), are abundant in Polish waters (Anon 1998, Horackiewicz and Skóra 1996, 1998).

A widespread perception of fishery as one of the most important anthropogenic factors resulting in the increased mortality of cetaceans seems to be valid also in the Polish Baltic, where surface and bottom set nets are used in coastal fishery. Surely, there are other factors which influence the mortality rate of these animals, but the fishery with its present fishing methods, is a factor important enough to be recognized as a potential threat to the Baltic population in Polish waters.

The data presented here should be regarded as a minimum estimate of bycatch in Polish waters. The impact of this factor on the population is not evaluated since an abundance estimate is not available for the area. However, taking into account the scarcity of harbour porpoise in Polish Baltic, observed bycatch may be considered as a serious threat for porpoises inhabiting this region.. While estimation of absolute abundance of porpoises is of highest priority in this respect, continued monitoring of bycatch rates and research on other, potentially dangerous factors such as: boat traffic, acoustic disturbance, habitat degradation and pollution is also important for an assessment of the status of the population. Despite the lack of data on absolute abundance, stock structure and trends, the limited occurrence of porpoises in Polish waters is a matter for concern. It might however, be difficult, or even impossible for scientists to acquire the sufficient materials and data needed for a reliable analysis in time to save the population from extinction.

There are plans to conduct a comparative study of the results obtained and the statistics for fishing gears collected by maritime offices. Further research *in situ* and analysis of statistical data will provide the base for the introduction of legal regulations pertaining to fishing strategy as seen in the context of protecting marine mammals. This will constitute an element in the implementation of the Agreement on the Conservation of Small Cetaceans on the Baltic and North Seas (ASCOBANS), which was ratified by Poland in 1995.

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Table 1. Biological information and location of harbour porpoises bycaught, stranded or sighted in Polish waters during 1990-1999. For bycaught animals type of fishing gear is also indicated.

Catalogue N^{o}	Date	Sex	Length (cm)	Weight kg)	Location*	Category of report	Type of net**	
3	27.01.1990	F	128	39.7	Puck Bay	bycatch	SDN	
6	??.07.1990	-	-	-	Gulf of Gdañsk	stranding		
7	15.09.1990	-	120	-	western coast	stranding		
8	28.02.1991	-	-	-	central coast	stranding		
-	??. 02.1991	-	-	-	central coast	bycatch	OS	
9	05.05.1991	F	125	32.7	Gulf of Gdañsk	bycatch	SDN	
10	26.03.1991	F	122	33.8	Gulf of Gdañsk	bycatch	SDN	
11	03.04.1991	M	118	33.2	western coast	bycatch	BSGO	
12	12.11.1991	-	150	-	Puck Bay	bycatch	BSGO	
13	13.12.1991	M	126	43.5	Puck Bay	bycatch	SDN	
14	22.12.1991	F	131	38.8	east coast	bycatch	BSGC	
15	07.01.1992	M	129	44.8	western coast	bycatch	BSGO	
16	29.01.1992	M	131	38.4	central coast	bycatch	BSGC	
-	??.03.1992	-	-	-	western coast	bycatch	BSGO	
17	02.09.1992	-	-	-	Puck Bay	sighting		
18	??.03.1992	-	-	-	Gulf of Gdañsk	bycatch	OS	
-	22.03.1992	-	-	-	western coast	bycatch	OS	
20	20.03.1993	F	128	48	western coast	bycatch	BSGO	
21	17.02.1993	M	129	38.2	Puck Bay	bycatch	BSGC	
22	01.07.1993	F	115	16.8	central coast	bycatch	BSGO	
23	02.08.1993	M	124	31.1	Puck Bay	bycatch	SDN	
24	23.12.1993	M	111	27.7	Puck Bay	bycatch	SDN	
-	26.12.1993	-	-	-	Puck Bay	bycatch	SDN	
25	29.12.1993	M	141	35.5	Puck Bay	bycatch	SDN	
26	29.12.1993	-	-	-	Puck Bay	sighting		
27	29.12.1993				Gulf of Gdañsk	sighting		
28	20.01.1994	F	127	30.5	central coast	bycatch	BSGC	
29	26.01.1994	F	147	50.5	Puck Bay	bycatch	SDN	
31	??.04.1994	M	120	30	western coast	bycatch	HG	
32	29.07.1994	-	-	-	Gulf of Gdansk	sighting		
34	18.02.1995	F	124	39.5	Puck Bay	bycatch	SDN	
35	20.02.1995	F	130	35	Puck Bay	bycatch	SDN	
36	08.03.1995	F	160	56	Gulf of Gdañsk	bycatch	SDN	
37	11.07.1995	-	120	-	central coast	stranding		
39	16.07.1995	-	-	-	central coast	sighting		
40	13.08.1995	-	-	-	Gulf of Gdañsk	sighting		
41	05.09.1995	-	-	-	central coast	sighting		
42	13.10.1995	F	165	57	central coast	bycatch	HTN	
-	??.11.1995	-	-	-	western coast	sighting		
43	28.12.1995	F	167	68	Puck Bay	bycatch	SDN	
44	17.03.1996	F	130	35	central coast	bycatch	BSGC	
45	19.03.1996	M	127	38	central coast	bycatch	BSGC	
46	21.03.1996	M	153	44	Puck Bay	bycatch	SDN	
47	26.03.1996	M	135	36	central coast	bycatch	BSGC	
48	28.03.1996	F	132	35	Gulf of Gdañsk	bycatch	SDN	
49	02.04.1996	M	146	45	Puck Bay	bycatch	SDN	
50	16.04.1996	M	151	48	central coast	bycatch	BSGC	
-	21.04.1996	-	-	-	Gulf of Gdañsk	sighting		
51	27.04.1996	M	143	37	central coast	bycatch	BSGC	
52	09.07.1996	-	180***	-	Puck Bay	stranding		
53	22.07.1996	M	130	26.3	Puck Bay	bycatch	SDN	
54	25.07.1996	M	120	25.1	central coast	bycatch	BSGO	
-	??.08.1997	-	-	-	western coast	stranding		
55	11.09.1997	F	105	21	central coast	stranding		
56	19.09.1997	M	110	25	east coast	bycatch	BSGC	
57	01.12.1997	F	117	21.3	Gulf of Gdañsk	bycatch	SDN	
58	06.01.1998	F	114	30	Puck Bay	bycatch	BSGC	
59	09.01.1998	M	155.5	55	Puck Bay	bycatch	BSGC	
60	03.11.1998	M	134	33	central coast	bycatch	BSGC	
-	11.02.1999	?	?	?	central coast	sighting		
61	09.11.1999	M	127	30	central coast	bycatch	BSGC	
62	09.12.1999	M	149	40	Puck Bay	bycatch	BSGC	

* geographical subregions are shown on the fig.2 , ** Type of nets, SDN – semi-drift net, BSGC – bottom set gillnet for cod, BSGO - bottom set gillnet for other fish, HG – herring gillnet, HTN – herring trawl net, OS – other set net

*** Approximate estimation from an incomplete carcass

Table 2. Bycatches of harbour porpoises in various kinds of fishing nets during 1990-1999.

Year	Total amount of by-caught animals	Type of nets					
		Semi-drift nets (salmon)	Bottom set gillnets		Herring gillnets	Herring trawl nets	Other set nets
			Cod	Others			
1990	1	1					
1991	7	3	1	2			1
1992	5		1	2			2
1993	7	4	1	2			
1994	3	1	1		1		
1995	5	4				1	
1996	10	4	5	1			
1997	2	1	1				
1998	3		3				
1999	**2**		**2**				
Total	45	18	15	7	1	1	3
%	100	40.0	33.3	15.5	2.2	2.2	6.8

Table 3. Number of fishing nets and long lines laid out in Puck Bay according to a special observation scheme in 1998 and 1999.

Type of fishing gear	Autumn (1998)	Summer (1999)
Salmon semi-drift nets	988	2
Bottom gill nets	53	34
Long lines	5	26
Fyke and trap nets	22	78
Total:	1069	140

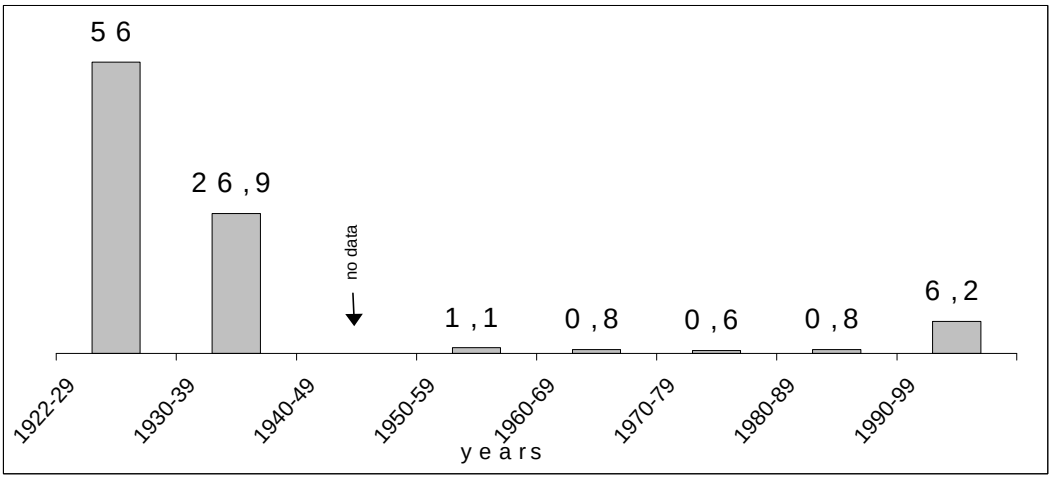

Figure. 1. Annual average number of harbour porpoises reported bycaught, stranded and sighted in Polish Baltic waters in consecutive decades. For the period before 1940, dataare derived solely from fishery catch statistics and concern only bycaught porpoises (Ropelewski 1952, 1957, Skora et al. 1988, Skora 1991, 1992), while the post-1940 data also include strandings and sightings.

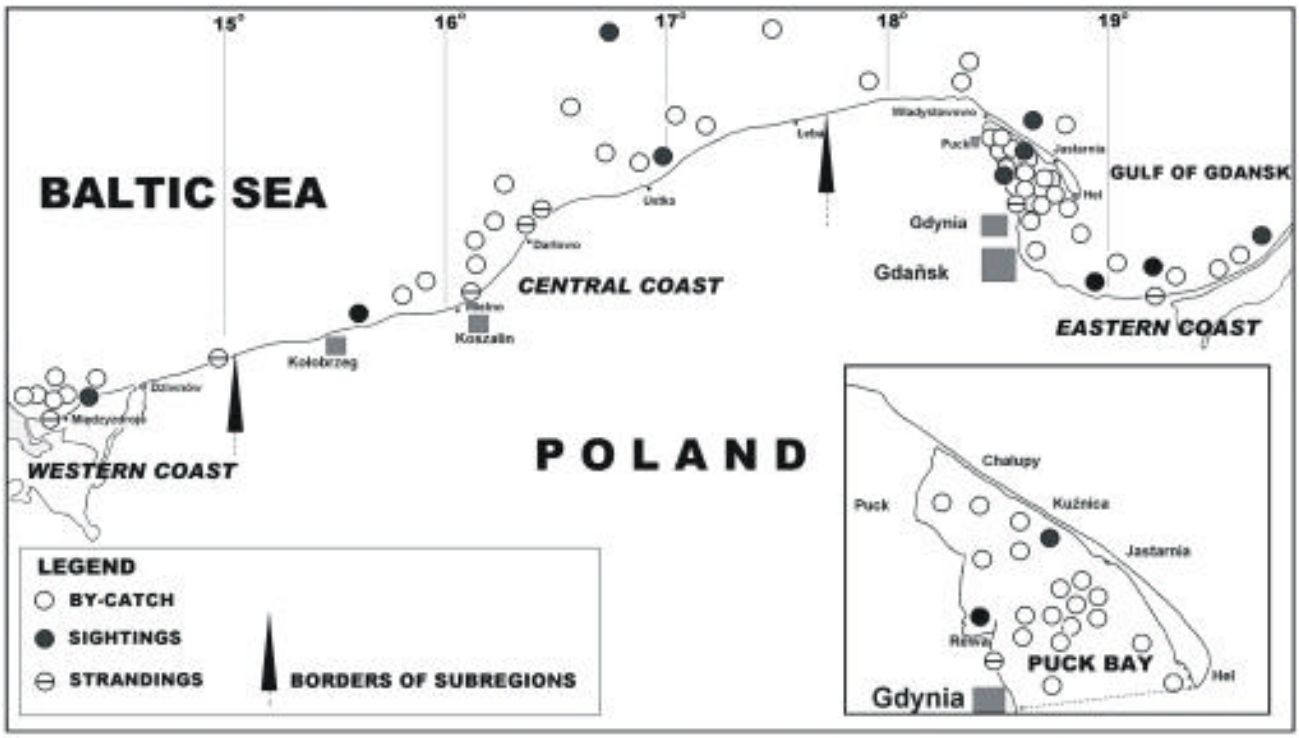

Figure. 2. Locations of sightings, bycatches and strandings of harbour porpoises on the Polish coast in the years 1990-1999. Geographical subregions of the coastal waters are according to Polish Sea Fishery Inspections.

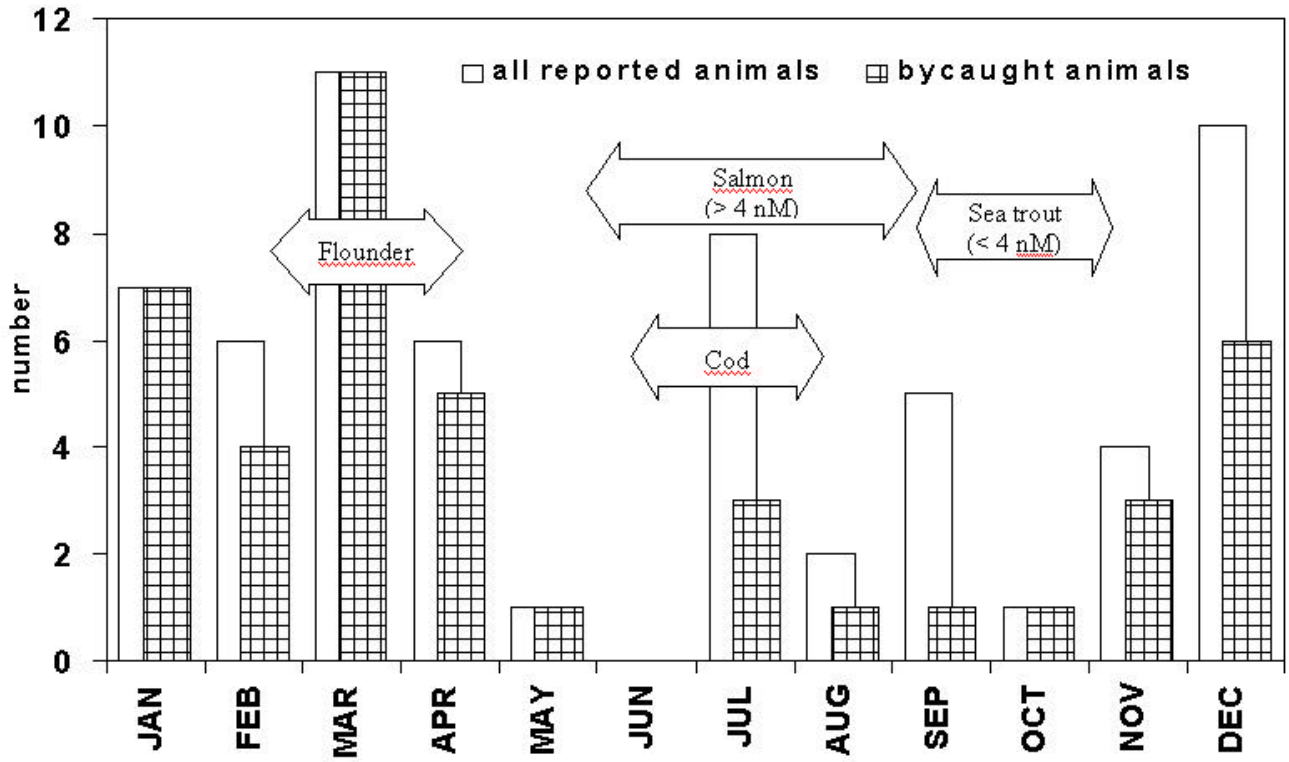

Figure. 3. Seasonal variation in bycatch rates in relation to the total number of all reports on harbour porpoise occurrence in Polish Baltic waters (including bycatch, strandings and sightings) during 1990-1999, and closed seasons for different fish species in Polish Baltic fishery (in arrows: >4Nm – closed season outside the zone of four nautical miles, <4Nm – inside the coastal zone of four nautical miles)

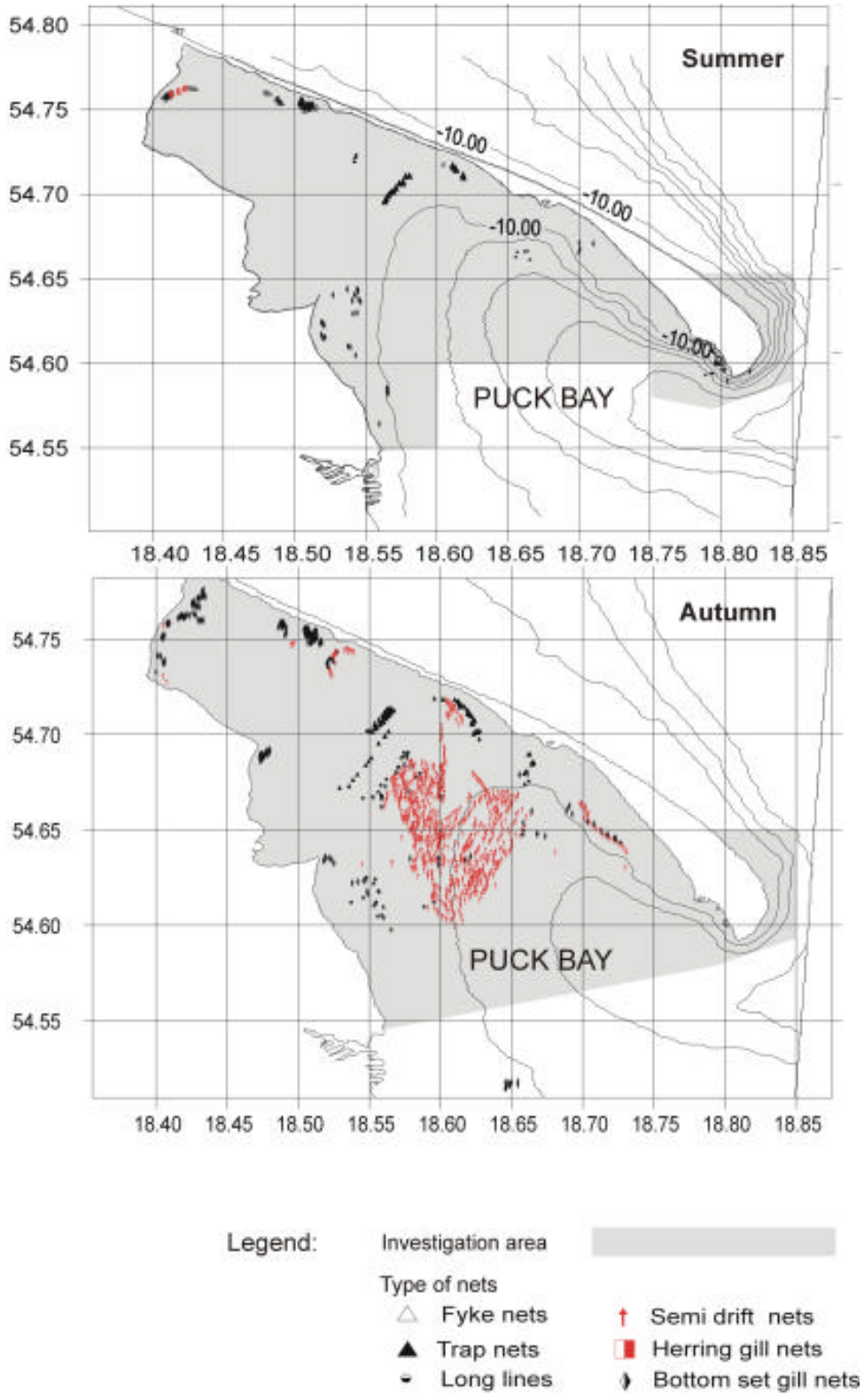

Figure. 4. Distribution of different types of fishing gear in the Puck Bay in the autumn of 1998 and the summer of 1999.

Table 4. Historical and contemporary data on the numbers of harbour porpoise in Polish Baltic waters (data prior to 1940 come from the Gulf of Gdansk, the Polish fleet operating area at that time).

Years	Number*	Data source
1922-29	over 448	Ropelewski (1952, 1957)
1930-39	over 269	Ropelewski (1952, 1957)
1940-49	no data	no data
1950-59	11	Ropelewski (1952, 1957)
1960-69	8	Skóra *et al* (1988)
1970-79	6	Skóra *et al* (1988)
1980-89	8	Skóra *et al* (1988), Skóra (1991,1992)
1990-99	62	Skóra (1991, 1992) + Skóra, Kuklik (unpubl. data)

*For the years 1922-1939 data on bycatches from fishery statistics; for 1940-1989 occasional data on bycatches, sightings and strandings; for 1990-99 data on bycatches, sightings and strandings collected as a result of information campaign.

Figure. 5
Polish maritime areas in the years 1920-1939 (dashed line) and at present (solid line).

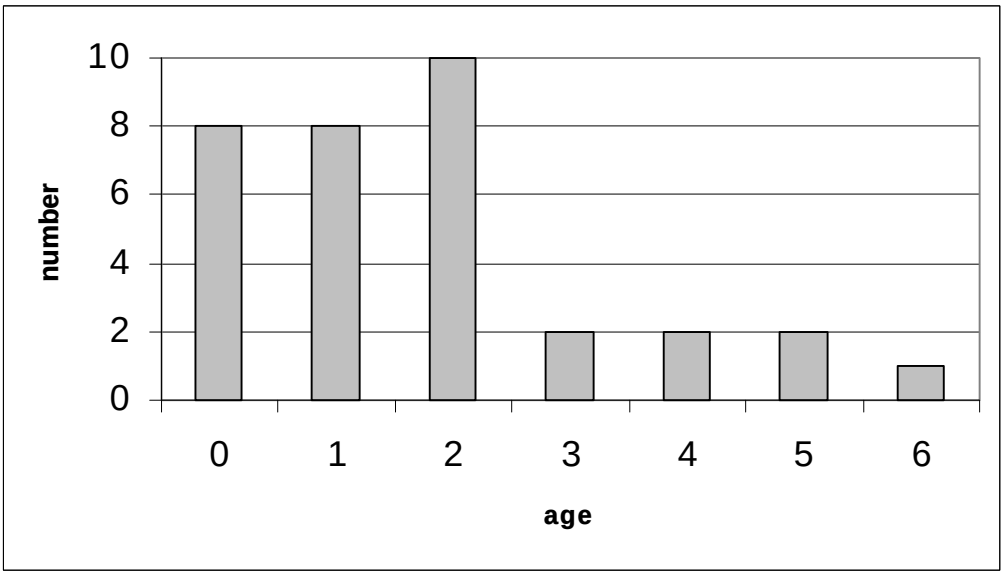

Figure. 6. Age distribution of harbour porpoises in the bycatch in 1990-1999