

Bycatches of the Harbour Porpoise (*Phocoena phocoena*) in the Swedish Skagerrak, Kattegat and Baltic Seas; 1973–1993

Per Berggren

Department of Zoology, Stockholm University, S-106 91 Stockholm, Sweden

ABSTRACT

The harbour porpoise is the only cetacean common to Swedish waters. This paper reviews data on harbour porpoise bycatches in the Swedish Skagerrak, Kattegat and Baltic Seas between 1973 and 1993. Bycatches in various fisheries are the major threat to harbour porpoises in Swedish waters. Gillnet fisheries are responsible for more than 80% of all incidental takes. Although bycatches occur year round in all areas, 51% were collected during three months; March, April and May. Bycatches occur in water depths between 0 and 100m, suggesting that depth restrictions for fisheries are not likely to reduce catches. In the Skagerrak Sea, 47.5% of the bycatches were taken in gillnets set for spiny dog fish in water depths between 40–80m; in the Kattegat Sea 72% were taken in gillnets set for cod in depths between 20–60m and in the Baltic Sea, 53.8% of the bycatches were taken in surface driftnets for salmon. It is not possible to quantify the threat bycatches represent to harbour porpoises in Swedish waters in the absence of reliable estimates of bycatches or abundance and uncertainty over stock identity. However, the existence of bycatches is a serious cause for concern and immediate action is needed.

KEYWORDS: INCIDENTAL CAPTURE; NORTH ATLANTIC; HARBOUR PORPOISE; FISHERIES.

INTRODUCTION

The harbour porpoise is the only cetacean common to Swedish and Baltic waters (e.g. see Aguayo L, 1978). There are reports of Polish (Skora *et al.*, 1988) and Danish (Kinze, 1995) fisheries for harbour porpoises as early as the 14th century. Anecdotal evidence suggests that all countries with a Baltic Sea coastline were engaged in harbour porpoise hunts to some extent during the 19th century. However, the only documented records of catches are from Danish waters in the 19th and early 20th centuries, when the annual hunt in the Danish Belt Seas in some periods averaged more than 1,000 animals (Andersen, 1982; Kinze, 1995). Catch numbers gradually decreased by the end of the 19th century, but whether this was due to a reduction in population size or a decreasing demand for porpoise meat and blubber is unclear. There have been no directed catches since the 2nd World War. There is no information to indicate a similar hunt in the Swedish Kattegat and Skagerrak Seas.

Every year, large numbers of harbour porpoises (*Phocoena phocoena*) are incidentally caught in fishing gear around the world (IWC, 1994). In most of these areas, population sizes have not been estimated and only minimum estimates of numbers of bycatches are available, based on the opportunistic collection of bycaught specimens. In a few cases, the development of independent observer schemes has made it possible to better estimate the total bycatch of animals (Smith *et al.*, 1993; Berrow *et al.*, 1994; Vinther, 1994) but unless the schemes are carefully designed and of adequate scale, the resultant estimates may still be unreliable (e.g. see Lowry and Teilmann, 1994). In perhaps the best studied area, the Gulf of Maine in the Northwest Atlantic, between 2 and 5% of the estimated population size has been estimated to be killed by incidental capture in the bottom set gillnet fishery (Smith *et al.*, 1993). Modelling exercises have shown that

harbour porpoise stocks have limited potential to replace even moderate takes (Barlow, 1986; Woodley and Read, 1991).

Swedish fisheries are no exception to the general pattern and this paper reviews data on the harbour porpoise bycatch in Swedish coastal waters between 1973 and 1993. Data up to 1988 were discussed briefly in Lindstedt and Lindstedt (1989). The data presented here have been divided up into three geographical areas: the Skagerrak Sea, the Kattegat Sea and the Baltic Sea (Fig. 1), based on oceanographic and habitat differences between these areas and, as discussed later, the possible existence of a separate harbour porpoise stock in the Baltic Sea.

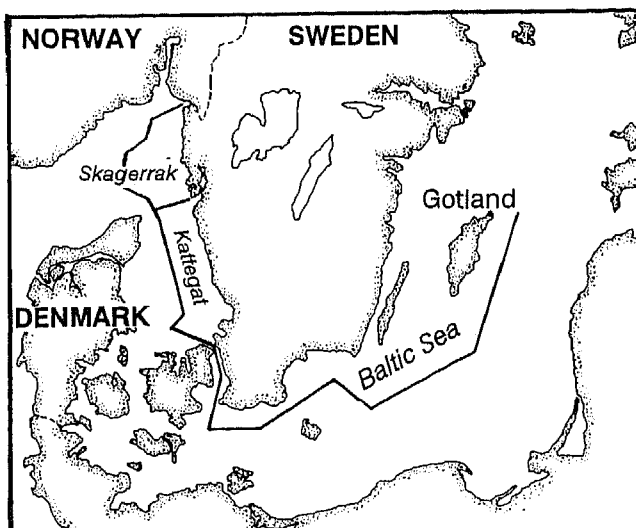


Fig. 1. Map showing the Skagerrak, Kattegat and Baltic Seas; areas where harbour porpoise bycatches occur in Swedish waters. The discontinuation of the line to the north of the island of Gotland in the Baltic Sea signifies no reports of bycatches beyond this point in the last two decades.

The areas were divided according to Fonselius (1994). The border between the Skagerrak and Kattegat Seas is between Skagen, Denmark and Pater Noster, Sweden, while that between Kattegat and the Baltic is the island of Saltholm in Öresund.

Legal status of the harbour porpoise in Swedish waters

The harbour porpoise has been protected in Sweden since 1 July 1973. Hunting Ordinance paragraph 33 states that any harbour porpoise found stranded, or that is incidentally killed, is state property and should (according to para. 36) be reported to the police as soon as possible. Para. 37 states that a report shall include information as to where and when the animal was killed or found dead. The police should, after receiving a report, ensure that the animal is properly handled according to regulations set by the Swedish Environmental Protection Agency (SEPA; para. 36). Para. 35, that allowed professional fishermen to kill trapped and entangled porpoises and keep them, was abolished in 1992.

MATERIALS AND METHODS

The Museums of Natural History in Sweden have collected and kept records of bycaught harbour porpoises for more than 100 years. However, only a few animals per year were collected prior to their protection in 1973. Following this, the collection of specimens became more systematic. The National Natural History Museum of Stockholm was the main collector of animals between 1973 and 1988. It also performed post-mortem analyses and collected samples for future analyses.

In June 1988, a scheme that attempted to collect all bycaught and stranded harbour porpoises was started. Requests for animals were sent to fishermen with a promise of a SEK 150 (approx. US\$25) reward for every animal submitted. This scheme continued until January 1992. In total, 504 harbour porpoises were collected in the Kattegat, Skagerrak and Baltic Seas between June 1988 and December 1991. Most of these were collected by the National History Museum of Gothenburg.

In Sweden, protected fauna and flora are managed by SEPA and in 1992, SEPA stipulated that all reports of harbour porpoises bycaught or found stranded be sent to them. They also set new guidelines to the effect that only animals from the Baltic Sea should be collected whilst those found in the Kattegat and Skagerrak Seas should merely be reported. For this purpose, in the summer of 1993, SEPA distributed a new combined information folder and reporting form for the recording of sightings, strandings and bycatches of harbour porpoises. The folder was distributed to all fishermen, the coastguard, police, county and municipal officials and others. Following the decision not to collect animals from any areas but the Baltic Sea, and the lack of follow-up on the distributed folder, there was a drop in the number of reported bycatches and strandings in the Kattegat and Skagerrak Seas to levels similar to the Baltic Sea; approximately 5 animals per year.

When submitting bycaught porpoises, fishermen also provided information on the bycatch location, the type of gear used and the water depth in which the gear was set.

At the time of writing no effort data are available for the different fisheries. It is thus not possible to provide any detailed analyses of bycatches by gear type or relative effort.

RESULTS

A summary of the number of harbour porpoises collected by the Museums of Natural History between 1973 and 1988 and at the Natural History Museum in Gothenburg between 1988 and 1991, and the relative frequency of bycatches and strandings is shown in Table 1. Reported and collected animals are given for 1992 and 1993.

Table 1

Number of harbour porpoises collected from bycatches and strandings during the two periods of 1973-1988 and 1988-1991. The records for 1992 and 1993 are for reported and, in the case of the Baltic, collected animals.

	1973-1988	1988-1991	1992	1993
Bycatches	169 (65%)	297 (59%)	6	9
Strandings and floaters	70 (27%)	201 (40%)	6	6*
Unknown	21 (8%)	6 (1%)	-	-
Total	260	504	12	15

* Including 3 collected from the Baltic.

The relative distribution of collected bycatches by month (Fig. 2) for the three years, January 1989 to December 1991 ($n=270$) shows that bycatches occur year round in all areas. During that period, most (70%) catches occurred in the Kattegat Sea followed by the Skagerrak (22%) and the Baltic (8%) Seas. There was a peak in bycatches in April and 51% of the bycatches were collected during the months of March, April and May.

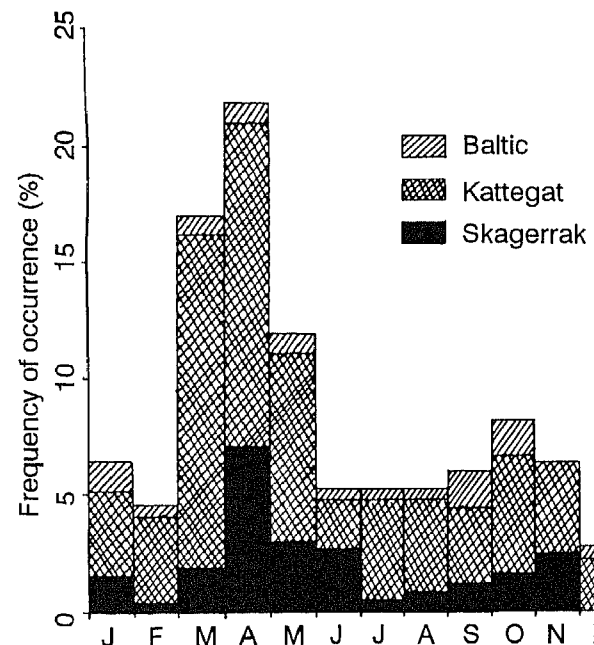


Fig. 2. The relative frequency of harbour porpoises caught by month for the Skagerrak, Kattegat and Baltic Seas between 1989 and 1991. A total of 270 specimens were collected.

The relative frequency of harbour porpoise bycatches in various gear used for the period 1989-1991 in the Skagerrak, Kattegat and the Baltic Seas is shown in Fig. 3. Gillnet fisheries are responsible for more than 80% of the bycatches in all three areas. In the Skagerrak Sea ($n=59$), 47.5% of the bycatches collected were in gillnets set for spiny dogfish while in the Kattegat Sea ($n=175$), 72% taken were in gillnets set for cod and in the Baltic Sea

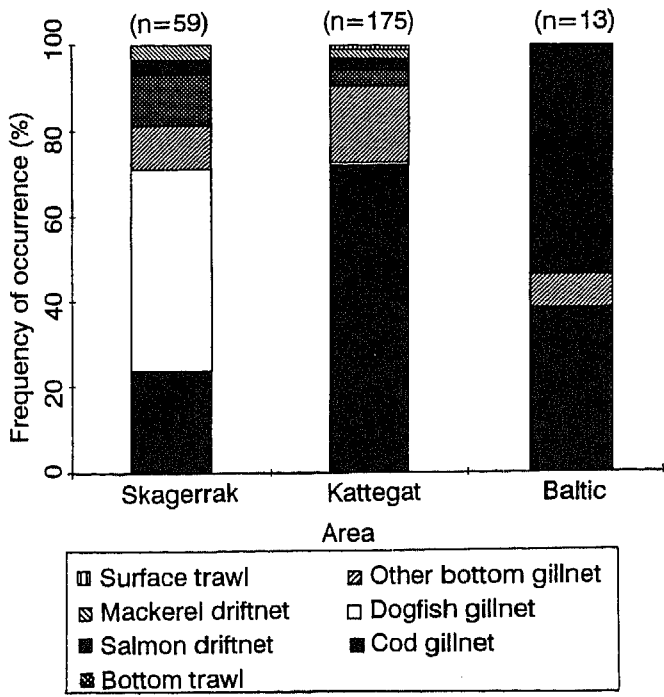


Fig. 3. The relative frequency of harbour porpoises bycaught in different types of fishing gear for the three areas studied; The Skagerrak, Kattegat and Baltic Seas between 1989 and 1991.

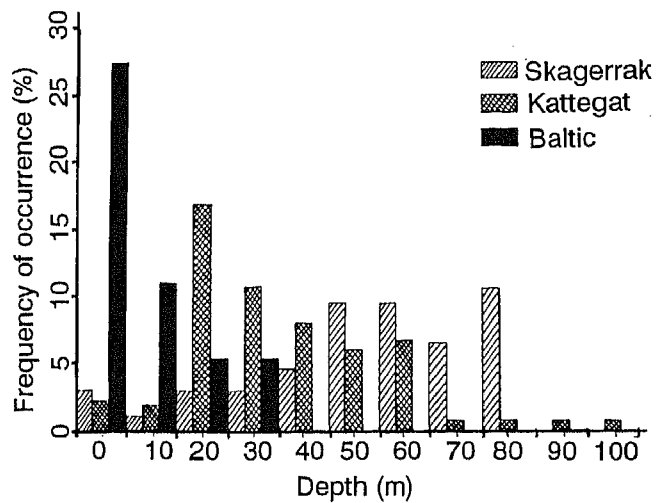


Fig. 4. The relative frequency of water depths in which 48 harbour porpoises were bycaught in the Skagerrak Sea between 1989 and 1991; 47 harbour porpoises were bycaught in the Kattegat Sea between 1989 and 1991 and 9 harbour porpoises were bycaught in the Baltic Sea between 1989 and 1991.

($n=13$), 53.8% of the bycatches were in driftnets for salmon. Mesh size varied between 40–180mm for the different fisheries.

Water depth

Fig. 4 shows the depth distribution of bycatches between 1989–1991. In the Skagerrak Sea (mean depth 218m), 79% of the bycatches ($n=48$) occurred in water depths between 40–80m whilst in the Kattegat Sea (mean 25m), 86% ($n=147$) were between 20–60m. In the Baltic Sea (mean depth 67m) most (78% $n=9$) catches were in shallow waters between 0 and 10m.

Age distribution

Fig. 5 shows the age distributions of collected harbour porpoises from Swedish waters that have been aged at the time of preparation of this paper (November 1994). We are currently ageing the samples at the University of Stockholm. No preference was given as to which animals were aged first.

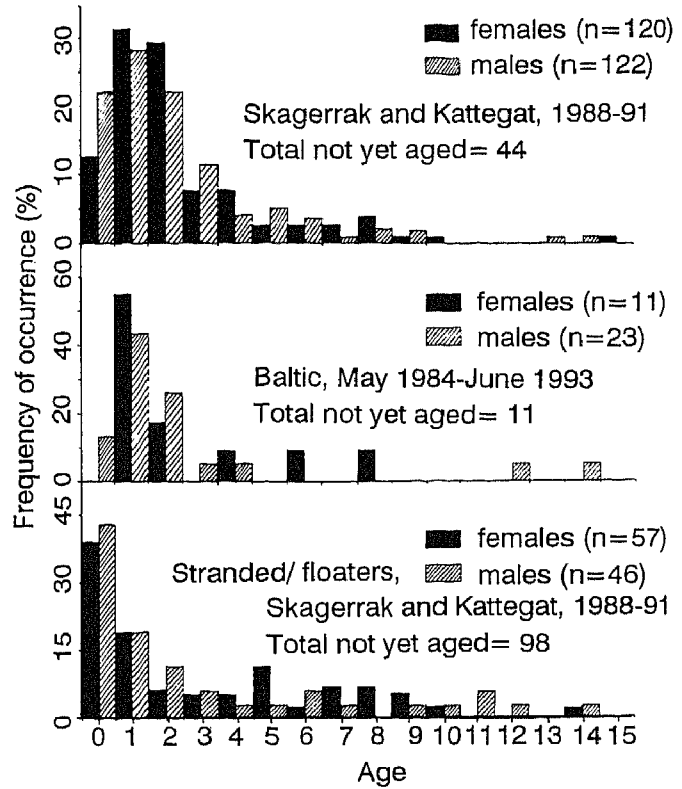


Fig. 5. The relative representation of age classes of harbour porpoises (a) bycaught in the Swedish Skagerrak and Kattegat Seas between 1988 and 1991; (b) bycaught in the Swedish Baltic Sea between 1984 and 1993; and (c) found dead, stranded or floating in the Skagerrak and Kattegat Seas during 1988–1991.

DISCUSSION

Impact of bycatches

In order to assess the impact of bycatches on a population or populations, the following information is needed:

- (1) an estimate of the total bycatch (from more than one nation where appropriate);
- (2) an understanding of stock identity and migration;
- (3) an estimate of population size for the relevant population(s).

Of course it must be recognised that other threats than bycatches (e.g. pollution, habitat degradation) may have a negative impact on harbour porpoises in these waters.

Estimation of bycatches

Sweden does not have an independent observer scheme to monitor bycatches aboard fishing vessels. The information presented in this paper is insufficient to allow a reliable estimate of the bycatch of harbour porpoises in Swedish waters to be made. The changes to the legal and reporting situations described above have also made interpretation of the available data problematic.

On average, about 17 harbour porpoises were collected annually in Swedish waters between 1973 and 1988, compared to 150 animals per year between 1988 and 1991. This approximately tenfold increase in the number of animals collected can largely be attributed to the increased effort made to collect animals during the latter period, as a result of the scheme established in June 1988. It is clearly inappropriate to interpret the difference between the two collection periods as either an indication of an increase in the abundance of harbour porpoises or an increase in the actual bycatch. This view is supported by the fact that only 12 and 15 animals were reported bycaught or stranded in 1992 and 1993, with the advent of the SEPA guidelines.

These changes in numbers are consistent with the findings of the first attempt to study the Swedish bycatch problem by Lindstedt and Lindstedt (1987), who carried out a questionnaire survey of 68 fishermen. They found that the fishermen had officially reported only 13% of their actual bycatches to the authorities between 1973 and 1986.

Despite our inability to estimate total bycatch, however, the 1988–91 data do provide an absolute minimum estimate of the number of bycaught animals in Swedish waters.

Bycatches by other fleets that may have an impact on harbour porpoise population(s) affected by Swedish fisheries are discussed in Kinze (1990), Lowry and Teilmann (1994), Benke (1994), Skora *et al.* (1988) and Skora (1991).

Stock identity and migration

The stock identity of harbour porpoises in the Baltic/North Sea region is poorly understood, although there is some evidence suggesting that there may be several population units (IWC, 1992; p. 209).

Preliminary results from morphometric studies (Börjesson and Berggren, 1993) indicate that harbour porpoises collected in the Baltic and Skagerrak Seas belong to separate stocks. Andersen (1982) described a migration of harbour porpoises into the Baltic Sea in early spring and out of the area during late autumn, based on anecdotal notes and catch statistics. Incidental takes in Swedish fisheries however, show that at least some harbour porpoises spend winter months in the Baltic proper (Fig. 2). Anecdotal records also show that during severe ice winters, bottom trawl fisheries in the Baltic Sea catch a large number of animals that have apparently drowned under the ice (Hanström, 1960). This supports the view that some animals stay in the Baltic Sea year round. Fig. 2 also shows that some animals remain in the Skagerrak and Kattegat Seas year round.

In the absence of better information on stock structure, a conservative management approach would be to treat harbour porpoises in these areas as separate 'units'.

Population size

There is little information on either the historic or current population abundance of harbour porpoises in Swedish waters. Berggren and Pettersson (1995) compared results from a questionnaire survey that strongly indicated that the number of sightings of harbour porpoises in Swedish waters had significantly declined since the 1950s.

In July 1994, a major multinational survey of the North Sea/Baltic Sea region was undertaken (Anon., 1994). This survey, however only attempted to cover the western part of the Baltic Sea and poor weather led to poor coverage in that area. However, even a crude examination of the results reveals considerably lower densities in Baltic waters, supporting the generally held view that the

numbers in the Baltic may have declined and its distribution narrowed (e.g. Kinze, 1995). There are plans to survey the whole of the Baltic Sea in summer 1995. The analyses of the 1994 data are not yet complete but the results should provide a useful base for attempting to assess the impact of bycatches in the surveyed area, including the Skagerrak and Kattegat Seas.

Possible measures to reduce bycatches

It is not appropriate here to discuss in detail the various approaches that have been suggested to try and reduce cetacean bycatches (e.g. see Dawson, 1994; Goodson *et al.*, 1994; IWC, 1994), but merely to note that no effective method of modifying gear has yet been developed. In this section I will simply examine the limited data available for the Swedish fishery and explore any potential for reducing bycatches (I have not commented on any effect on fishery yields).

Seasonal restrictions

Fig. 2 showed that the peak months for bycatches in the Skagerrak and Kattegat Seas were from March–May. Fig. 3 reveals that 81.4% of the Skagerrak and 90.3% of the Kattegat Sea bycatches occurred in the bottom set gillnets. Clearly in the absence of fishing effort data it is not possible to determine the strength of the seasonality factor i.e. whether it is merely a direct reflection of effort, but the possibility of reducing bycatches by restricting bottom set gillnet effort in the spring warrants further attention.

Depth restrictions

Fig. 4 shows that bycatches are taken in nets set at all depths down to 100m in the Kattegat and Skagerrak Seas. This suggests that depth restrictions are unlikely to reduce bycatches in these Seas. In the Baltic, over half the bycatches occur in the salmon driftnet fishery in depths of 0–10m.

Age distribution of the samples

Fig. 5 shows the age distributions of the animals aged thus far. In all areas, animals between 0–2 years predominated. This is not an unknown feature in several areas and may be a result of a number of factors including lack of experience or greater curiosity in juveniles (e.g. see IWC, 1994). The samples revealed no apparent difference in mortality between males and females.

Yearlings of both sexes were the most common age class found stranded in the Skagerrak and Kattegat Seas. This indicates that for whatever reason females are not always successful in raising their young. Of the older animals found stranded, some will probably have died of natural causes and others will be animals that have been caught and then fallen out of nets, or been dumped at sea by fishermen. That the latter occurs is supported by fresh net marks found on some stranded animals.

CONCLUSIONS AND RECOMMENDATIONS

The data presented in this paper do not allow for an evaluation of how serious a threat bycatches are to harbour porpoises in the Swedish Skagerrak, Kattegat and Baltic Seas, since no reliable estimates of either bycatches or abundance exist yet, and stock identity is uncertain.

However, the level of bycatches appears to be the most serious threat to harbour porpoises in Swedish waters, although other factors such as habitat degradation and pollution should also be regarded when assessing the status

of this species in the Skagerrak, Kattegat and Baltic Seas. This is particularly true if the animals in the Baltic represent a separate population; even the low level of bycatches may be sufficient to prevent recovery.

I recommend that the following action should be taken:

- (1) immediate efforts should be made to reduce bycatches;
- (2) reliable estimates of bycatches (through a scientifically designed observer programme) should be obtained;
- (3) estimates of the abundance of harbour porpoises in Swedish and adjacent waters should be obtained;
- (4) the question of stock identity should be addressed.

ACKNOWLEDGEMENTS

I would like to thank Patrik Börjesson, Julia Carlström and Magnus Kull of the Harbour Porpoise Project at the Department of Zoology, Stockholm University for preparing some of the data. The Museum of Natural History in Gothenburg and the National Museum of Natural History of Stockholm for access to their collections. World Wide Fund for Nature (WWF-Sweden) for research and collection grants 1988-1994. Thanks are also due to the Swedish Environmental Protection Agency (SEPA) for grant 12407. Greg Donovan and an anonymous reviewer made useful comments on the manuscript.

REFERENCES

- Aguayo L, A. 1978. Smaller cetaceans in the Baltic Sea. *Rep. int. Whal. Commn* 28:131-46.
- Andersen, S.H. 1982. Changes of occurrence of the harbour porpoise, *Phocoena phocoena*, in Danish waters as illustrated by catch statistics from 1834-1970. *FAO Fish. Ser. (5) [Mammals in the Seas]* 4:131-3.
- Anonymous. 1994. Small cetacean abundance in the North Sea: Progress Report - 21 September 1994. Paper CMS/ASCOBANS/1/INF.5 presented to the first meeting of the Parties to ASCOBANS, September 1994 (unpublished). 4pp.
- Barlow, J. 1986. Factors affecting the recovery of *Phocoena sinus*, the vaquita or Gulf of California harbor porpoise. *SWFC Admin. Rep. No. LJ-86-37*:19pp.
- Benke, H. 1994. A note on cetacean bycatches in German waters. (Published in this volume.)
- Berggren, P. and Arrhenius, F. 1995. Sightings of harbour porpoises (*Phocoena phocoena*) in Swedish waters. *Rep. int. Whal. Commn* (special issue 16):In press.
- Berrow, S.D., Tregenza, N.J.C. and Hammond, P.S. 1994. Marine mammal bycatch on the Celtic Shelf. European Commission Document: DG XAV/C/1 Study Contract 92/3503.
- Börjesson, P. and Berggren, P. 1993. Morphometric comparisons of harbour porpoise (*Phocoena phocoena*) skulls from the Swedish Baltic and Skagerrak Seas. Paper presented to the Tenth Biennial Conference on the Biology of Marine Mammals, Galveston, Texas, USA, November 1993.
- Dawson, S.M. 1994. The potential for reducing entanglement of dolphins and porpoises with acoustic modifications to gillnets. (Published in this volume.)
- Fonselius, S.D. 1994. *Oceanografi*. Generalstabens Litografiska Anstalts Förlag, Stockholm. 248pp.
- Goodson, A.D., Mayo, R.H., Klinowska, M. and Bloom, P.R.S. 1994. Field testing passive acoustic devices designed to reduce the entanglement of small cetaceans in fishing gear. (Published in this volume.)
- Hanström, B. (ed.). 1960. *Djurens Värld*. Vol. 3. *Däggdjur*. Förlagshuset Norden AB, Sweden.
- International Whaling Commission. 1992. Report of the sub-committee on small cetaceans. *Rep. int. Whal. Commn* 42:178-234.
- International Whaling Commission. 1994. Report of the Workshop on Mortality of Cetaceans in Passive Fishing Nets and Traps. (Published in this volume.)
- Kinze, C.C. 1990. Cetacean mortality in passive fishing nets and traps in the Baltic Sea: a review. Paper SC/O90/G25 presented to the IWC Symposium on Mortality of Cetaceans in Passive Fishing Nets and Traps, La Jolla, California, October 1990 (unpublished). 22pp.
- Kinze, C. 1995. Exploitation of harbour porpoises (*Phocoena phocoena*) in Danish waters: A historical review. *Rep. int. Whal. Commn* (special issue 16):In press.
- Lindstedt, I. and Lindstedt, M. 1987. Skattning av antalet tumlare som omkom i fiskeredskap under perioden 1973-1986. WWF-Sweden (unpublished).
- Lindstedt, I. and Lindstedt, M. 1989. Incidental catch of harbour porpoises *Phocoena phocoena* in Swedish waters in the years 1973-1988. *Eur. Res. Cetaceans [Abstracts]* 3:96-8.
- Lowry, N. and Teilmann, J. 1994. Bycatch and bycatch reduction of the harbour porpoise (*Phocoena phocoena*) in Danish waters. (Published in this volume.)
- Skora, K.E. 1991. Notes on cetacea observed in the Polish Baltic Sea, 1979-1990. *Aquat. Mamm.* 17:67-70.
- Skora, K.E., Pawliczka, I. and Klinowska, M. 1988. Observations of the harbour porpoise *Phocoena phocoena* on the Polish Baltic coast. *Aquat. Mamm.* 14(3):113-9.
- Smith, T.D., Palka, D. and Bisack, K. 1993. Biological significance of by-catch of harbour porpoise in the Gulf of Maine demersal gillnet fishery. NOAA/NMFS/NEFSC, Woods Hole, MA. Northeast Fisheries Science Center, Reference Document 93-23. 15pp.
- Vinther, M. 1994. Incidental catches of the harbour porpoise (*Phocoena phocoena*) in the Danish North Sea gillnet fisheries. Preliminary results. Paper presented to Conference on the state of the North Sea, Ebeltoft 1994. 11pp.
- Woodley, T.H. and Read, A.J. 1991. Potential growth of a harbour porpoise, *Phocoena phocoena*, population subjected to incidental catches. *Can. J. Fish. Aquat. Sci.* 48:2429-35.