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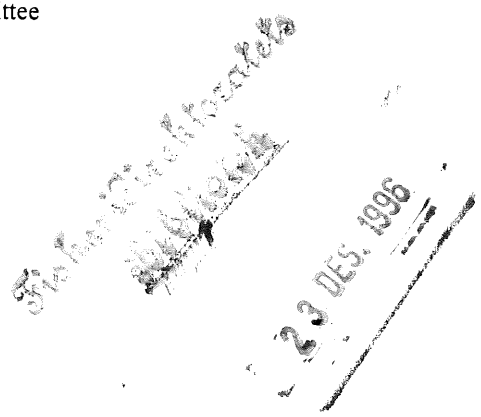

REPORT OF THE STUDY GROUP ON SEALS AND SMALL CETACEANS IN EUROPEAN SEAS

Cambridge, England
4–6 December 1995

International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

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1 INTRODUCTION

The Study Group on Seals and Small Cetaceans in European Seas (SGSEAL) met at the British Antarctic Survey headquarters in Cambridge, England from 4–6 December 1995 under the chairmanship of Dr J. Harwood. The agreed agenda for the meeting is attached as Annex 1. Annex 2 contains a list of meeting participants. Working Papers (WPs) for the meeting are listed in Annex 3.

2 TERMS OF REFERENCE

The terms of reference (C.Res. 1994/2:57) for the 1995 meeting of SGSEAL were to:

a) assess the status of small cetacean populations in the North Sea in the light of the recent Small Cetacean Abundance Survey in the North Sea and the available information on by-catches;

b) assess the status of the three seal populations in the Baltic Sea in the light of modelling studies of population dynamics conducted by the Study Group, and available information on by-catches;

c) review available information and planned research on the potential effects of acoustic disturbance on marine mammal populations;

d) advise (with the Working Group on the Biological Effects of Contaminants) on the use of biological effects techniques for identifying the extent to which PCBs in marine mammals generate effects at the species and/or population level;

e) develop plans for a review of contaminant levels in marine mammal populations and the possible effects of these compounds, and identify data sets on contaminants in marine mammals that are suitable for inclusion in the Environmental Data Bank;

f) identify and review the data that will be required to evaluate the impact of different fisheries in the Baltic Sea on marine mammal populations;

g) report the findings to the Marine Mammals Committee, ACFM, and ACME.

3 ASSESSMENT OF THE IMPACT OF FISHERIES ON MARINE MAMMALS

3.1 General Approach

SGSEAL considered a draft review of marine mammal by-catch observer schemes with recommendations for best practice (WP2), which had been prepared for the Advisory Committee of the Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS). The paper reviews different methods that are used to determine by-catch, including: opportunistic and systematic port interviews and surveys; market monitoring; recovering by-catches from fishermen; logbook schemes; and independent observer schemes. The author concludes that, although port surveys can help to identify fisheries where significant by-catches might occur, only data collected by trained observers can provide reliable estimates of the size of by-catches. SGSEAL agreed with this conclusion. The paper notes that an estimate of cetacean population size is required if the effects of by-catches are to be assessed.

Observer schemes designed to record marine mammal by-catches have problems similar to schemes intended to document levels of discarding. These include:

i) the need to obtain full cooperation from the fishing industry (this may be a greater problem for schemes aimed at marine mammal by-catch due to public emotion associated with these animals);

ii) sampling difficulties in widely dispersed and heterogeneous fisheries;

iii) safety and insurance for observers;

iv) the need to make an agreement with skippers on the expenses involved in carrying observers;

v) the need to ensure confidentiality of data.

The number of trips which can be monitored in any scheme will be determined by the expenses agreed with skippers, the salaries of qualified observers, travel and insurance costs, and the costs of data entry, data handling and analysis. WP2 notes that better quality data are more likely to be obtained from schemes employing paid observers than those relying on volunteers. Once the cost of each trip has been determined, coverage of the fishery should be designed to obtain as accurate and precise an estimate of total by-catch as possible. An optimal design requires prior knowledge about variability in by-catch rates which will probably not be available. In most cases the proportion of the marine mammal population removed by fisheries within the area covered by SGSEAL is likely to be small and the variance of the estimated population size is likely to be large (see Section 4, below). As a result, the variance of the ratio will be insensitive to the variance in the estimate of total by-catch. WP2 suggests that it may be appropriate to concentrate on obtaining an unbiased estimate of by-catch rather than a very precise one. This will necessitate representative sampling of all components of the target fisheries. The paper recommends that, at least initially, sampling should be widespread throughout the seasonal and geographical distribution of the relevant fisheries.

Some fisheries are carried out from vessels which cannot accommodate observers. In these cases observers may be able to operate from a specially-chartered accompanying vessel or from a vantage point on shore.

Although WP2 is an initial draft, SGSEAL felt that it provides good advice for the development of new observer schemes.

3.2 Data Requirements

SGSEAL agreed on a standard set of information for all independent observer schemes, and specific information which is required for particular fisheries. This basic information is:

- Date and port of departure
- Date and port of landing
- Gear type(s)
- Declared catch, by species and weight
- Declared effort
- Value of catch (based on official port prices)
- Number and species of marine mammal caught

If a socioeconomic analysis is to be carried out, the following information is desirable:

- Vessel size
- Vessel age
- Fuel consumption (if available)
- Number and age of crew
- Amount of gear lost

For gillnet fisheries SGSEAL recommends that the following information be collected for each string of nets set:

- Location (preferably latitude and longitude)
- Water depth
- Net material (filament type, diameter, colour)
- Mesh size(s)
- Flotation devices
- Headline length
- Net height (in meshes)
- Hanging ratio
- Length of individual nets (in metres and knots)
- Number of nets in string
- Footrope type
- Depth at which net fished
- Time and date at which setting started
- Time and date at which setting ended
- Time and date at which hauling started
- Time and date at which hauling ended
- Location of observer relative to net at hauling*
- Number and species of marine mammals brought on board
- Number and species of marine mammals seen to drop out of string
- Number and species of marine mammals seen to be shaken out of string
- Number and species of marine mammals seen floating in the vicinity of string
- Number and species of fish caught
- Number and species of other by-catches (seabirds, turtles)

* this may affect the ability of the observer to detect drop-outs.

For each marine mammal brought on board, the following should be recorded:

- Species
- Photograph
- Live or dead (live animals should be released immediately after a photograph has been taken)
- Length
- Sex
- Skin sample (for DNA analysis)
- Tooth (for age determination)

If possible, information on reproductive condition, nutritional condition, and stomach contents should be collected. These recommendations are largely based on data requirements identified by the Small Cetacean Sub-committee of the International Whaling Commission (IWC) and cited in WP1.

For towed net fisheries the following information should be collected for each tow:

- Gear type (this should include as much of the following as possible: gape, circumference, length, wingspread, head line height, mesh size)
- Location, time, and date of start of tow
- Location, time, and date of end of tow
- Water depth
- Towing speed
- Depth at which net was fished (for pelagic trawls)
- Number and species of marine mammals brought on board

SGSEAL was less certain about additional data needed for trap net fisheries. However, it was felt that the following should be included:

- Location, time, and date when trap was set
- Time and date when trap was raised or inspected
- Depth of water
- Size of opening

- Length of leader
- Presence/absence of marine mammal excluder
- Presence/absence of marine mammal escape/breathing mechanism
- Number and species of fish in net (including damaged fish)
- Number and species of marine mammals caught
- Number and species of other by-catches

In general, it will not be possible to place observers on every trip undertaken by a fishery; therefore, some kind of sampling scheme must be devised. Results can then be extrapolated to cover the entire fishery and, indeed, to cover the entire range of the cetacean populations which are affected. Thus, it is essential that some of the measures of fishing effort recorded by observers are identical to those which are included in the official fisheries statistics for the national fleet.

SGSEAL noted that the statistics on marine mammal by-catch (species, number, area, type of fishing gear, raw data or extrapolated) which ICES urges its Member Countries to report (C.Res. 1994/4:8) are not sufficient to allow total by-catch to be estimated and are, subsequently, of limited value for ecological assessment. In contrast, the requested resolution for data on the location of by-catches is overly precise. **SGSEAL recommends that, in future, Member Countries be requested to provide estimates of by-catch per unit of effort in individual fisheries for each ICES Area with a complete description of how the estimate was arrived at.** In general, this will restrict the requirement to data from independent observer schemes. Effort data for each fishery by ICES Area should also be provided, if countries do not already report this information.

Certain cetacean populations are frequently subjected to by-catch by fleets from different nations. Agreed international standards to describe effort in gillnet and trawl fisheries could be included in the forthcoming revision of the European Commission's logbook recording scheme. In the absence of standardization, national fisheries will have to be examined on an individual basis.

3.3 Estimating the Impact of Fisheries and Incorporating the Effects of Population Structure

There has been considerable debate in the scientific community about how to assess the impact of by-catches on marine mammal populations. At its 1995 meeting, the Scientific Committee of the IWC had considered what levels of by-catch can be sustained for particular cetacean populations (WP1). It concluded that by-catches exceeding half of the estimated maximum growth rate for the population might not be sustainable. This approach was applied to harbour porpoise populations in the North Atlantic, where the Committee concluded that if recorded by-catch exceeded 1% (1/4 of the estimated maximum rate of increase), then this should trigger urgent research. Such research would involve an attempt to determine the actual impact of by-catches on the population (and the overall status of the population—including the effects of factors such as pollution—see Section 7) and assess what management actions could be taken to reduce by-catch. SGSEAL noted that the estimate of maximum rate of increase for harbour porpoises was based on very little data, and that the "half of maximum growth rate" rule was only appropriate for populations believed to be stable or increasing. If a population is decreasing (not necessarily because of the effects of by-catch) but by-catch remains constant, then by-catch mortality will increase with time. However, this might not be recognized until after the next population survey, which could be a decade after the initial survey. By this time the population could have declined substantially. This concern emphasises the need for cost-effective methods for the monitoring of marine mammal populations which SGSEAL recommended at its last meeting ("The Study Group recommended more research on low cost methods for monitoring the abundance and population characteristics of marine mammals".) SGSEAL also noted that the Small Cetacean Sub-committee of the IWC would be considering "criteria for assessing the status of harbour porpoise populations" as a priority item at its 1996 meeting.

The most recent meeting of the Advisory Committee of ASCOBANS (WP10) had requested the opinion of SGSEAL on an appropriate definition of what constitutes an "unacceptable take" of small cetaceans. The discussion planned for the IWC Scientific Committee meeting in 1996 will address this question. The meeting will be attended by members of SGSEAL as well as many other international experts. SGSEAL will await the outcome of that meeting before drafting a statement of its own.

Defining the biological population affected by by-catches is a fundamental problem. For small cetaceans, which are highly mobile and which do not breed in colonies, there may be no clear geographical boundaries for the distribution of a population. At certain times of the year, different biological populations may mix on the same fishing grounds. This is an issue which the IWC's Scientific Committee addressed during the development of its *Revised Management Procedure*. The Committee's basic approach has been to test the robustness of management practices to violations of the underlying assumptions about population structure. SGSEAL recommends that this approach also be adopted for evaluating the impact of by-catches on marine mammals. A preliminary analysis using this approach on the harbour porpoise population in the North Sea is described in Section 4.3.

3.4 Evaluating the Effects of Management Actions

SGSEAL recommends that any evaluation of the impact of by-catches on marine mammal populations and of the effects of management action aimed at reducing such catches should also take into account the effect of such actions on the fishery. The most appropriate way to do this is to develop a framework which allows a risk analysis of the trade-offs between the effect of management (including no action) on the future size of the marine mammal population and on the economics of the fishery. Such a framework should also take into account the uncertainties involved at each stage of the analysis.

4 IMPACT OF FISHERIES ON CETACEANS IN THE NORTH SEA

4.1 Results from SCANS

WP3 is a revision of a paper that was presented at the 1995 Annual Science Conference on the results of a major survey of cetacean abundance in the North Sea and adjacent areas in the summer of 1994. The Small Cetacean Abundance in the North Sea survey (SCANS) was co-funded by the European Commission and a number of national governments. Ships and aircraft were used to survey the area synoptically. Weather conditions were generally good but SGSEAL noted that coverage in the southern and northern parts of block J (the coastal areas of Shetland and northeast Scotland) was poor due to limited visibility. Aerial surveys of the Baltic Sea were not possible in 1994 because of bad weather; however, they were conducted in 1995 (see Section 5.1.1).

SCANS provided data for the following estimates of abundance, with their coefficients of variation (CVs) for small cetaceans in the North Sea (as defined by the 1995 North Sea Conference):

Harbour porpoise	268,452 (0.13)
Minke whale	7,201 (0.21)
Whitebeaked and whitesided dolphin	10,927 (0.27)

These estimates, and those derived by SCANS for other areas within the region covered by SGSEAL, are shown in Appendix Tables 4 and 5. The estimate of harbour porpoise numbers on the Celtic Shelf (approximately equivalent to ICES Areas VIIg, j, and h) is 36,280 (0.57).

4.2 Available Information on By-catches

The only new information on by-catches in the North Sea presented at the meeting is found in WP4, which estimates that 20–30 harbour porpoises are caught each year in the German set net fishery. Published information was also available from a Danish study of by-catches in the bottom set gillnet fisheries for cod and turbot (Vinther, 1995) which operates in ICES Areas IVb and c. The harbour porpoise was the most frequently caught species and it was estimated that 4,449 animals were caught each year in these fisheries. However, it is likely that harbour porpoises were also caught in Danish gillnet fisheries for plaice and hake, and in equivalent English fisheries. SGSEAL noted that independent observer schemes to determine by-catch in these fisheries are now being carried out.

Estimates of by-catch in the English and Irish gillnet fisheries operating on the Celtic Shelf have also been published (Berrow *et al.*, 1994). Again, the harbour porpoise was the most frequently caught species. The by-catch in 1993 was estimated to be 1,937 animals.

4.3 Preliminary Evaluation of the Effects of By-catches

The recorded by-catch of harbour porpoises in the Danish cod and turbot gillnet fishery in the central North Sea is 2.6% (95% confidence limits 1.2–4.0%) of the estimated population size in ICES Areas IVb and c, and 1.7% (95% confidence limits 0.9–2.5%) of the population size in the entire North Sea. These values are substantially higher than the 1% limit adopted by the IWC Scientific Committee as a level which requires urgent investigation, especially since the recorded by-catch is almost certainly an underestimate of the total because it represents catches made by only part of the fishery. **SGSEAL therefore recommends that the impact of the by-catch in these, and related, fisheries on harbour porpoises in the North Sea and the effect of management action aimed at reducing by-catch should be investigated as a matter of urgency.** SGSEAL was pleased to be informed that the European Commission had agreed to co-fund a major international project (BY-CARE) to carry out these investigations and to study the impact of by-catches in the English and Irish driftnet fishery for albacore tuna. This project is described in WP5. The same study will also investigate by-catches in the Swedish and Danish gillnet fisheries operating in the Kattegat/Skagerrak and Baltic Proper, thus addressing a recommendation made by SGSEAL at its 1994 meeting. Finally, the project will attempt to establish an integrated decision-making framework for assessing the implications of changes in management practice which takes account of the different values of the resources involved.

The recorded by-catch in the English and Irish gillnet fisheries in ICES Areas VIIg and j is 5.3% (95% confidence limits 1.5–9.1%) of the estimated abundance of harbour porpoises in these Areas. **SGSEAL recommends that the impact of by-catches of porpoises in the English and Irish gillnet fisheries in ICES Areas VII g and j be investigated as a matter of urgency.** SGSEAL also notes, however, that there is

likely to be a substantial reduction in effort in these fisheries from 1995 onwards due to decommissioning in the English fishery and changes in fishing practices in Ireland. In addition, the harbour porpoise population affected by these catches is likely to extend beyond Areas VIIg and j into the Irish Sea and the west coast of Ireland. Thus, the estimated by-catch of these fisheries as a percentage of population size is probably an overestimate.

5 IMPACT OF FISHERIES ON MARINE MAMMALS IN THE BALTIC SEA

Locations mentioned in Section 5 are shown in Figure 1.

5.1 Status of Marine Mammal Populations in the Baltic

5.1.1 Harbour porpoise *Phocoena phocoena*

As noted above, the SCANS survey of small cetaceans in the Baltic was carried out in 1995. Information on the results of this survey was not submitted to SGSEAL, but a preliminary estimate of 1,200 animals in ICES Area IIId was provided to the ASCOBANS Advisory Committee. Permission to survey Polish and Russian territorial waters in the southern Baltic Sea was not obtained, therefore figures for these areas are not available. The harbour porpoise is apparently much less abundant in the Baltic Sea than it was earlier this century, but it is impossible to estimate the extent of depletion.

5.1.2 Grey seal *Halichoerus grypus*

WP6 is a review of recent estimates of grey seal numbers. Grey seals in the Baltic normally breed on ice and the location of breeding varies unpredictably from year to year. It has therefore not been possible to use conventional survey techniques to monitor the number of pups born each year. However, as a result of a series of mild winters, a large proportion of the grey seal pups born along the Estonian coast over the last five years have been produced on land. In 1992, 876 pups were counted in Estonia and total pup production was estimated to be 1,000.

Annual counts of grey seals hauled out during the moult have been made in Sweden and Finland for more than a decade. Counts at Swedish sites north of 59°N have increased by 12% annually since 1982. Similar counts in Finland have increased by 14% per annum since 1985. However, counts of the approximately 200 individuals at Swedish sites south of 58°N have only increased by about 3% during this period. The species is still absent from most of its former range in the southern Baltic (along the German, Polish, and Russian coasts). Based on counts made during the moult at approximately the same time throughout the Baltic, the minimum size of the grey seal population in the Baltic is estimated to be 5,300 individuals. This figure is not inconsistent with the estimated pup production from Estonian counts.

In the past, the grey seal population has been affected by a high frequency of uterine occlusions which rendered adult females sterile. Data from animals found dead or caught in fishing gear suggests that these occlusions are now mostly confined to animals older than 30 years.

5.1.3 Ringed seal *Phoca hispida*

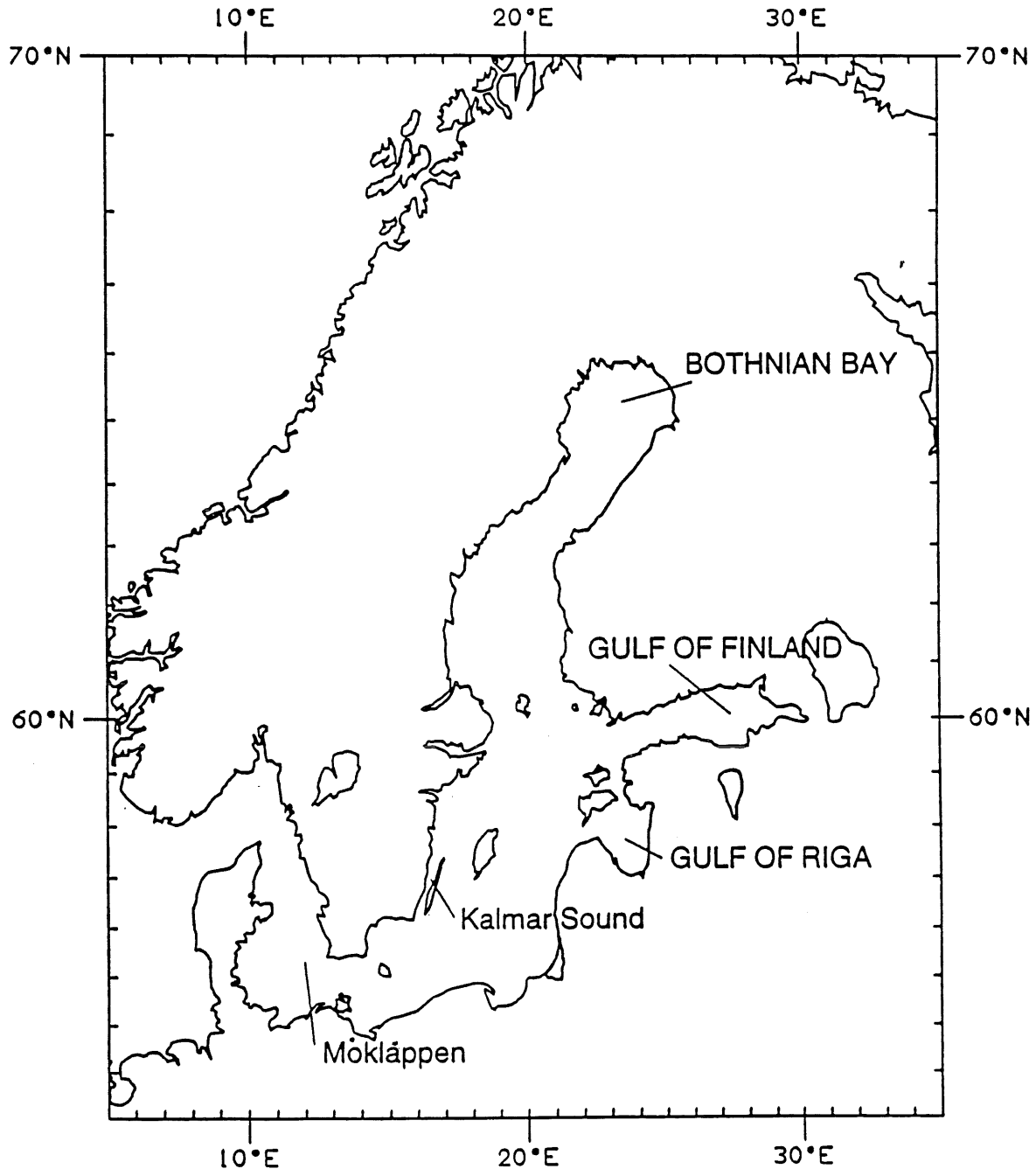
Aerial surveys of ringed seals hauled out on ice in the Bothnian Bay were carried out in 1988, 1989, 1990, 1991, 1993, and 1995. They show an increase of around 5% per year with a current count of around 3,000 animals (Härkönen and Lunneryd, 1992; WP6). Surveys in the Gulf of Finland in 1995 revealed only 162 animals, much less than the number previously reported for this area. These numbers give cause for concern because 100–150 ringed seals were found dead in the winter of 1991/1992. The mean estimate of abundance from three surveys made in the Gulf of Riga in 1994 was 780. Taken together these figures suggest that there are at least 4,000 ringed seals in the Baltic Sea. Range studies of five animals fitted with satellite transmitters suggest that they do not move far and the tagged individuals spent about 70% of their time on the ice during the aerial surveys. If these results are representative of the entire population, the total size of the Baltic population is 5,600 (4,000/0.7).

Like the grey seal, ringed seals in the Baltic have suffered from heavy exploitation in the past and from a high frequency of uterine occlusions in recent years. The prevalence of these occlusions has declined from higher levels recorded in the 1970s. However, unlike the grey seal, occlusions continue to be detected even in the youngest age classes. Data from the Finnish seal hunt and recent scientific sampling indicate that approximately 30% of the mature female population is affected by uterine occlusions.

5.1.4 Harbour (common) seal *Phoca vitulina*

At its last meeting SGSEAL expressed concern about the status of both the populations of harbour seals in the Baltic, in one case because of the effects of the 1988 phocine distemper epidemic and in the other because it is a small population which appears to be genetically distinct. However, data presented in WP6 indicates that both populations are increasing. In the case of the "east Baltic" population in Kalmar Sound, the annual rate of increase has been 11% since 1989, although the maximum count is still only 209 animals. The rate of increase of the "west Baltic" population centred around Mokläppen has been slower, probably due to high and variable pup mortality caused by foxes and grey seals. The maximum count in Swedish and Danish waters has

Figure 1. Location of areas in the Baltic Sea mentioned in the text.



been 170 animals, giving a minimum population estimate for the whole Baltic in 1994 of 379.

5.2 Available Information on By-catches

SGSEAL noted that although the guidelines for estimating by-catches of marine mammals contained in Section 3 were primarily designed for the by-catch of cetaceans, they are also appropriate for determining by-catch of seals. The important features of such schemes are the use of independent observers, the recording of an appropriate measure of fishing effort, representative sampling of the fishery, and the recording of information on the species, age, and sex of by-caught animals.

There are few published data of any kind on by-catches of marine mammals in the Baltic. However, studies of harbour porpoise by-catches in the Swedish gillnet fishery using independent observers began in 1994. These will continue as part of the BY-CARE project and will be extended to Danish vessels operating in the same area. A review of reports of seal by-catches in 1989, 1990, and 1991 provided to HELCOM had been prepared by E. Helle for the 1994 SGSEAL meeting. This review is reproduced in Annex 4. In addition, a study of the by-catch of seals in the Estonian trap net fishery (largely for pike-perch in summer and for herring and whitefish in autumn) had estimated that at least 280 seals were drowned in this fishery in 1994 (WP6). No information on the species of seal which were by-caught has been published, but it is believed that more than 80% were grey seals and that the rest were ringed seals (M. Jüssi, pers. comm. to Härkönen). Using these figures and the average by-catches reported in Annex 4, SGSEAL calculated that a minimum of 300 grey seals, 80 ringed seals, and 7–8 harbour seals are by-caught in the Baltic each year.

5.3 Preliminary Evaluation of Effect of By-catches

The estimated by-catch of grey seals is 5.7% of the minimum population size for the entire Baltic. Given the fact that the population appears to be increasing, this by-catch may be sustainable. However, its impacts will depend on the ages and sex of animals by-caught in the Estonian trap net fishery, since a seal population can sustain a much higher catch of juvenile animals than of adults. **SGSEAL therefore recommends further studies of the by-catch in this fishery to determine the age and species of the seals which are caught. Gear modifications to reduce the by-catch should also be investigated.**

The by-catch of ringed seals is 2% of the estimated number of seals hauled out on the ice and 1.4% of the estimated total population. Most of this by-catch is probably taken in Estonia, where the local ringed seal population is relatively small (around 1,000 animals). These local catches may not be sustainable if ringed seals are as sedentary as the satellite transmitter data indicates and if the relatively high frequency of uterine occlusions which are still observed in ringed seals from the Bothnian Bay also occurs in the Gulfs of Riga and Finland.

By-catches of harbour seals are 2.5–3% of the minimum size of the population. Whether or not this by-catch is sustainable will depend on the ages of animals which are caught. However, the regular monitoring of these populations which is currently underway should allow the negative effects of by-catch and other factors to be detected. **SGSEAL recommends an analysis of the statistical power of the time series of harbour seal counts in the Baltic to detect change (see Taylor and Gerodette, 1994).**

SGSEAL reiterates its 1994 recommendation for further modelling studies of the population dynamics of all three seal species in the Baltic Sea. This should include an investigation of the effect of current reported by-catches on the recovery of the ringed and grey seal populations, and back calculations of population size to the beginning of the century.

SGSEAL is concerned by the recommendation in WP7 that "as one of several steps to reduce the damage caused to the fishing industy grey seals should be culled with a view to studying the effect of limited culls in areas where extensive damage is caused by seals". SGSEAL notes that the Scientific Advisory Committee of the UNEP Marine Mammal Action Plan had drawn up detailed guidelines for the evaluation of proposals to cull marine mammals to benefit fisheries. This will soon be published by UNEP. **SGSEAL recommends that this document be considered by the international management group which is planning the limited culls of seals in the Baltic Sea.**

6 EFFECTS OF ACOUSTIC DISTURBANCE ON MARINE MAMMALS

A number of studies have indicated that marine mammals respond to acoustic disturbances by changing their surfacing behaviour, vocalizing less frequently or moving out of the area where disturbances occur. Usually these responses are temporary. A number of more detailed studies are now underway in EU waters, and additional studies are being conducted in the USA as part of the Environmental Impact Assessment carried out in conjunction with the Acoustic Thermometry of Ocean Climate experiment. Preliminary results of a number of these studies will be presented at the Biennial Conference of the Society of Marine Mammalogists in Orlando, Florida, in December 1995.

SGSEAL is not aware of any study addressing the population implications of the changes in the behaviour

of marine mammals or of their prey species which have been observed in response to acoustic disturbances. This is a substantial analytical problem which also besets the analysis of data on the effects of pollution. It can probably be addressed through the use of individual-based models of population dynamics (see DeAngelis and Gross, 1992). This approach is discussed in more detail in Section 7.

7 EFFECTS OF CONTAMINANTS ON MARINE MAMMALS

7.1 Review of Contaminant Levels and Effects

SGSEAL noted the report of the 1995 IWC Workshop on Chemical Pollution and Cetaceans (WP8). The Workshop reviewed information on the effects of chemical pollution on cetaceans and considered information from studies of pinnipeds where this was relevant. A Special Issue of the Reports of the International Whaling Commission will include the report of the Workshop and a number of other relevant papers. The Workshop had purposefully not considered the effects of marine debris, sewage, and other non-chemical forms of pollution. Nor did it have the expertise to consider the effects of oil pollution. SGSEAL noted that there is a need for a Workshop to address the oil pollution issue.

Other recently published symposium volumes (e.g., Science of the Total Environment vol. 154 combined issues 2 and 3, Blix *et al.*, 1995) have also included reviews of contaminant levels and their potential effects on marine mammals. In addition, the forthcoming Special Issue of the Reports of the International Whaling Commission on harbour porpoises will include a thorough review of contaminant levels in this species by a member of SGSEAL (A. Aguilar).

The general conclusion of these reviews was that epidemiological studies have shown a link between high levels of heavy metals, organochlorines, and polycyclic aromatic hydrocarbons (PAHs) and reproductive and immune system disfunction as well as pathological abnormalities in marine mammals. However, no direct cause and effect relationship has been demonstrated. Laboratory studies of harbour seals have shown that a diet which is high in organochlorines results in reproductive failure and immunosuppression. Possible population consequences of these observed relationships are discussed below.

Reijnders offered to prepare a review extending the work of the IWC Workshop to cover pinnipeds for the 1996 ICES Annual Science Conference. This review will focus on species in the North Atlantic, although it will take account of data from other areas to place the results from the North Atlantic in a global context. It will also identify potential sources of data for the ICES Environmental Data Bank, and will take account of the recent ICES/IOC/OSPARCOM Intercomparison Exercises on the Analysis of Chlorobiphenyl Congeners in Marine Media (*ICES Cooperative Research Report* Nos. 183 and 204).

SGSEAL discussed the suitability and availability of data on contaminant levels for inclusion in the ICES Environmental Data Bank. Most members felt that their laboratories would only be willing to provide data which had already been published. WP8 stresses the importance of biological data on animals which have been sampled for interpreting contaminant levels. It suggests that information on age, sex, reproductive state, and nutritional condition should be provided for each animal sampled. The Environmental Data Bank has fields for all these variables, but this information is often not available for older samples. It is also important to ensure that data from different laboratories are compatible, especially if they are to be used to provide summary statistics. The Data Bank also has fields which allow laboratories to indicate their Quality Assurance/Quality Control procedures and which ICES intercallibration exercises they have participated in. **SGSEAL recommends that only data which include quality assurance information should be accepted for the Data Bank.**

7.2 Applicability of Biological Effects Techniques

Although the terms of reference for SGSEAL relate only to PCBs, it is usually impossible to distinguish the effects of these compounds from other halogenated organic compounds. SGSEAL therefore considered the applicability of biological effects techniques for assessing the effects of a wide range of organic compounds of anthropogenic origin.

The Chairman of SGSEAL had discussed how to coordinate common activities with Dr R Stagg, Chairman of the Working Group on Biological Effects of Contaminants (WGBEC). The next meeting of WGBEC is scheduled for March 1996. Dr Stagg suggested that SGSEAL should consider the biological effects techniques which were reviewed by WGBEC at its 1995 meeting (CM 1995/ENV:3) and identify the techniques that might be appropriate for use on marine mammals. WGBEC would then consider how these techniques might be implemented in a monitoring programme at its March 1996 meeting.

The IWC Workshop (WP8) also reviewed a wide range of biological effects techniques which had either been used on marine mammals or which were being considered for that purpose. Many of these techniques are still at an experimental stage and, therefore, they were not considered by WGBEC. Two main problems in the use of such techniques on marine mammals are that suitable samples are difficult to collect for ethical and practical reasons and there is a lack of experimental and

baseline data (especially from cetaceans) to establish a dose-related response.

The Workshop identified four areas of research which were particularly relevant for the development of biological techniques to be applied to marine mammals:

i) **Toxicokinetic markers**. In particular, the use of enzyme induction (MFO) such as EROD and 4-OHAA for the methylcholantrene type of PCB, and PROD for the phenobarbital type of PCB; the use of an enzyme-based DNA adduct method such as the luciferase assay for the AH-receptor type of PCB; and chemical specific anitibodies as direct measures of contaminant exposure.

ii) **Reproduction and early development**. Here there is a need for samples from foetal, neonatal and juvenile animals of the same species which suffered different levels of exposure. Protocols for tissue collection and analysis are described in WP8.

iii) **Immunosuppression**. A number of techniques have been developed and used with harbour seals and bottlenose dolphins (see WP8 for references), but there is a particular need for baseline measurements of immune system performance in animals from uncontaminated environments.

iv) **Cancer induction and mutagenic effects**. Cancer is seldom documented in marine mammals (except in the case of beluga whales from the St Lawrence estuary, Canada) and is rarely a cause of death. However, carcinogenic and mutagenic effects in beluga whales are usually associated with exposure to PAHs, although their effects can be reinforced by coplanar PCBs.

The majority of the biological effects techniques considered by WGBEC are directed at monitoring in lower trophic levels or early stages of development, and tend not to be contaminant specific. Of the approaches reviewed at the IWC Workshop, only the use of bulk DNA adducts (to measure genotoxic effects), EROD induction, and general measures of immunocompetence were considered by WGBEC.

The IWC Workshop identified a clear need for more fundamental research on the biological response of marine mammals to contaminants, in order to provide techniques which could be used to measure exposure and adverse effects on a large scale. Until such techniques are available and tested it will be difficult to carry work on the impact of pollution on marine mammal populations much further.

However, even when such techniques do become available, they can only be used to determine the response of individual marine mammals. **At present no techniques are available which can be used to estimate the effects of PCB exposure on populations or species.** Even the experimental immunotoxicological studies of harbour seals, which had been reasonably successful in demonstrating differences between differentially exposed groups, have not provided data which can be used to estimate population implications of particular contaminant levels either in the environment or in the tissue of marine mammals.

The IWC Workshop recommended that the best approach to the population problem is to carry out intensive studies of a number of populations of three relatively well-studied species (beluga whales, harbour porpoises, and bottlenose dolphins) whose ranges expose them to different environmental levels of contaminants. SGSEAL supports this approach but notes that there are a number of confounding factors which could seriously limit the statistical power of any analysis.

SGSEAL proposes that an alternative approach borrowed from human epidemiology be developed. The aim would be to target groups of individuals within each study population which have a number of characteristics in common and to study their survival and reproduction in relation to contaminant exposure and its related adverse effects. Results from such an epidemiological study could then be incorporated into individual-based population models to investigate the population consequences of different levels of exposure. However, the basic techniques necessary to carry out such studies are still under development.

SGSEAL recommends that the ICES General Secretary approach the IWC regarding a co-sponsored workshop early in 1997 to evaluate and refine the experimental approach outlined above, and to develop protocols appropriate for field studies of marine mammals. The report of this workshop could then be used as a basis for a theme session on the same subject at the 1997 Annual Science Conference.

8 FUTURE ACTIVITIES

SGSEAL has been in existence for much longer than most ICES Study Groups. During this time the group has addressed varied terms of reference. Members of the group see a continuing need for the function provided by SGSEAL. In particular, SGSEAL serves as a mechanism for responding relatively rapidly to requests for advice on marine mammal issues other than those directly related to the management of pilot whales, harp seals, and hooded seals (which are covered by other Working Groups). It was proposed that J. Harwood should remain as the elected chairman of SGSEAL, but that future membership should be determined by the Delegates in consultation with the chairman in response to specific terms of reference.

9 ANY OTHER BUSINESS

SGSEAL updated the Appendix Tables summarizing marine mammal abundance and by-catch published in its 1994 report.

At previous meetings SGSEAL took note of the importance of protected areas for encouraging the recovery of harbour seal populations in Denmark and Sweden and fully supports proposals to HELCOM for the establishment of more protected areas in the Baltic Sea, particularly those which will allow grey and harbour seals to recolonize their former range in Germany, Poland, and Russia.

10 REFERENCES

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ANNEX 1

ICES STUDY GROUP ON SEALS AND SMALL CETACEANS IN EUROPEAN SEAS

Cambridge, England
4–6 December 1995

AGENDA

1. Opening of meeting

2. Assessment of impact of fisheries on marine mammals
   - 2.1 General approach
   - 2.2 Data requirements
   - 2.3 Estimating the impact of fisheries and incorporating the effects of population structure
   - 2.4 Evaluating the effects of management actions

3. The impact of fisheries on cetaceans in the North Sea
   - 3.1 Results from SCANS
   - 3.2 Available information on by-catches
   - 3.3 Preliminary evaluation of effect of by-catches

4. The impact of fisheries on marine mammals in the Baltic Sea
   - 4.1 Status of marine mammal populations in the Baltic
   - 4.2 Available information on by-catches
   - 4.3 Preliminary evaluation of effect of by-catches

5. Effects of acoustic disturbance on marine mammals
   - 5.1 Review of available information
   - 5.2 Review of planned research

6. Effects of contaminants on marine mammals
   - 6.1 Review of contaminant levels and effects
   - 6.2 Applicability of biological effects techniques

7. Future activities

8. Any other business

9. Agreement of final report

ANNEX 2

ICES STUDY GROUP ON SEALS AND SMALL CETACEANS IN EUROPEAN SEAS

Cambridge, England
4–6 December 1995

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ANNEX 3

ICES STUDY GROUP ON SEALS AND SMALL CETACEANS IN EUROPEAN SEAS

Cambridge, England
4–6 December 1995

WORKING PAPERS

WP1 Report of the Scientific Committee of the International Whaling Commission, Dublin. 1995. Section I: small cetaceans.

WP2 Northridge, S. A review of marine mammal observer schemes with recommendations for best practice.

WP3 Hammond, P.S., *et al.* The distribution and abundance of harbour porpoises and other small cetaceans in the North Sea and adjacent waters. ICES CM 1995/N:10 revised.

WP4 Kock, K.-H. Preliminary investigations on the German set net fishery in the North Sea in 1995.

WP5 Assessment and reduction of the by-catch of small cetaceans (BY-CARE).

WP6 Olsson, M. 1995. Baltic seals, a status report.

WP7 Report from the informal meeting on conflicts between seals and fishing industry in the Baltic Sea.

WP8 Report of the Workshop on Chemical Pollution and Cetaceans. International Whaling Commission document SC/47/Rep 2.

WP9 Draft Executive Summary of the Second Meeting of the Advisory Committee on the Agreement for the Conservation of Small Cetaceans of the Baltic and North Seas.

WP10 Skora, K. Marine mammals in Polish waters.

ANNEX 4

ICES STUDY GROUP ON SEALS AND SMALL CETACEANS IN EUROPEAN SEAS

Cambridge, England
4–6 December 1995

DATA ON NUMBERS OF SEALS REPORTED TO BE DROWNED IN FISHING GEAR IN THE BALTIC SEA AS REPORTED TO HELCOM

Summarized by Dr E. Helle

GREY SEAL

	Baltic Proper			Bothnian Bay			Gulf Of Finland			Gulf Of Riga			Total		
Year	1989	1990	1991	1989	1990	1991	1989	1990	1991	1989	1990	1991	1989	1990	1991
Estonia	12	27	15	0	0	0	-	3	2	-	5	17	12	34	34
Finland	0	0	0	11	17	23	20	5	13	0	0	0	31	32	36
Germany	1	-	-	0	-	-	0	-	-	0	-	-	1	-	-
Latvia	-	-	1	0	0	0	0	0	0	3	1	35	3	1	36
Lithuania	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Poland	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-
Russia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sweden	8	6	10	18	6	7	0	0	0	0	0	0	26	12	17
Total	21	34	26	29	23	30	20	8	15	3	6	52	73	70	123

HARBOUR SEAL

	Baltic Proper			Bothnian Bay			Gulf Of Finland			Gulf Of Riga			Total		
Year	1989	1990	1991	1989	1990	1991	1989	1990	1991	1989	1990	1991	1989	1990	1991
Estonia	0	0	0	0	0	0	-	0	0	-	0	0	0	0	0
Finland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Germany	1	-	-	0	-	-	0	-	-	0	-	-	1	-	-
Latvia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lithuania	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Poland	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-
Russia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sweden	7	5	10	0	0	0	0	0	0	0	0	0	7	5	10
Total	8	5	10	0	0	0	0	0	0	0	0	0	8	5	10

RINGED SEAL

	Baltic Proper			Bothnian Bay			Gulf Of Finland			Gulf Of Riga			Total		
Year	1989	1990	1991	1989	1990	1991	1989	1990	1991	1989	1990	1991	1989	1990	1991
Estonia	0	0	0	0	0	0	-	3	2	-	0	0	0	3	2
Finland	0	0	0	1	3	9	25	4	9	0	0	0	26	7	18
Germany	2	-	-	-	-	-	-	-	-	-	-	-	2	-	-
Latvia	-	-	0	0	0	0	0	0	0	2	1	0	2	1	0
Lithuania	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Poland	-	0	-	-	-	-	-	-	-	-	-	-	-	0	-
Russia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sweden	0	0	2	2	4	3	0	0	0	0	0	0	2	4	5
Total	2			3	7	12	25	7	11	2	1		32	15	25

ANNEX 5

ICES STUDY GROUP ON SEALS AND SMALL CETACEANS IN EUROPEAN SEAS

Cambridge, England
4–6 December 1995

ACTION LIST AND RECOMMENDATIONS

The response of the Study Group on Seals and Small Cetaceans in European Seas to its terms of reference is summarized below:

a) assess the status of small cetacean populations in the North Sea in the light of the recent Small Cetacean Abundance Survey in the North Sea and the available information on by-catches;

The results from SCANS provided the following estimates of abundance, with their coefficients of variation (CVs) for small cetaceans in the North Sea (as defined by the last North Sea Conference):

Harbour porpoise	268,452 (0.13)
Minke whale	7,201 (0.21)
Whitebeaked and whitesided dolphins	10,927 (0.27)

The recorded by-catch of harbour porpoises in the Danish cod and turbot gillnet fishery in the central North Sea is 2.6% (95% confidence limits 1.2–4.0%) of the estimated population size in ICES Areas IVb and IVc, and 1.7% (95% confidence limits 0.9–2.5%) of the population size in the entire North Sea. These values are substantially higher than the 1% limit adopted by the IWC Scientific Committee as a level which requires urgent investigation, especially since the recorded by-catch is almost certainly an underestimate of the total because it represents catches made by only part of the fishery. **The Study Group on Seals and Small Cetaceans in European Seas therefore recommends that the impact of the by-catch in these, and related, fisheries on harbour porpoises in the North Sea, and the effect of management action aimed at reducing by-catch should be investigated as a matter of urgency. The Study Group also recommends that any evaluation of the impact of by-catches on marine mammal populations and of the effects of management action aimed at reducing such catches should take account of the effect of such action on the fishery. The Study Group also recommends that there is an urgent need to investigate the impact of by-catches of porpoises outside the North Sea, in the English and Irish gillnet fisheries in ICES Areas VIIg and VIIj.**

b) assess the status of the three seal populations in the Baltic Sea in the light of modelling studies of population dynamics conducted by the Study Group, and available information on by-catches;

Annual counts of grey seals hauled out during the moult have been made in Sweden and Finland for more than a decade. Counts at Swedish sites north of 59N° have increased by 12% annually since 1982. Similar counts in Finland have increased by 14% per annum since 1985. The species is still absent from most of its former range in the southern Baltic (the German, Polish, and Russian coasts). Based on counts made during the moult at approximately the same time throughout the Baltic, the minimum size of the grey seal population in the Baltic is estimated to be 5,300 individuals. The estimated by-catch of grey seals is 5.7% of this minimum population size. Given the fact that the population appears to be increasing, this by-catch may be sustainable. However, its impacts will depend on the ages and sex of animals by-caught in the Estonian trap net fishery, since a seal population can sustain a much higher catch of juvenile animals than of adults. **The Study Group on Seals and Small Cetaceans in European Seas therefore recommends further studies of the by-catch in the Estonian trap-net fishery to determine more precisely the age and species of seals caught and the potential for gear modification to reduce the by-catch.**

Aerial surveys of ringed seals hauled out on ice in the Bothnian Bay were carried out in 1988, 1989, 1990, 1991, 1993, and 1995. They show an increase of around 5% per year with a current count of around 3,000 animals. Taken together with the results of surveys in the Gulf of Finland and Gulf of Riga, these figures suggest that there are at least 4,000 ringed seals in the Baltic. The total size of the Baltic population may be around 5,600 animals, based on the results of satellite-tagging studies. The by-catch of ringed seals is 2% of the estimated number of seals hauled out on the ice and 1.4% of the estimated total population. Most of this by-catch is probably taken in Estonia, where the local ringed seal population is relatively small (around 1,000 animals).

The "east Baltic" population of harbour seals in Kalmar Sound has increased by 11% annually since 1989. The rate of increase of the "west Baltic" population centred around Mokläppen has been slower. The minimum size of the harbour seal population in the Baltic in 1994 is estimated to be 379. Recorded by-catches are 2.5–3% of this estimate. The regular monitoring of these populations which is currently underway should allow the negative effects of by-catch and other factors to be detected. However, **the Study Group on Seals and Small Cetaceans in European Seas recommends an analysis of the statistical power of the time series of harbour seal counts in the Baltic to detect change.**

The Study Group on Seals and Smal Cetaceans in European Seas reiterates the recommendation it made at its 1994 meeting that there should be further modelling studies of the population dynamics of all three seal species in the Baltic. This should include an investigation of the effect of current reported by-catches on the recovery of the ringed and grey seal populations, and back calculations of population size at the beginning of the century.

c) ***review available information and planned research on the potential effects of acoustic disturbance on marine mammal populations;***

A number of studies have indicated that marine mammals respond to acoustic disturbance by changing their surfacing behaviour, vocalizing less frequently, or moving out of the area where disturbance occurs. A number of more detailed studies are now underway in EU waters, and additional studies are being conducted in the USA. No study known to the Study Group has addressed the population implications of the changes in the behaviour of marine mammals or of their prey species which have been observed in response to acoustic disturbance.

d) ***advise (with the Working Group on the Biological Effects of Contaminants) on the use of biological effects techniques for identifying the extent to which PCBs in marine mammals generate effects at the species and/or population level;***

A Workshop on Chemical Pollution and Cetaceans convened by the International Whaling Commission (IWC) in 1995 had reviewed a wide range of biological effects techniques which had either been used with marine mammals or which were being considered for this purpose. Many of the techniques were at an experimental stage and had not been considered by the Working Group on the Biological Effects of Contaminants (WGBEC). There are two main problems with using such techniques on marine mammals: suitable samples are difficult to collect for ethical and practical reasons; and there is a lack of experimental and baseline data (especially from cetaceans) to establish a dose-related response. The majority of the biological effects techniques considered by WGBEC are directed at monitoring in lower trophic levels or at early stages of development, and tend not to be contaminant specific. Of the approaches reviewed at the IWC Workshop, only the use of bulk DNA adducts (to measure genotoxic effects), EROD induction, and general measure of immunocompetence were considered by WGBEC.

There is a clear need for more fundamental research on the biological response of marine mammals to contaminants in order to provide techniques which could be used to measure exposure and adverse effects on a large scale. **At present there is no technique which can be used to estimate the effects of PCB exposure on populations or species.** The Study Group suggested that this problem could be addressed by investigating survival and reproduction rates in relation to contaminant exposure and its related adverse effects in targetted groups of individuals. Results from such a study could then be incorporated into individual-based population models to investigate the population consequences of different levels of exposure. However, the basic techniques necessary to carry out such work are still being developed. **The Study Group on Seals and Small Cetaceans in European Seas recommends that the ICES General Secretary approach the IWC about a co-sponsored workshop early in 1997 to evaluate and refine the an experimental approach to the problem of the population consequences of contaminant exposure and to develop protocols appropriate for field studies of marine mammals. The report of this workshop could then be used as a basis for a theme session on the same subject at the 1997 Annual Science Conference.**

e) ***develop plans for a review of contaminant levels in marine mammal populations and the possible effects of these compounds, and identify data sets on contaminants in marine mammals that are suitable for inclusion in the Environmental Data Bank;***

The IWC Workshop had reviewed information on the effects of chemical pollution on cetaceans and had considered information from studies of pinnipeds where this was relevant. Reijnders will prepare a review which extends the work of the IWC Workshop to cover pinnipeds for the 1996 ICES Annual Science Conference. This review will focus on species in the North Atlantic, although it will take account of data from other areas to place the results from the North Atlantic in a global context. It will also identify potential sources of data for the ICES Environmental Data Bank, and

will take account of the recent ICES/IOC/OSPARCOM Intercomparison Exercise on the Analysis of Chlorbiphenyl Congeners in Marine Media (*ICES Cooperative Research Report* No. 183 and No. 204).

The Study Group on Seals and Small Cetaceans in European Seas recommends that only results from marine mammals for which there is associated information on analytic procedures, Quality Assurance/Quality Control procedures, and participation in intercallibration exercises should be included in the ICES Environmental Data Bank. In addition, at a minimum, information on age, sex, reproductive state and nutritional condition should be provided for each animal sampled.

f) identify and review the data that will be required to evaluate the impact of different fisheries in the Baltic Sea on marine mammal populations;

Guidelines for estimating by-catches of marine mammals can be found in Section 3 of this report. Although these are primarily designed for determining by-catch of cetaceans, they are also appropriate for determining by-catch of seals. The important features of such schemes are the use of independent observers, the recording of an appropriate measure of fishing effort, representative sampling of the fishery, and the recording of information on the species, age and sex of by-caught animals.

The Study Group on Seals and Small Cetaceans in European Seas recommends that, in future, Member Countries are requested to provide estimates of by-catch per unit of effort in individual fisheries for each ICES Area with an indication of how that estimate was arrived at. Effort data for each fishery by ICES Area should also be provided.

APPENDIX TABLES

THESE APPENDIX TABLES SUMMARIZE ALL DATA ON THE CURRENT AND HISTORICAL SIZE OF SEAL AND SMALL CETACEAN POPULATIONS IN EUROPEAN SEAS WHICH WERE AVAILABLE TO THE STUDY GROUP

THE SOURCE OF DATA IS INDICATED BY A SUPERSCRIPT, IF THERE IS NO SUPERSCRIPT DATA WERE PROVIDED BY MEMBERS OF THE STUDY GROUP

THE FOLLOWING LETTERS IN THE COLUMNS LABELLED "METHODS" INDICATE WHICH TECHNIQUE WAS USED TO ESTIMATE NUMBERS:

A Single count of grey seal pups. These figures are usually multiplied by a correction factor to obtain an estimate of the total number of pups born during the season. The way in which this factor has been obtained is not always clearly specified in published reports, so the figures shown are the actual number of pups counted. Confidence limits for these numbers cannot be calculated.

B. Estimate of grey seal pup production obtained from a series of counts made during the breeding season. These estimates are inherently more accurate than those obtained using method A. Confidence limits can be calculated.

C. Counts made from aerial survey of seals hauled out in a particular area during the moult. Harbour seals spend much of their time out of the water during the moult, thus a large proportion (probably around 60%) of the population can be counted in surveys conducted at this time. Confidence limits are available for locations where more than one survey has been made in a year.

D. Estimates of abundance based on aerial survey of ringed seals hauled out on ice during the moult. Confidence limits can be calculated for these estimates.

E. Counts of seals hauled out made from boat, land or air at times other than the moult. The total count for a region is often made over a number of years, thus there may have been movement of animals between areas. No confidence limits are available.

F. Line transect survey of cetacean abundance. Such surveys provide estimates of the density of cetaceans in the area of the survey. These can be adjusted to take account of animals missed on the track line, and are scaled up to provide an estimate of total population size in the area surveyed. Confidence limits can be calculated.

G. Estimation based on photo-identification.
G1 Number of individuals in the photo-identification catalogue.
G2 Capture-recapture estimate

H. Back-calculation of population size from catch records.

I. "Instantaneous" count of all cetaceans visible in a particular area over a short period; for large areas counts are made simulataneously by a number of observers.

Numbers in the column labelled REPORTED CATCH come from official statistics of the number of animals killed each year for commercial purposes or fisheries protection. For seals, the numbers refer to pups only, unless otherwise indicated. The absence of figures from this column or the one labelled BY-CATCH does not mean that there was no catch, only that no figures are available.

APPENDIX TABLE 1: HARBOUR SEAL

NORWAY - BARENTS SEA COAST

YEAR	ESTIMATE	METHOD	COMMENTS	REPORTED CATCH	BY-CATCH
1964-66	180[1]	E	Does not include Russia		
1977-89	195[1]	E	Does not include Russia		

NORWAY - WEST AND NORTH SEA COASTS

YEAR	ESTIMATE	METHOD	COMMENTS	REPORTED CATCH	BY-CATCH
1964-66	3670[1]	E	-		
1977-89	3341[1]	E	-		

NORWAY - OSLOFJORD

YEAR	ESTIMATE	METHOD	COMMENTS	REPORTED CATCH	BY-CATCH
1964-66	190[1]	E			
1977-89	93[1]	E			

BALTIC

YEAR	ESTIMATE	METHOD	COMMENTS	REPORTED CATCH	BY-CATCH
1989					8
1990					5
1991					10
1992	367	E+C	120 in Denmark		
1993	269	E+C	Does not include Denmark		
1994	379	E+C	209 in Denmark		7-8

APPENDIX TABLE 1: HARBOUR SEAL

KATTEGAT / SKAGERRAK

YEAR	ESTIMATE	METHOD	95% CONFIDENCE LIMITS	REPORTED CATCH	BY-CATCH
1979	2350[2]	C			
1980	2825[2]	C			
1981	3100[2]	C			
1983	3800[2]	C			
1984	3975[2]	C			
1985	5275[2]	C			
1986	5700[2]	C			
1988	2901[3]	C	2497-3305		
1989	3146[3]	C	2823-3469		
1990	2820[3]	C	2247-3393		
1991	3897[3]	C	3157-4636		
1994	5184	C	4145-6223		

APPENDIX TABLE 1: HARBOUR SEAL

DENMARK - LIMFJORDEN

YEAR	ESTIMATE	METHOD	95% CONFIDENCE LIMITS	REPORTED CATCH	BY-CATCH
1976	90[4]	C			
1977	200[4]	C			
1978	330[4]	C			
1979	326[4]	C			
1980	300[4]	C			
1981	440[4]	C			
1982	420[4]	C			
1983	588[4]	C			
1984	639[4]	C			
1985	657[4]	C			
1986	710[4]	C			
1987	682[4]	C			
1989	490	C	229-752		
1990	498	C	426-570		
1991	628	C	345-910		
1994	510	C	199-821		

APPENDIX TABLE 1: HARBOUR SEAL

WADDEN SEA - DENMARK					
YEAR	ESTIMATE	METHOD	COMMENTS	REPORTED CATCH	BY-CATCH
1976	389[4]	C			
1977	410[4]	C			
1978	332[4]	C			
1979	421[4]	C			
1980	671[4]	C			
1981	656[4]	C			
1982	789[4]	C			
1983	924[4]	C			
1984	853[4]	C			
1985	958[4]	C			
1986	1261[4]	C			
1987	1477[4]	C			
1988	-	C			
1989	868[4]	C			
1990	1048	C			
1991	1097	C			
1992	1168	C			
1993	1433	C			
1994	1507	C			

APPENDIX TABLE 1: HARBOUR SEAL

WADDEN SEA - SCHLESWIG-HOLSTEIN					
YEAR	**ESTIMATE**	**METHOD**	**COMMENTS**	**REPORTED CATCH**	**BY-CATCH**
1951	1200	C		88	
1952	1200	C			
1953	1275	C		94	
1954	1350	C		109	
1955	1700	C		172	
1956	1200	C		166	
1957	1650	C		194	
1958	1700	C		254	
1959	1420	C		270	
1960	1410	C		261	
1961	1720	C		272	
1962	1400	C		256	
1963	1210	C		206	
1964	1420	C		276	
1965	1620	C		273	
1966	1660	C		277	
1967	1605	C		226	
1968	1560	C		265	
1969	1710	C		261	
1970	1647	C		230	
1971	1490	C		178	
1972	1500	C		195	
1973	1600	C		93	
1974	1544	C		31	
1975	1749	C		39	
1976	1653	C		36	

APPENDIX TABLE 1: HARBOUR SEAL

WADDEN SEA - SCHLESWIG-HOLSTEIN					
YEAR	**ESTIMATE**	**METHOD**	**COMMENTS**	**REPORTED CATCH**	**BY-CATCH**
1977	1806	C		25	
1978	1795	C		10	
1979	1919	C		12	
1980	2202	C		15	
1981	2200	C		20	
1982	2350	C		35	
1983	2500	C		25	
1984	2700	C		24	
1985	3300	C		11	
1986	3195	C		15	
1987	3793	C		17	
1988	4209	C			
1989	1741	C			
1990	1974	C			
1991	2313	C			
1992	2861	C			
1993	3285	C			
1994	3085	C			

APPENDIX TABLE 1: HARBOUR SEAL

WADDEN SEA - NIEDERSACHSEN					
YEAR	**ESTIMATE**	**METHOD**	**COMMENTS**	**REPORTED CATCH**	**BY-CATCH**
1958/59	1827	?		365	
1959/60	1936	?		368	
1960/61	2250	?		482	
1961/62	2165	?		377	
1962/63	2238	?		286	
1963/64	1899	?		282	
1964/65	1695	?		318	
1965/66	1670	?		268	
1966/67	1744	?		245	
1967/68	1665	?		180	
1968/69	1541	?		185	
1969/70	1347	?		142	
1970/71	1299	?		97	
1971/72	1282	?		72	
1972/73	1441	?		47	
1973/74	1276	?		7	
1974/75	1240	?		10	
1975/76	1121	?		7	
1976/77	1163	?		4	
1977/78	1140	?		5	
1978/79	1228	?		11	
1984	1870	C			
1985	1929	C			

APPENDIX TABLE 1: HARBOUR SEAL

WADDEN SEA - NIEDERSACHSEN					
YEAR	**ESTIMATE**	**METHOD**	**COMMENTS**	**REPORTED CATCH**	**BY-CATCH**
1986	2032	C			
1987	2245	C			
1988	-	C			
1989	1400	C			
1990	1620	C			
1991	1924	C			
1992	2255	C			
1993	2482	C			
1994	3078	C			

APPENDIX TABLE 1: HARBOUR SEAL

WADDEN SEA - NETHERLANDS					
YEAR	**ESTIMATE**	**METHOD**	**COMMENTS**	**REPORTED CATCH**	**BY-CATCH**
1900	16 000	H			
1960	1250	E			
1961	1250	E			
1962	1375	E			
1963	1500	E			
1964	1515	E			
1965	1450	E			
1966	1245	E			
1967	890	E			
1968	920	E			
1969	975	E			
1970	965	E			
1971	665	E			
1972	650	C			
1973	540	C			
1974	530	C			
1975	520	C			
1976	480	C			
1977	485	C			
1978	505	C			
1979	545	C			
1980	515	C			
1981	585	C			

APPENDIX TABLE 1: HARBOUR SEAL

WADDEN SEA - NETHERLANDS					
YEAR	**ESTIMATE**	**METHOD**	**COMMENTS**	**REPORTED CATCH**	**BY-CATCH**
1982	654	C			
1983	710	C			
1984	740	C			
1985	775	C			
1986	800	C			
1987	1055	C			
1988	975	C			
1989	535	C			
1990	560	C			
1991	750	C			
1992	960	C			
1993	1075	C			
1994	1230	C			

APPENDIX TABLE 1: HARBOUR SEAL

THE NETHERLANDS - DELTA

YEAR	ESTIMATE	METHOD	COMMENTS	REPORTED CATCH	BY-CATCH
1900	11500	H			
1953	1000	E			
1954	900	E			
1955	800	E			
1956	590	E			
1957	560	E			
1958	515	E			
1959	435	E			
1960	350	E			
1961	330	E			
1962	310	E			
1963	325	E			
1964	290	E			
1965	250	E			
1966	180	E			
1967	135	E			
1968	30	E			
1969	10	E			
1970	15	E			
1992	18	E			

APPENDIX TABLE 1: HARBOUR SEAL

FRANCE

YEAR	ESTIMATE	METHOD	COMMENTS	REPORTED CATCH	BY-CATCH
	30	E			

ENGLAND - EAST COAST

YEAR	ESTIMATE	METHOD	COMMENTS	REPORTED CATCH	BY-CATCH
1968	1468	C			
1969	1722	C			
1970	1662	C			
1971				315	
1972	1632	C		385	
1973				395	
1974				1	
1975				1	
1976					
1977					
1978	2176	C			
1980	2191	C			
1988	3026	C			
1989	1576	C			
1990	1531	C			
1991	1551	C			
1992	1645	C			
1993	1721	C			
1994	2309	C			
1995	2575	C			

APPENDIX TABLE 1: HARBOUR SEAL

SCOTLAND - NORTHEAST COAST

YEAR	ESTIMATE	METHOD	COMMENTS	REPORTED CATCH	BY-CATCH
1971				66	
1972				70	
1973				59	
1974				105	
1975				50	
1976				121	
1977				40	
1978					
1979					
1980				5	
1981				3	
1988	1249	C	Moray Firth only	30	
1989	1118	C	Moray Firth only		
1990	1570	C	Moray Firth 1103		
1991	1836	C	Moray Firth 1166	5	
1992	2081	C	Moray Firth 1308	1	

APPENDIX TABLE 1: HARBOUR SEAL

SCOTLAND - ORKNEY

YEAR	ESTIMATE	METHOD	COMMENTS	REPORTED CATCH	BY-CATCH
1971				12	
1972				116	
1973				198	
1974				198	
1975				86	
1976				96	
1977				17	
1978					
1979					
1980				28	
1982				2	
1985	6600	C			
1989	7100	C			
1993	7873	C			

SCOTLAND - SHETLAND

YEAR	ESTIMATE	METHOD	COMMENTS	REPORTED CATCH	BY-CATCH
1971	2500	E			
1978	4000	E			
1984	4800	E		4	
1985				3	
1986				10	
1987				12	
1988				23	
1991	4797	C			
1993	6227	C			

APPENDIX TABLE 1: HARBOUR SEAL

SCOTLAND - WEST COAST

YEAR	ESTIMATE	METHOD	COMMENTS	REPORTED CATCH	BY-CATCH
1971				267	
1972				230	
1973				250	
1974				235	
1975				190	
1976				208	
1977				211	
1978				340	
1979				350	
1980	5900	E		350	
1981				350	
1982				3	
1983					
1984					
1985				1	
1986				22	
1987					
1988				44	
1989	8044	C			

APPENDIX TABLE 1: HARBOUR SEAL

SCOTLAND - OUTER HEBRIDES

YEAR	ESTIMATE	METHOD	COMMENTS	REPORTED CATCH	BY-CATCH
1974	1300	E		15	
1975				50	
1976				42	
1977				39	
1992	2278	C			

NORTHERN IRELAND

YEAR	ESTIMATE	METHOD	COMMENTS	REPORTED CATCH	BY-CATCH
1977	348	E	Stangford Lough only		
1978	585	E	Strangford Lough 332		
1988	1112	E	Strangford Lough only		
1989	784	E	Strangford Lough only		
1990	898	E	Strangford Lough only		
1991	718	E	Strangford Lough only		
1992	603	E	Strangford Lough only		

APPENDIX TABLE 1: HARBOUR SEAL

REPUBLIC OF IRELAND

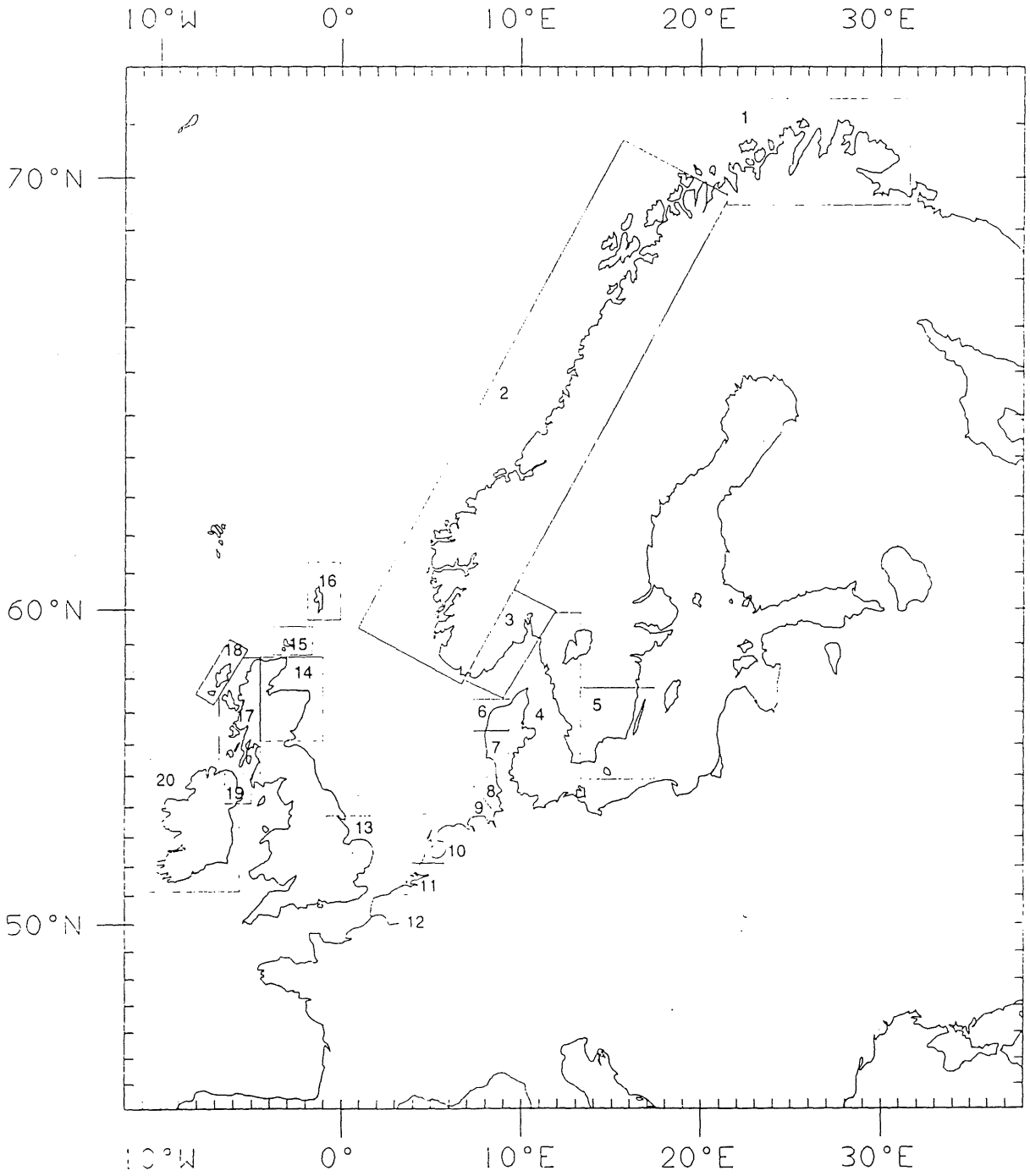
YEAR	ESTIMATE	METHOD	COMMENTS	REPORTED CATCH	BY-CATCH
1972				176	
1973				68	
1974				52	
1975				117	
1976				38	
1978	1248[5]	E			

APPENDIX FIGURE 1.1

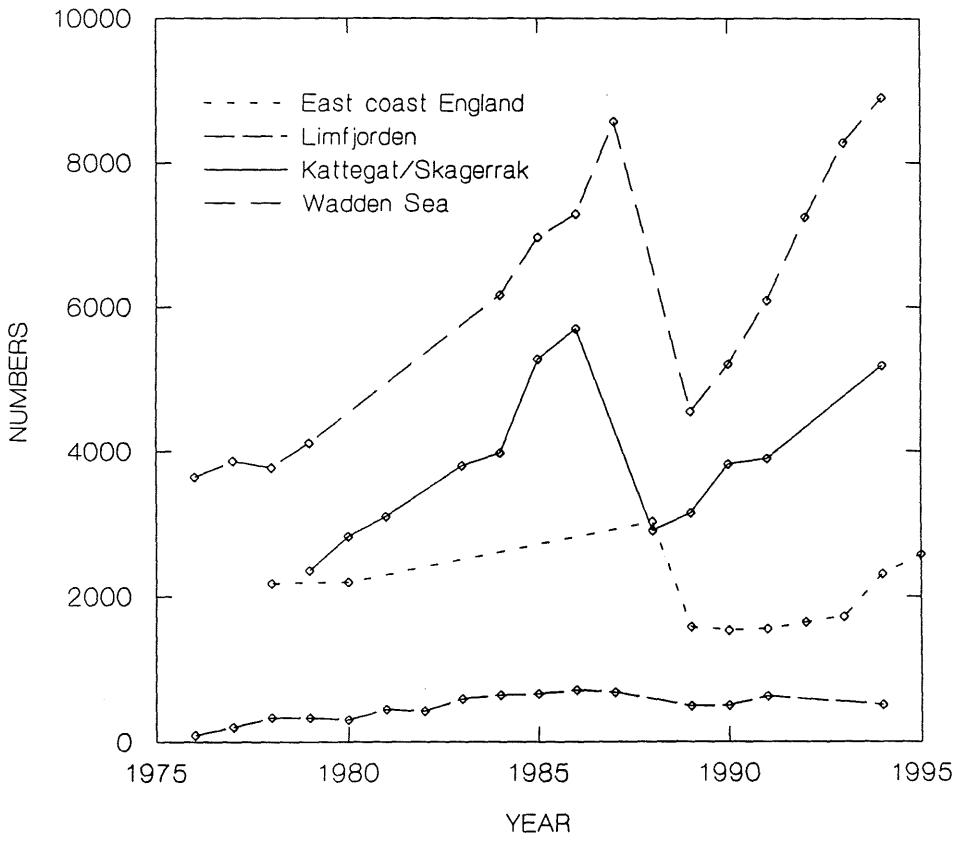
KEY

1. Norway - Barents Sea coast
2. Norway - West and North Sea coasts
3. Norway - Oslofjord
4. Kattegat/Skagerrak
5. Baltic
6. Denmark - Limfjorden
7. Wadden Sea - Denmark
8. Wadden Sea - Schleswig-Holstein
9. Wadden Sea - Niedersachsen
10. Wadden Sea - Netherlands
11. Netherlands - Delta
12. France
13. England - East coast
14. Scotland - East coast
15. Scotland - Orkney
16. Scotland - Shetland
17. Scotland - West coast
18. Scotland - Outer Hebrides
19. Northern Ireland
20. Republic of Ireland

APPENDIX FIGURE 1.1
Location of Areas referred to in APPENDIX TABLE 1
(see p A18 for a key to the areas)



APPENDIX FIGURE 1.2
Trends in the abundance of the major harbour seal populations in Europe over the period 1975-95.



APPENDIX TABLE 2 RINGED SEALS

BALTIC - BOTHNIAN BAY					
YEAR	**ESTIMATE**	**METHOD**	**95% CONFIDENCE LIMITS**	**REPORTED CATCH**	**BY-CATCH**
1900	300 000[6]	H			
1975	3000	D			
1984	2000	D			
1989	2500[7]	D	2075-2925		
1991	2970	D			24
1993	3140	D			24
1995	2800	D			

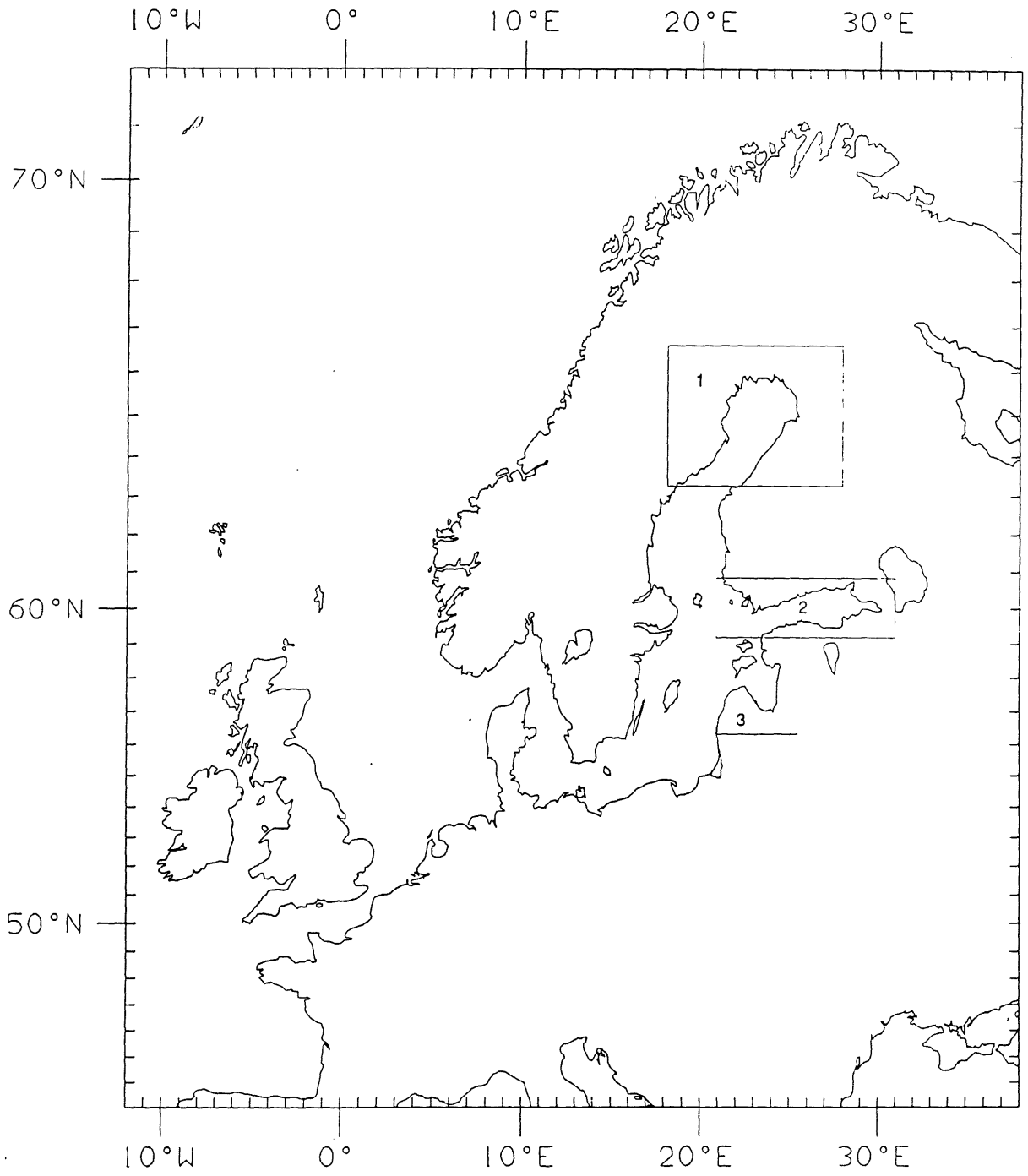
BALTIC - GULF OF FINLAND					
YEAR	**ESTIMATE**	**METHOD**	**95% CONFIDENCE LIMITS**	**REPORTED CATCH**	**BY-CATCH**
1994	170-200	D			
1995	162	D			

BALTIC - GULF OF RIGA					
YEAR	**ESTIMATE**	**METHOD**	**95% CONFIDENCE LIMITS**	**REPORTED CATCH**	**BY-CATCH**
1994	780	D			56

APPENDIX FIGURE 2
Location of Areas referred to in APPENDIX TABLE 2.

KEY

1. Bothnian Bay 2. Gulf of Finland 3. Gulf of Riga



APPENDIX TABLE 3 GREY SEALS

Note: These are counts or estimates of pup numbers, ***not total numbers***

RUSSIA - KOLA PENINSULA

YEAR	ESTIMATE	METHOD	COMMENTS	REPORTED CATCH	BY-CATCH
1960s	200	A			
1986	233[8]	A			
1987	230[8]	A			
1990	203[8]	A			
1991	328[8]	A			

NORWAY - FINNMARK

YEAR	ESTIMATE	METHOD	COMMENTS	REPORTED CATCH	BY-CATCH
1990	39[8]	A.			

NORWAY - TROMSO

YEAR	ESTIMATE	METHOD	COMMENTS	REPORTED CATCH	BY-CATCH
1986	27[8]	A			
1991	17[8]	A			

NORWAY - NORDLAND

YEAR	ESTIMATE	METHOD	COMMENTS	REPORTED CATCH	BY-CATCH
1976	130[8]	A			
1977				70	
1987				324	
1989	105[8]	A		32	
1991	171[8]	A			

APPENDIX TABLE 3 GREY SEALS

Note: These are counts or estimates of pup numbers, ***not total numbers***

NORWAY - NORD-TRØNDELAG

YEAR	ESTIMATE	METHOD	COMMENTS	REPORTED CATCH	BY-CATCH
1979	47[9]	A		27	

NORWAY - SØR-TRØNDELAG

YEAR	ESTIMATE	METHOD	COMMENTS	REPORTED CATCH	BY-CATCH
1974	97[9]	A	Froan only	27	
1978	118[9]	A	Froan only	310	
1979	228[9]	A			
1982	114[9]	A	Froan only		
1983	172[9]	A	Froan only		
1985	173[9]	A	Froan only		
1986	167[9]	A	Froan only		
1987	141[9]	A	Froan only		

BALTIC

YEAR	ESTIMATE	METHOD	COMMENTS	REPORTED CATCH	BY-CATCH
1989					73
1990					70
1991					123
1992	876	A			
1994					300

APPENDIX TABLE 3 GREY SEALS

Note: These are counts or estimates of pup numbers, ***not total numbers***

WADDEN SEA - THE NETHERLANDS

YEAR	ESTIMATE	METHOD	COMMENTS	REPORTED CATCH	BY-CATCH
1985	2	A			
1986	2	A			
1987	5	A			
1988	6	A			
1989	6	A			
1990	6	A			
1991	9	A			
1992	21	A			
1993	25	A			

WADDEN SEA - SCHLESWIG-HOLSTEIN

YEAR	ESTIMATE	METHOD	COMMENTS	REPORTED CATCH	BY-CATCH
1993	7	A			
1991	6	A			
1990	7	A			
1989	3	A			
1988	9	A			

FRANCE

YEAR	ESTIMATE	METHOD	COMMENTS	REPORTED CATCH	BY-CATCH
1993	2	A			

APPENDIX TABLE 3 GREY SEALS

Note: These are counts or estimates of pup numbers, ***not total numbers***

ENGLAND AND SCOTLAND - NORTHEAST COAST					
YEAR	ESTIMATE	METHOD	COMMENTS	REPORTED CATCH	BY-CATCH
1956	751	B	complete counts		
1957	854	B			
1958	869	B			
1959	898	B			
1960	1020	B			
1961	1141	B			
1962	1118	B			
1963	1259	B			
1964	1439	B			
1965	1404	B			
1966	1728	B			
1967	1779	B			
1968	1800	B			
1969	1919	B			
1970	1987	B		6	
1971	2041	B		17	
1972	1617	B		1329	
1973	1678	B		20	
1974	1668	B		9	
1975	1617	B		1467	
1976	1426	B		8	
1977	1243	B		343	
1978	1162	B		175	
1979	1620	B		217	
1980	1617	B		93	
1981	1531	B		226	

APPENDIX TABLE 3 GREY SEALS

Note: These are counts or estimates of pup numbers, ***not total numbers***

ENGLAND AND SCOTLAND - NORTHEAST COAST					
YEAR	ESTIMATE	METHOD	COMMENTS	REPORTED CATCH	BY-CATCH
1982	1637	B		190	
1983	1238	B		28	
1984	1325	B		37	
1985	1711	B		37	
1986	1834	B		31	
1987	1867	B		13	
1988	1556	B			
1989	1921	B			
1990	2341	B		18	
1991	2368	B		13	
1992	2354	B		13	
1993	2724	B			
1994	2735	B			

APPENDIX TABLE 3 GREY SEALS

Note: These are counts or estimates of pup numbers, ***not total numbers***

SCOTLAND - ORKNEY					
YEAR	ESTIMATE	METHOD	95% CONFIDENCE LIMITS	REPORTED CATCH	BY-CATCH
1964	2163	B			
1965	2266	B			
1966	2394	B			
1967	2522	B			
1968	2722	B			
1969	2443	B			
1970	2638	B		731	
1971	2914	B		975	
1972		B		699	
1973	2704	B		341	
1974	2836	B		975	
1975	2876	B		1050	
1976	3407	B		1020	
1977	3520	B		841	
1978	3947	B		1067	
1979	4135	B		1015	
1980	4616	B		1195	
1981	5146	B		1219	
1982	5344	B		1184	
1983				8	
1984	4741	B	± 10%	2	
1985	5199	B	± 10%	1	
1986	5796	B	± 10%	2	
1987	6340	B	± 10%	21	

APPENDIX TABLE 3 GREY SEALS

Note: These are counts or estimates of pup numbers, ***not total numbers***

SCOTLAND - ORKNEY					
YEAR	**ESTIMATE**	**METHOD**	**95% CONFIDENCE LIMITS**	**REPORTED CATCH**	**BY-CATCH**
1988	5983	B	± 10%		
1989	6911	B	± 10%		
1990	7037	B	± 10%		
1991	8964	B	± 10%		
1992	10408	B	± 10%	1 adult	
1993	11108	B	± 10%		
1994	11864	B	± 10%		

SCOTLAND - SHETLAND					
YEAR	**ESTIMATE**	**METHOD**	**COMMENTS**	**REPORTED CATCH**	**BY-CATCH**
1970				60	
1971				39	
1972				30	
1973	578	A		49	
1974				73	
1975				68	
1976				72	
1977	700	A		10	
1978				59	
1979				37	
1980				40	
1981				40	
1982				49	
1983				1	
1984				1	

APPENDIX TABLE 3 GREY SEALS

Note: These are counts or estimates of pup numbers, ***not total numbers***

SCOTLAND - OUTER HEBRIDES					
YEAR	ESTIMATE	METHOD	95% CONFIDENCE LIMITS	REPORTED CATCH	BY-CATCH
1961	3142	B			
1966	3311	B			
1967	3265	B			
1968	3421	B			
1970	5070	B			
1971		B		11	
1972	4933	B		7	
1973		B		386	
1974	6173	B		868	
1975	6946	B		754	
1976	7147	B		600	
1977	-	B		718	
1978	6243	B		85	
1979	6670	B		200	
1980	8026	B		7	
1981	8086	B		2	
1982	7763	B			
1983		B			
1984	8000	B	±10%		
1985	8571	B	±10%	5	
1986	8861	B	±10%		
1987	9235	B	±10%	15	
1988	9259	B	±10%		
1989	9901	B	±10%		
1990	10642	B	±10%		
1991	11300	B	±10%		
1992	12496	B	±10%		

APPENDIX TABLE 3 GREY SEALS

Note: These are counts or estimates of pup numbers, ***not total numbers***

SCOTLAND - OUTER HEBRIDES					
YEAR	ESTIMATE	METHOD	95% CONFIDENCE LIMITS	REPORTED CATCH	BY-CATCH
1993	12715	B	±10%		
1994	12926	B	±10%		

SCOTLAND - INNER HEBRIDES					
YEAR	ESTIMATE	METHOD	95% CONFIDENCE LIMITS	REPORTED CATCH	BY-CATCH
1984	1332	B	±10%		
1985	1190	B	±10%		
1986	1711	B	±10%		
1987	1969	B	±10%		
1988	1950	B	±10%		
1989	1945	B	±10%		
1990	2092	B	±10%		
1991	2498	B	±10%		
1992	2851	B	±10%		
1993	2938	B	±10%		
1994	2788	B	±10%		

APPENDIX TABLE 3 GREY SEALS

Note: These are counts or estimates of pup numbers, ***not total numbers***

WALES

YEAR	ESTIMATE	METHOD	95% CONFIDENCE LIMITS	REPORTED CATCH	BY-CATCH
1977	645	A			
1992	1321	B			
1993	1377	B			
1994	1343	B			

ENGLAND - SOUTHWEST

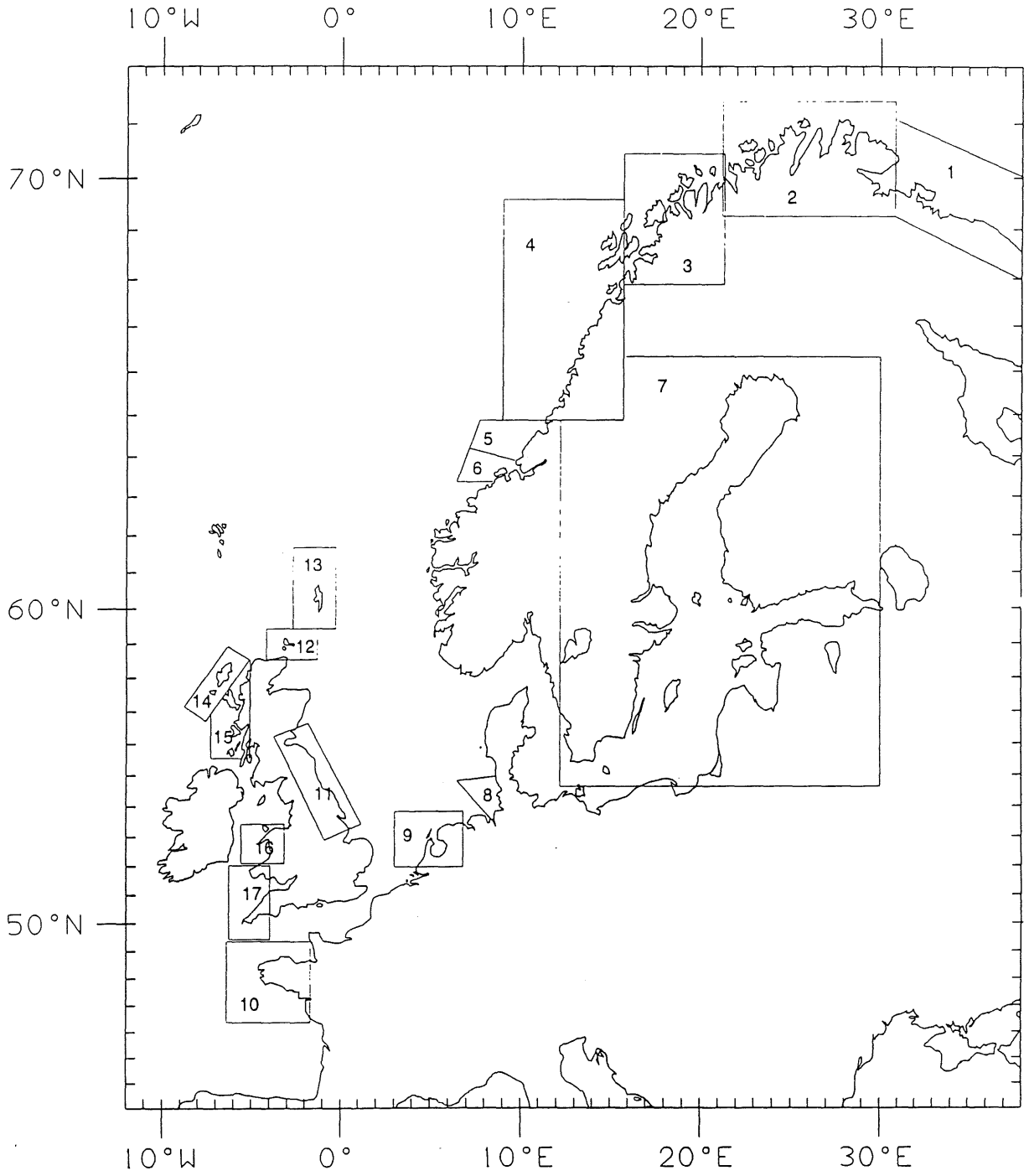
YEAR	ESTIMATE	METHOD	95% CONFIDENCE LIMITS	REPORTED CATCH	BY-CATCH
1973	107	A			

APPENDIX FIGURE 3.1

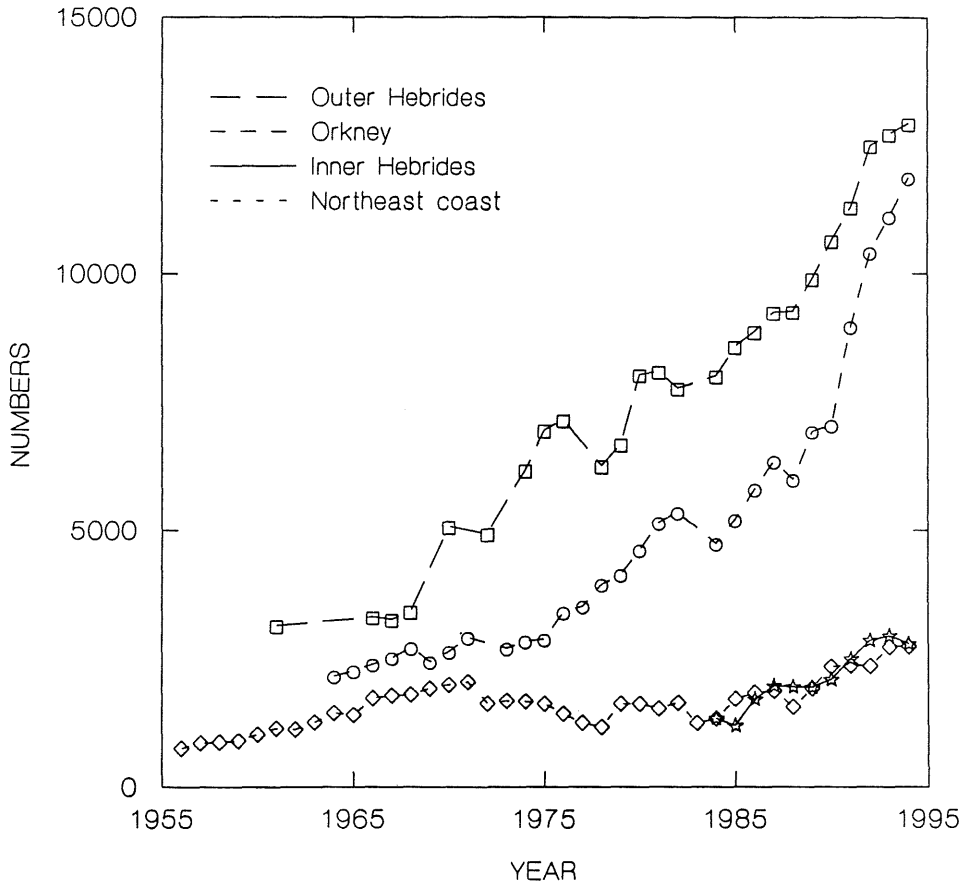
KEY

1. Russia - Kola peninsula
2. Norway - Finnmark
3. Norway - Tromso
4. Norway - Nordland
5. Norway - Nord-Trøndlag
6. Norway - Sør-Trøndlag
7. Baltic
8. Wadden Sea - Schleswig-Holstein
9. Wadden Sea - Netherlands
10. France
11. England & Scotland - northeast coast
12. Scotland - Orkney
13. Scotland - Shetland
14. Scotland - Outer Hebrides
15. Scotland - Inner Hebrides
16. Wales
17. England - southwest

APPENDIX FIGURE 3.1
Location of Areas referred to in APPENDIX TABLE 3
(see p A32 for a key to the areas)



APPENDIX FIGURE 3.2
Trends in the number of grey seal pups born at the major colonies in England and Scotland over the period 1955-95



APPENDIX TABLE 4 HARBOUR PORPOISES

BALTIC

YEAR	ESTIMATE	METHOD	95% CONFIDENCE LIMITS	REPORTED CATCH	BY-CATCH
1819-1892	50 000	H		≈1035 per year	
1916-1919				≈ 500 per year	
1941-1944				≈ 320 per year	

ICES AREA IIIa + b

YEAR	ESTIMATE	METHOD	95% CONFIDENCE LIMITS	REPORTED CATCH	BY-CATCH
1994	36 046[10]	F	20 276 - 64 083		

ICES AREA IIIc

YEAR	ESTIMATE	METHOD	95% CONFIDENCE LIMITS	REPORTED CATCH	BY-CATCH
1992	1 196[11]	F			
1994	5 850[10]	F	3 749 - 9 129		

KATTEGAT/SKAGERRAK + DANISH NORTH SEA COAST

YEAR	ESTIMATE	METHOD	95% CONFIDENCE LIMITS	REPORTED CATCH	BY-CATCH
1987	7000	F	2800 - 11200		
1988 (January/ February)	7600	F	3500 - 11700		
1988 (April/May)	12800	F	6300 - 25900		

APPENDIX TABLE 4 HARBOUR PORPOISES

GERMAN BIGHT

YEAR		ESTIMATE	METHOD	95% CONFIDENCE LIMITS	REPORTED CATCH	BY-CATCH
1992	January/February	8 800	F	5 200 - 15 000		
	April/May	17 000	F	8 400 - 34 600		

ICES AREAS IIa + IVa

YEAR	ESTIMATE	METHOD	95% CONFIDENCE LIMITS	REPORTED CATCH	BY-CATCH
1989	82 600[12]	F	42 740 - 121 460		

ICES AREA IVa

YEAR	ESTIMATE	METHOD	95% CONFIDENCE LIMITS	REPORTED CATCH	BY-CATCH
1994	98 564[10]	F	66 679 - 145 697		

ICES AREA IV b + c

YEAR	ESTIMATE	METHOD	95% CONFIDENCE LIMITS	REPORTED CATCH	BY-CATCH
1980-81					1000-3000[a]
1990					750[b]
1993					7000[c]
1994	169 888[10]	F	124 121 - 232 530		

a based on interviews with Danish fishermen
b based on interviews with Danish fishermen in one harbour
c estimated by-catch in Danish gill net fishery

APPENDIX TABLE 4 HARBOUR PORPOISES

ICES AREA VIIj

YEAR	ESTIMATE	METHOD	95% CONFIDENCE LIMITS	REPORTED CATCH	BY-CATCH
1989	19 210[13]	F	6 408 - 32 012		

ICES AREA VIIf + g + h + j

YEAR	ESTIMATE	METHOD	95% CONFIDENCE LIMITS	REPORTED CATCH	BY-CATCH
1994	36 280[10]	F	12 828 - 102 604		1 937[d]

d estimated by-catch in Irish and English gillnet fishery

APPENDIX TABLE 5 - OTHER SMALL CETACEANS

BOTTLENOSE DOLPHIN

AREA	YEAR	ESTIMATE	METHOD	REPORTED CATCH	BY-CATCH
NORTHEAST SCOTLAND	1991	78-95	E+G1		
BRITANY	1993	30	E+G1		
MONT ST MICHEL	1993	60	E		
ARCACHON	1993	6	G1		
SADO ESTUARY		?			
CORNWALL	1991/93	15	E		
DORSET	1994-95	5[14]	G1		
CARDIGAN BAY	1991	14-106	G1		
SHANNON ESTUARY	1995	50-60	I		
GALWAY BAY		?			
CLEW BAY		?			
DINGLE BAY	1995	12	I		

KILLER WHALE

AREA	YEAR	ESTIMATE	METHOD	95% CONFIDENCE LIMITS	REPORTED CATCH	BY-CATCH
NORTHERN NORTH SEA	1989	7 029	F	3 400 - 14 400		
NORTH NORWAY	1991/ 92	475	G2			

LAGENORHYNCHUS spp (WHITE-BEAKED AND WHITE-SIDED DOLPHINS)

ICES AREA	YEAR	ESTIMATE	METHOD	95% CONFIDENCE LIMITS	REPORTED CATCH	BY-CATCH
IIa + IVa	1989	26 665[15]	F	7 623 - 93 279		
IIa & IVa	1990	16 781[15]	F	3 955 - 71 206		
IVa	1994	1 685[10]	F	690 - 4 113		
IVb	1994	9 242[10]	F	5 344 - 15 981		
VIIf+g+h+j	1994	833[10]	F	159 - 4 360		

APPENDIX TABLE 5 - OTHER SMALL CETACEANS

COMMON DOLPHIN

AREA	YEAR	ESTIMATE	METHOD	95% CONFIDENCE LIMITS	REPORTED CATCH	BY-CATCH
NORTHEAST ATLANTIC	1992					410*
	1993	61 888[16]	F			419*
ICES VIIf+g+h+j	1994	75 449[10]	F	22 900 - 284 900		

* data from French albacore fishery only

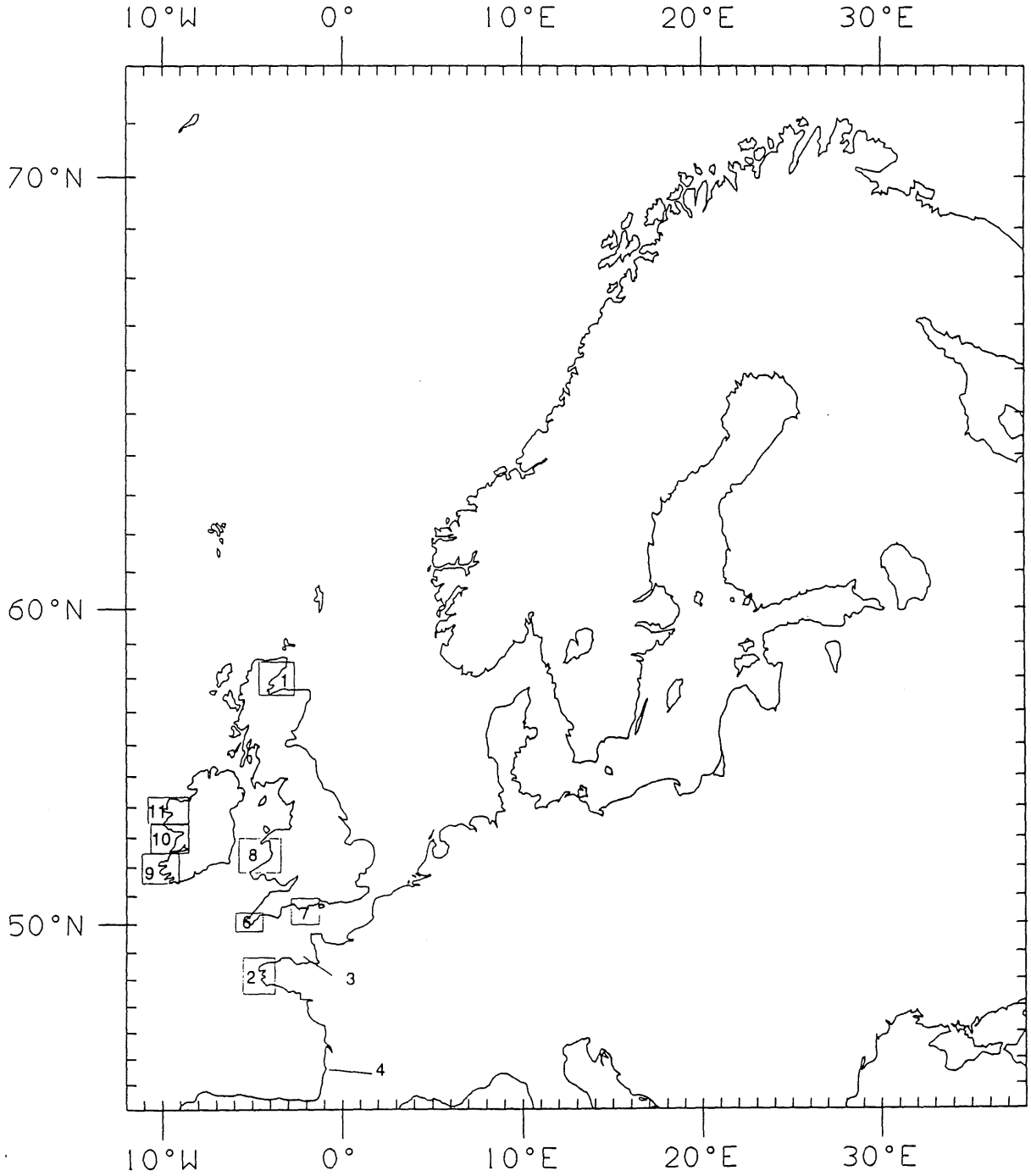
STRIPED DOLPHIN

AREA	YEAR	ESTIMATE	METHOD	95% CONFIDENCE LIMITS	REPORTED CATCH	BY-CATCH
NORTHEAST ATLANTIC	1992					1193*
	1993	73 843[16]	F			1152*

* data from French albacore fishery only

APPENDIX FIGURE 5
Location of Areas referred to in APPENDIX TABLE 5
KEY

1.	northeast Scotland.	2.	Brittany	3.	Mont St Michel		
4.	Arcachon	6.	Cornwall	7.	Dorset		
8.	Cardigan Bay	9.	Shannon	10.	Galway Bay	11.	Clew Bay



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