JOINT REPORT OF THE

WORKING GROUP ON MARINE MAMMAL HABITATS
and the
WORKING GROUP ON MARINE MAMMAL POPULATION DYNAMICS AND TROPHIC INTERACTIONS

Helsinki, Finland
28 February–3 March 2000

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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1 INTRODUCTION AND MEETING ARRANGEMENTS

Professor Eero Helle welcomed the participants in the meetings of the Working Group on Marine Mammal Habitats (WGMMHA) and the Working Group on Marine Mammal Populations and Trophic Interactions (WGMMPD) to Helsinki, and to the Finnish Game and Fisheries Research Institute. The Chairs thanked E. Helle for his hospitality and for the excellent meeting facilities provided by the Institute. The list of participants is attached as Annex 1.

2 APPOINTMENT OF RAPPORTEURS

M. Hammill, T. Härkönen, C. Lockyer, R. Merrick, R. Mohn, and K. Nilssen agreed to assist the Chairs as rapporteurs.

3 TERMS OF REFERENCE AND ADOPTION OF AGENDA

The review of the status of marine mammals in the Baltic Sea was the main item in the Terms of Reference for both WGMMHA and WGMMPD, as detailed below.

ICES C.Res. 1999/2:E:02

The **Working Group on Marine Mammal Habitats** [WGMMHA] (Chair: Dr A. Bjørge, Norway) will meet in Helsinki, Finland from 28 February to 3 March 2000 to:

a) review progress in studies of marine mammal habitat requirements, including spatial and temporal aspects of habitat use, with emphasis on topics of relevance for marine mammal exposure to contaminants;

b) evaluate, in a joint session with WGMMPD, the populations of grey seals (*Halichoerus grypus*), harbour seals (*Phoca vitulina*), ringed seals (*Phoca hispida botnica*) and harbour porpoises (*Phocoena phocoena*) in the Baltic Sea, including distribution and migration, effects of contaminants, health status and reproductive capacity [HELCOM 2000/1];

c) review progress in implementing the research programme on cause-effect relationships between contaminants and population-level effects in seals, and ensure quality control of the research and results in collaboration with other relevant ICES Working Groups, in particular, MCWG and WGBEC;

d) review invited papers and other available documents on status, recent achievements, and new ideas for progress in techniques and methodology for life history studies, including defining specific projects and evaluating and exploring possibilities for their funding.

WGMMHA will report to the ACME before its June 2000 meeting and to the Marine Habitat Committee at the 2000 Annual Science Conference.

ICES C.Res. 1999/2:G:05

The **Working Group on Marine Mammal Population Dynamics and Trophic Interactions** [WGMMPD] (Chair: Dr G.T. Waring, USA) will meet in Helsinki, Finland from 28 February to 3 March 2000 to:

a) evaluate, in cooperation with WGMMHA, the populations of grey (*Halicheorus grypus*), harbour (*Phoca vitulina*) and ringed (*Phoca hispida bothnica*) seals and harbour porpoises (*Phocoena phocoena*) in the Baltic Sea, including the size of the populations, distribution, migration, reproductive capacity, effects of contamination, and health status, and additional mortality owing to interactions with commercial fisheries (by-catch, intentional killing);

b) review invited papers and other information on techniques and methodology on seal abundance, particularly, grey seal and harbour seals, including census methodologies and techniques, population growth rates and trends, mortality and by-catches;

c) review progress, and new techniques and methodology in marine mammal dietary studies, including sampling design, sample processing, reconstructive techniques, data biases, and consumption models.

WGMMPD will report to ACFM and ACME before their meetings in May/June 2000 and to the Living Resources and Marine Habitat Committees at the 2000 Annual Science Conference.

In light of the integrated nature of the terms of reference for the HELCOM review, it was decided to merge the two agendas and convene a joint meeting of the two Working Groups.

The Agenda for the joint meeting was adopted as amended and is attached as Annex 2.

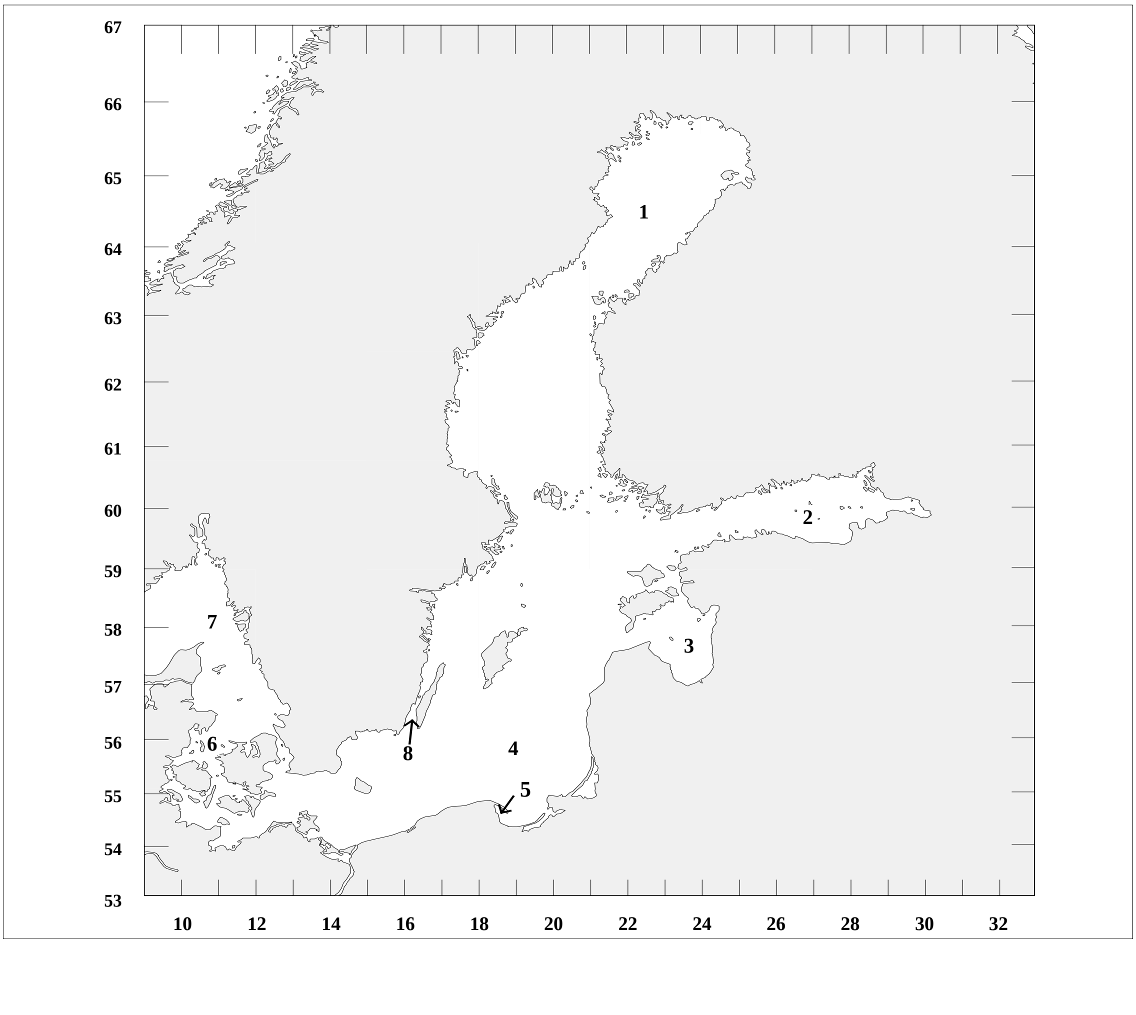
4 EVALUATION OF THE POPULATIONS OF GREY SEALS, (*Halichoerus grypus*), HARBOUR SEALS (*Phoca vitulina*), RINGED SEALS (*Phoca hispida botnica*), AND HARBOUR PORPOISES (*Phocoena phocoena*) IN THE BALTIC SEA

New information was available to the Working Groups on the abundance and trends in seal populations (see also Annex 3). However, no new information was available on abundance of the harbour porpoise (see Section 4.4.7). Information was reported on by-catches of seals and porpoises. However, the Working Groups noted that there was no systematic recording that provided total estimates for by-catches of marine mammals in a fishery. The WGs therefore reiterated the recommendation of the WGSEAL (ICES CM 1997/N:1) that: *All ICES Member Countries be requested to provide estimates of the by-catch of marine mammals per unit effort in individual fisheries with a clear description of how the estimates were obtained.*

Information was presented on recent studies in Finland of effects of contaminants on ringed and grey seals. No new information on effects on seals in other areas of the Baltic or on the harbour porpoise in the Baltic were presented. The WGs therefore draw attention to ongoing work at the Swedish Museum of Natural History, which reportedly includes development of a report to HELCOM.

The Baltic Sea area shown in Figure 4.1 indicates some of the geographic names used in the review.

Figure 4.1. The Baltic Sea area. 1: Bothnian Bay, 2: Gulf of Finland, 3: Gulf of Riga, 4: Baltic Proper, 5: Puck Bay, 6: Inner Danish waters and the Belt Seas, 7: Skagerrak and Kattegat, 8: Kalmarsund.



4.1 Grey Seals

4.1.1 Population discreteness, distribution, and migration

WP7 indicates that grey seals probably entered the Baltic Sea area around 10 000 yr B.P., and they dominated central and southern areas until about 2 000 yr B.P. Hunting has had a major impact on this population. Numbers were substantially reduced in the Kattegat area by around 1850. The introduction of modern rifles and national bounty programmes in the beginning of the 20th century resulted in more significant population declines, which were somewhat mitigated by general ice conditions that affected the availability of the herd to hunters. Hunting also intensified in the 1930s when a series of warm winters concentrated grey seals in limited ice areas of the Bothnian Bay. Hunting took adults and pups in equal proportions.

In Poland, based on hunting statistics, there were approximately 1000 grey seals in 1881 (WP12). Hunting is considered to be the main reason for the disappearance of grey seals from this area. The population disappeared during the 1930s or 1940s. Occurrences of seals seem to have increased since 1990, but it is difficult to separate the effects of increased sighting effort and increased numbers.

Grey seals were extirpated along the German Baltic coast around 1930 (WP18). Both strandings and the number of sightings have been increasing since the 1950s. In the 1950s only ten animals were seen. This increased to 49 in the 1990s (J. Schwarz, pers. comm.).

Extensive tagging completed over a four-year period (N = 1073), 1990–1993 in Estonia has provided information on grey seal movements between regions. Approximately 10 % of the tags have been recovered, primarily from the eastern central and southern parts of the Baltic. About 80 % of the recoveries are from animals incidentally caught in fyke nets (eastern central Baltic) and salmon drift nets (southern Baltic). About 20 % of the returns are from observations, which include strandings and observations of live animals. Most recoveries are from pups, some from animals 2–5 years old, and none from older animals. Tagging has been done in Finland (N = 900), but it stopped in 1993. Three tags (two grey seals tagged in Estonia, one tagged in Finland) were recovered in the Kattegat area off the Danish coast.

Movement information obtained from satellite telemetry was presented (WP2). These data indicated that juvenile grey seals occupy a home range in autumn with a radius area of roughly 50 km^2, but the data may be biased because all classes of positions were used in the analyses. The Working Groups noted that in general grey seals undertake long distance movements, and shift to alternative haul-out sites.

4.1.2 Effects of contaminants

PCBs are decreasing more slowly in grey seals than in other biota. It was also pointed out that congener effects must be considered in addition to overall PCB effects (WP18). Furthermore, although some of the classical contaminants were declining, some of the newer contaminants such as the organobromines should be examined. In the 1990s, there has been an increase in intestinal ulcers and a decline in uterine tumours, when compared to the 1980s (Bergman, 1999). Experimental work has shown cause-effect relationships between contaminant levels and skull lesions mediated through hormone secretions by the adrenal gland (Lohman *et al.*, 1998).

Increased levels of pathological changes in bone structure, similar to those in human osteoporosis, have been reported in grey seals during 1965–1985 compared to previous and later decades (Lind, 2000).

Elevated calcium and phosphorus levels showing a strong correlation with both DDTs and PCBs was observed in Baltic grey seals, but not in ringed seals. This suggests that grey seals are more sensitive to toxic effects on the bone turnover (Nyman *et al.*). In addition, reduced vitamin A levels in Baltic grey seals showed a strong negative correlation with both DDTs and PCBs, indicating that the contaminant load in the Baltic Sea reduces the vitamin A stores.

Similar as for ringed seals: vitamin E is elevated in Baltic grey seals, possibly as a result of an increased need for oxidative stress, a toxic state caused by organic contaminants. The elevated levels of alkaline phosphatase seen in Baltic seals show a strong positive correlation with the organochlorine load. This indicates oestrogenic effects of some of the xenobiotics. Clearly elevated cytochrome P450 levels indicate that the seals are exposed to a high load of dioxin-like compounds.

4.1.3 Health status

Bergman (1999) conducted a time-trend analysis for grey seals in the decades 1977–1986 and 1987–1996 and a similar analysis for animals born before 1980 and animals born in 1980 and later. He revealed a positive trend in gynaecological health of grey seals during these two decades, with a decrease in the prevalence of uterine obstructions from 42 % to 11 %, and an increase in pregnancies from 9 % to 60 %. The high incidence of uterine tumours (leiomyomas) seems to have decreased slowly from 53 % to 43 %. Further, Bergman (1999) also pointed at an increased prevalence of colonic ulcers in young animals, and he indicated that this might be caused by new or increased amounts of unidentified toxic factors in the seals' food.

4.1.4 Reproductive capacity

There was some discussion on the importance of changes in adult female survival rates, and changes in reproductive rates and their impacts on population changes. Declines in contaminant levels are thought to have been an important factor, since they have decreased during the 1985–1995 period compared to the previous decade. In grey seals, the negative effects of contaminants on reproductive rates, unlike for the ringed seal, appear to have been reversible. The question of uterine disorders and their impact on population reproduction in this species needs to be re-examined (Bergman, 1999). Sample sizes are small, but it was suggested that samples from the various countries be pooled to re-examine this.

Much of the reproductive data are from the incidental catch. Continued improvements in reproductive rates since 1985 are expected as contaminant levels decline. Modelling and empirical data show that maximum long-term growth rates in grey seals cannot exceed 11 % per year (Harwood, 1978; WP5). Observed growth rates in parts of the Finnish and Estonian sea areas have been up to 20 % and 50 %, respectively. These rates must have been caused by migrations among areas, changes in methods and/or changes in population structure. Current rates of increase along the Swedish coast are 7–8 % per year.

Reconstruction of the historical population size was carried out to provide minimum original population estimates of around 100 000 in the year 1900. Reproductive changes were taken into account in the back calculations.

WP19 suggests that the Baltic Sea grey seal is primarily an ice breeder. In mild winters they will breed on land, largely on islands just off the Estonian coast. Observed, pup mortality appears to be higher on land than on the ice, but is quite variable between years (0–30 %). The ice-born pups are larger than the land-born pups at weaning. The smaller size in land-breeding grey seals appears to be linked to disturbance of females during lactation.

Preferred ice-breeding habitat is on the pack ice found at the fast ice-pack ice interface. An analysis of ice cover data collected since the 1700s indicates that the ice edge forms around the central Baltic, with the eastern edge not far from the Estonian islands. Animals might aggregate here in winter. The proximity of the Estonian islands to this area might account for recent observations of breeding on these islands.

Until their extirpation in Poland and Germany, grey seals also used the ice edge in these areas for pupping, especially in the shallow bays, which would provide ice even in less severe winters. In winters without ice, grey seals pupped on land.

It was suggested that ice drift may promote pup dispersal into Gdansk Bay. Pup births were reported in Latvia, but inspection identified tagged animals from the Estonian colony. Some breeding was reported in the Finnish archipelago in 1975. In the late 1990s, increasing numbers of pups have been seen on islands off the Finnish and Swedish coasts, leading to speculation that disturbance on the Estonian island colony might lead to animals pupping elsewhere. It is suggested that some coordinated research be carried out to look at the proportion of animals pupping in different areas throughout the Baltic on land and on the ice.

Some questions were raised about the discovery of the Estonian island colony. Did the colony exist earlier in history? There does not appear to be any records of it in Estonian historical accounts, but some earlier Swedish accounts suggest that the colony may have existed.

4.1.5 Current abundance and survey methodology

WP18 provided information on survey methodology. Grey seal abundance estimates are based on counting hauled-out animals during the moult. Most of the haul outs in the Estonian archipelago are counted. No correction is made for animals in the water. Counts have been coordinated recently among colonies to minimize double counting. Higher counts since 1998 are due in part to new spotting equipment. In 2000, aerial surveys will also be conducted to compare with the ground counts.

The WGs had available information on total counts of Baltic grey seals from the Baltic Seal 99 Conference in Pärnu, Estonia, for 1999 (WP18) and from a couple of international meetings for 1994 (Soikkeli and Stjärnberg, 1996). Total counts were 5300 in 1994 and 7600 specimens in 1999. However, these figures cannot be used to calculate exact rates of increase because methods have changed between these years. The recent aim at avoiding double counting has 'decreased' the total estimate, and the figure for 1999 of seals hauling out on land did not take into account animals hauled out on ice in the Bothnian Bay. It is suggested that these ice-covered areas be included in future surveys.

Currently, boat and aerial counts are used in Sweden, ground counts in Estonia and mostly aerial counts in Finland. Pooling of the counts is done, but is complicated by the differences between areas. All regions appear to have used maximum counts before 1999 when arriving at total counts. This is because the maximum counts appear to be more precise, but they also may have led to an increase in double counting as animals move between colonies, particularly in the central part of their range. Because of complications associated with double counts (especially earlier) and no correction for animals in the water, the moult counts are less useful for providing an estimate of absolute population size. However, they likely describe population trend fairly well. In Sweden considerable work has been undertaken to 'ground-truth' aerial and ground counts. Ground-truthing in other areas has started to cross-check counts from aerial, shore-based, and boat observations and needs to be continued.

A photo-id project was started in 1994 in Sweden (WP20; WP18). A preliminary analysis provided an abundance estimate for the three major Swedish haul-out areas which is almost two times higher than the moulting counts from those areas. The WGs recognize that this technique is a major advance in estimating population size, but some additional refinements in the model used are still needed. It is recommended that the effort be extended to encompass the whole grey seal range in the Baltic.

The WGs are concerned about double counting. The major area where double counting may occur is the region of Estonia – SW Finland – Åland – SE Sweden, where roughly 30 % of the population is found. Other areas of concern include North Quark between Finland and Sweden, and the eastern Gulf of Finland between Finland and Russia. A system of having one group responsible for the surveys was proposed, but jurisdiction and funding problems complicate this approach. The WGs strongly **recommended** synchronizing surveys in all countries, to minimize double counting.

4.1.6 Current information on by-catches and other human-induced mortality

Estimates of by-catches are presented in Table 4.1.6.1. Since the 1970s hunting pressure has been reduced, and incidental catches form an important component of human-induced mortality.

In Sweden, interviews with fishermen indicated that a minimum of 176 seals were caught in 1996. An extrapolation to the whole fishery indicates that at least 400 seals are incidentally killed annually. The majority of by-catches occurs in salmon gear in the Gulf of Bothnia.

In Estonia, interactions between grey seals and fishing gear became more acute near the end of the 1980s. This may have been related to changes in fish stocks, changes in fish movements, or to increases in the number of seals.

In Finland, mail surveys and interviews with fishermen were conducted to evaluate seal damage to fish during July 1997 to October 1998 (WP18). Survey results indicate that 37 grey seals drowned in fishing gear, and 73 % of the interactions were in the Gulf of Bothnia. Examination of stomach contents from 47 animals < 1 year old, caught in salmon nets found herring and bottom fish, but no salmon. However, evidence of scarring possibly caused by seals was observed in salmon caught in the nets.

By-catch in Poland occurs at low levels, and is dominated by pups (WP12). Most of the by-catch in Polish waters occurs during April–June in salmon semi-drift nets and bottom gillnets. Two salmon pieces were found in the stomach of a pup, still partially covered in lanugo.

In Latvia by-catches have been increasing in recent years (WP18). About 90 % of the by-caught seals occur in fish traps. The other 10 % are mostly juveniles and are caught in eelpout fyke-nets and anchored salmon gillnets. Most of the by-catch occurs in spring, mainly April–May. Recent by-catch estimates of 200–300 animals in Latvia may be significant overestimates.

The WGs expressed some interest in comparing the age structure of the incidental catch with that of stranded animals. However, it was noted that the two data sets might reflect different sampling periods because stranded animals may stay on the beach for several weeks before they are reported. Also, in many cases the carcasses are incomplete.

In 1999, 120 hunting licenses were issued in Finland (60 licenses on the mainland, 60 in Åland). Catch data and biological samples will be provided to researchers at the end of the hunting season.

Table 4.1.6.1. Data on grey seal by-catches in fishing gear.

Country	Year	Fyke nets	Gillnets	Cod hooks	Trawls	Salmon gears	Fish traps
Finland[1]	1997–1998					37	
Germany	1960–1969	3		1			
	1970–1979	3					
	1980–1989	1			1		
	1990–1999		1				
Latvia[2]	1994–1996					1	3
	1997–1998	1				1	7
Poland[3]	1990–1999	12	41		7	36	
Sweden[4]	1996					400	

[1]Based on a survey of fishermen for the period July 1997 – October 1998.
[2]Numbers are estimated based on by-catch data reported in WP18. Rough estimates of 200–300 by-caught seals (73 % assumed to be grey seals) annually were reported. The WGs felt that these estimates were too high.
[3]Fisherman-reported by-catches; salmon gear is semi-drift nets.
[4]Based on interviews with fishermen and extrapolation of those reports.

4.1.7 Current population status

The total number of grey seals counted on the Swedish Baltic coastline was 3200–3300 in 1997–1998 (WP18). This includes 2100–2500 for the four largest colonies north of 59°N latitude and 600–900 for the six largest colonies south of 59°N. The average growth rate based on the ten colonies was 6.6 %.

In the Gulf of Finland, approximately 400–500 grey seals utilize haul-out sites along the Russian coast in summer (WP18). No information was available to the WGs on previous estimates.

During the 1990s, a rapid increase in the grey seal numbers in parts of Finland has been recorded (WP18). From 1991–1999, total numbers along the southwestern coast increased from 400 to 2200. This represents an annual average increase of 24 %, which is not biologically possible. A similar increase has not been observed in other regions (e.g., Gulf of Bothnia), and the rapid local increase is likely due to immigration from other areas during the 1990s. These changes demonstrate the need for coordinated international surveys throughout the Baltic.

In 1999, 1417 grey seals were counted during a census of haul-out sites in Estonian coastal waters (WP18). Five sites were located in the Archipelago Sea on the Estonian west coast and two in the Gulf of Finland. Between 1994–1998, counts in the Gulf of Finland have declined slightly, whereas counts along the western coast have shown a slight increase. However, these changes may be an artifact of improvements in survey techniques (WP18).

Grey seal sightings have increased in recent years along the German and Polish coasts, but there is no evidence that breeding is occurring in those regions (WP12; WP11; WP18).

By-catch levels appear to be increasing, particularly in coastal waters (e.g., Poland, Latvia) where fisheries are being developed or expanded.

4.1.8 Current information on trophic interactions

No new data were available on food habitats.

4.2 Harbour Seals

4.2.1 Population discreteness, distribution, and migration

Harbour seals colonized the Kattegat and the western Baltic Sea beginning approximately 6000–8000 yr B.P. (WP7). Seals subsequently expanded to the east into the Kalmarsund and Gotland area. The Kattegat population was then extirpated around 5000 yr B.P. (due perhaps to competition/interference from grey seals), leaving only eastern Baltic Sea animals (the ancestors of the present Kalmarsund population). The Kattegat area was again colonized around 250 yr B.P. by animals from the Norwegian coast when grey seals were substantially reduced. As a result, Kalmarsund harbour seals differ genetically from the current Kattegat and West Baltic harbour seal populations (Stanley *et al.,* 1996; Goodman, 1998). No evidence exists that harbour seals have ever inhabited the Baltic Sea north of Gotland.

Presently, there are three groups of harbour seals in the Baltic Sea environs. These include the Kalmarsund, West Baltic, and Kattegat-Skagerrak-Danish Strait groups. Beginning about 1850, the Kalmarsund population increased as grey seal numbers declined. There could have been 5000 harbour seals in the population around 1900. The population declined to around 1000 animals during the next decade due to hunting. Numbers remained at this level through the 1930s, but declined to the low hundreds through the mid-1970s (WP7).

4.2.2 Effects of contaminants

No recent information was presented. However, it was suggested that harbour seals had been little affected by contaminants in the Baltic Sea. Evidence was found of increased exostosis manifested as a problem with mineralization of the bones (e.g., the lower mandible; Mortensen *et al.,* 1992). Though the 1980s, the incidence had risen to 50 % of animals examined in the Skagerrak. Levels there tend to be lower than to the east in the Kattegat and Baltic. Similar temporal and spatial clines were found in another type of bone lesion (paradontitis). Levels around 1950 were about 30 % of the sampled population, but this rose to 40–60 % by the late 1980s.

4.2.3 Health status

It was noted that the evidence of reproductive disorders due to contaminants was very low for harbour seals in the Baltic Sea. However, very few animals have been examined. Although it has been shown experimentally that harbour seals fed Baltic Sea herring had severely depleted reproductive function (Reijnders, 1996; De Swart *et al*., 1994), there is no direct evidence available on the status of the Kalmarsund population.

4.2.4 Reproductive capacity

No trends in reproductive capacity have been observed; ratios of pups to adult females appear to have remained constant. Trends for the Kalmarsund population during 1977–1998 for non-pups (+9.5 % per year) and pups (+11.5 % per year) were not significantly different (WP7).

4.2.5 Current abundance and survey methodology

In 1998, the Kalmarsund population included 270 non-pups and 55 pups, and was increasing at around 9.5 % per year (WP7). This population does not appear to have been impacted by the 1988 epizootic, because no mortalities were found that could be associated with the epizootic.

The West Baltic Sea population experienced 50–60 % mortality during the epizootic. By 1998, there was a slight positive trend (+4.8 %) and non-pup numbers totalled 315 animals. Note that this is different from the adjacent harbour seal populations, which are increasing at near theoretical limits (WP5). West Baltic Sea pup numbers may be decreasing with mortality caused by grey seal or fox predation.

The third population of harbour seals is in the Kattegat-Skagerrak-Danish Straits area (WP5). Surveys of these three sub-areas during 1988 found around 3000 animals (range from 2715 to 3015). By 1998, numbers had increased to around 9000 animals (range from 7900 to 9747 seals). Growth during the period was 13 % per year for the area.

Counts of non-pups in these areas were obtained using replicate (3 to 6) aerial surveys during late August. All sites were photographed obliquely for later counting of seals from slides. All sites were surveyed in a single day. Pups were counted from the ground at the main breeding sites during June–July using spotting scopes.

Population estimates and trends were analysed using two models:

1) continuous exponential model, unstructured;
2) discrete Leslie matrix model, stage (age and sex) classified.

These models were then used to explore consequences of changes in demographic parameters. That is, what is the consequence of not having a stable age distribution, or alternatively what happens when the structure changes? The 1988 epizootic provided a test in that virtually all pups of the year and adult males died, resulting in a population dominated by adult females.

A problem with assessing the population from survey data results from differential rates in hauling out (WP5; WP6). Analysis of haul-out behaviour of freeze-branded animals suggests that pups of the year haul out much less frequently than adult females, while a larger portion of the adult male population hauls out than adult females. Thus, the age and sex composition on rookeries prior to the epizootic was different than afterwards. Consequently, compared with a model using the stable age structure before the 1988 seal epizootic, subsequent annual surveys overestimated population size (ca. 20 %) just after the epizootic in August 1988, and underestimated population levels for the following years (ca. 15 %).

The unstructured model can be a very powerful tool and, under certain conditions, may be equivalent to the age/sex structured model. However, depending on the initial condition, the unstructured model may overstate the population size compared to the Leslie model. Using a range of reasonable values for survival and natality, it appears that growth rates of 13 % per year are the maximum than can be achieved in a closed population with a stable age distribution. Reported values of harbour seal population growth greater than this are suggestive of either in-migration or of a disturbed population structure. For example, a population dominated by adult females with few adult males or juveniles could achieve growth rates greater than 13 % on a temporary basis.

Sightings of seals from the Baltic Sea in Poland and Germany are rare. Three animals were observed in the water, near shore in Poland during the 1990s (I. Kuklik, pers. comm.). Thirty-five sightings and 22 dead seals were observed in Germany during the 1990s (J. Schwarz, pers. comm.).

4.2.6 Current information on by-catches and other human-induced mortality

Some by-catch occurs with both the Kalmarsund and West Baltic populations. In southeastern Sweden, up to twenty Kalmarsund population seals (pups of the year) were taken in the eel/fyke net fishery. This fishery no longer exists. Seals are taken in bottom gillnet fisheries in the area. A few seals were observed by-caught in the bottom gillnet gear fishery in Swedish waters.

In Denmark, fishermen may be allowed to shoot harbour seals because of seal interactions with the eel/fyke net fishery. In 1999, two fishermen were each licensed to shoot up to five animals; however, it is presently unknown how many seals were actually taken.

Four harbour seals were reported by-caught in German waters during the 1990s (J. Schwarz, pers. comm.). One was caught in a fyke net, one in a trawl net, and two in unknown gear.

By-catch has occurred in Poland but at very low levels (WP12). One take occurred in a cod gillnet in 1995.

4.2.7 Current population status

In 1998, the Kalmarsund population included 270 non-pups and 55 pups, and was increasing at around 9.5 % per year. This group is genetically distinct from the other two populations in the Baltic. Observed by-catch is currently low.

The West Baltic Sea population exhibited a slight positive trend (+4.8 %) in 1998, with non-pup numbers totaling 315 animals. This trend was less than that observed in the adjoining populations. A few animals are by-caught each year in Sweden, Denmark, Germany, and Poland. Impacts of this by-catch and the Danish licensing of takes could further reduce the population's growth rate, and should be monitored.

The Kattegat-Skagerrak-Danish Straits population had increased to around 9000 animals by 1998; this was a growth rate of 13 % per year. By-catch levels appear to be low.

4.2.8 Current information on trophic interactions

No new data on food habits of Baltic Sea harbour seals has been prepared since the 1970s. Those data suggest that seals generally consume the most commonly available fish in an area. Studies conducted in the Kattegat-Skagerrak during 1977–1979 and 1989 showed that prey were flatfish in the Kattegat, and up to 30 different fish species in the Skagerrak (Söderberg, 1992; Härkönen and Heidi-Jørgensen, 1991). Herring, flatfish, gadoids, but not eels were consumed. It was noted that seals probably enter eel fyke nets for other species caught in the net.

Changes in prey stocks were discussed. It was suggested that the collapse in cod abundance in 1988–1989 might have changed seal food habits in the central Baltic Sea. However, another common prey, herring, remains relatively high in abundance, although the size and fat content have declined. Abundance of flatfish prey is unknown.

The absence of cod worm problems in the Baltic Sea was discussed. This may be a result of the low sea temperature greatly increasing the incubation time of cod worm eggs. A similar absence of cod worms was noted to exist in the seas near Murmansk.

4.3 Ringed Seals

4.3.1 Population discreteness, distribution, and migration

Ringed seals entered the Baltic around 11 000 yr B.P., and have been there continuously until the present with the largest concentrations in the north. They are separated into three main ‘groups’: Bothnian Bay, Gulf of Finland, and further south in the Gulf of Riga (WP7, Härkönen *et al*., 1999). The word ‘group’ has been used temporarily to describe the geographically distinct concentrations of ringed seals—it will be replaced later when a more suitable word is found.

Time series of the population, which were reconstructed from removals data and trends, seem identical to those of grey seals. The numbers were estimated to be on the order of 200 000 at the beginning of the 20th century, but fell rapidly from 1910 to 1940 and have been at a low level since the early 1970s (see Figure 3 of WP7). The similarity in the patterns may be due to the advent of high power rifles, and socio-economic and weather conditions which affected both species.

A comment was made that about 16 000 ringed seals per year were taken from 1910–1913 from a population estimated at 150 000+; would this be enough to cause the strong drop reported in WP7? Ignoring age structure, a 10 % removal should balance the 10 % intrinsic growth rate, but it was observed that a large proportion of mature females was taken which would be more harmful to the population reproductive capacity. In the Gulf of Finland, the hunt was directed against adult females for the period up to 1940.

A genetic screening showed no significant differences among the main groups (WP18). This is not unexpected, since there was a single population covering the Baltic, which only recently separated into the three groups observed today.

A satellite tagging study of ten mature animals in Estonian coastal waters was conducted by a multinational Baltic research programme (WP9). Movements of five animals tagged in the Bothnian Bay (645 locations) were compared to the Estonian tagged animals (2305 locations). Each ‘group’ exhibited limited movements within the respective tagging areas. These areas are centred around regions of ice cover, which is necessary for whelping. In this context, it was noted that the recent reduced amount of ice cover would affect carrying capacity. There are ice statistics from 1720 onwards. In the 19th century, there was very good ice coverage; the 20th century saw increasing temperatures and less ice coverage, especially in the past ten years (Seinä and Palosuo, 1996).

Seasonal changes in diving behaviour in Estonian waters were monitored for ten satellite tagged animals (WP9). About 200 000 dives were recorded from Estonian coastal seals. After molt (May–June), the dives are deeper and of longer duration. Mean weights of ringed seals approximately doubled over the six months after molting. During summer, both sexes make migrations offshore for a few deep dives. About 70 % of the time is spent diving in July compared to 30 % in January–March. The depth of dives corresponded with the seasonal distribution of Baltic herring, which are in shallow coastal areas in spring and deeper offshore waters in summer.

4.3.2 Effects of contaminants

Physiology and relationships to contaminants were reviewed (WP18). Toxic effects on the immune system and reproduction caused by environmental contaminant exposure are reversible until a certain threshold has been reached (Reijnders, 1986; De Swart *et al*., 1994). PCB and DDT levels are still high in Baltic ringed and grey seals. Ringed seals suffer from a clearly higher toxic burden than grey seals. Cytochrome P4501A (CYP1A) induction is a biomarker for organochlorine exposure. CYP1A activity is elevated in both Baltic seal species compared to the Arctic ringed seals and to Atlantic grey seals from Sable Island, Canada. A gender difference in the enzyme activity is seen only in the Canadian seals, with males showing higher CYP1A activities. This could be due to two of the males having a PCB and DDT burden similar to that of the Baltic seals, and therefore also induced CYP1A activities. As females transfer a major part of their contaminant burden to their pups during lactation, the contaminant load does not increase with age, as it does in males. In the Baltic Sea, although females had lower PCB and DDT levels, their CYP1A activity was on the same level as that of the males. A commonly used biomarker for DDT and PCB exposure is an induced CYP2B activity. This enzyme is probably not present in ringed and grey seals (Nyman *et al*., 1998). The CYP2B assay (PROD) has been used incorrectly as a CYP2B biomarker also in seals, as PROD actually measures the CYP1A activity (Nyman *et al*., 1998). Hepatic and blubber vitamin A levels are depleted in both Baltic seal populations compared to reference populations in terms of contaminant exposure. The depletion could be due to dietary differences or to the toxic effects of the contaminant load on the vitamin A status. Dietary differences between the regions should be taken into account before ascribing the differences to contaminant effects. Vitamin E, an anti-oxidant, showed the opposite trend to vitamin A and was higher in the Baltic than the references. This could again be due to dietary differences between areas, or it could be a result of an increased demand for radical scavengers (anti-oxidants), as some contaminants cause the production of toxic oxygen radicals.

Concentrations of mercury (Hg), cadmium (Cd), lead (Pb), and selenium (Se) in ringed seal tissues from 37 animals (ages 0–32) caught in the Gulf of Bothnia, Baltic Sea, and at Svalbard, in the Arctic were compared to concentrations in tissues from 40 grey seals (ages 5–35) caught in the Gulf of Bothnia and at Sable Island (WP18). Concentrations of Hg and Se were considerably higher in Baltic ringed seals, but Cd was lower than in Svalbard ringed seals. There were no differences in Pb concentrations between regions. In the Baltic, the Hg and Se burdens in ringed seal livers were considerably lower than in grey seals. The Cd and Pb levels in the Baltic were similar in both species. By comparison with effect threshold levels reported in the literature, only the Hg levels can be considered high.

Elevated alkaline phosphatase, vitamin E, and vitamin A in Baltic ringed seals is also correlated with the contaminant burden.

4.3.3 Health status

WP18 contained a summary of the pathology of ringed seals from Finnish coastal waters during 1982–1995. Among natural causes of mortality, heartworm was the most prevalent, but still rare. Many parasites were found and heartworms were the most common in young seals, up to 21 % in 104 young of the year in the Gulf of Finland. Heartworms were only found in one specimen out of thirteen from the Bothnian waters. Heartworms were not found in any specimen over 3 years of age. Every individual over 2 months of age was infested with lungworms (*Parafilaroides* sp.), gastrointestional nematodes *(Contracaecum osculatum*) and certain acanthocephalan worms (*Corynosoma strumosum* and *C. semerme*). These parasites may be significant health factors in individual animals.

4.3.4 Reproductive capacity

Population growth rate is used as an index of health (inference of mortality rate). Pregnancy rates are used as indices of fertility. They were seen to drop significantly from the 1960s to the late 1970s, then recover in the 1990s. The recovery coincides with a decrease in PCB concentrations in herring. Bothnian Bay population estimates fell from 14 000 in the 1960s to about 4000 in the early 1980s, with a modest recovery ($\lambda = 1.05$) since then (WP 8).

Several reports were presented on uterine occlusion, which affects only ringed seals and only in the Baltic (Bergman and Olsson (1986), Helle in WP18 and this meeting). These occlusions lead to sterility but otherwise the animals are in good condition. This condition was first seen in the early 1970s, peaked in the late 1970s, and has slowly decreased since then. It has been estimated retrospectively that uterine occlusions emerged in the Bothian Bay group in the latter half of the 1960s (Helle, 1980a). The uterine occlusion originates from a disrupted pregnancy development and its occurrence is dependent on the age of the female. The relationship between the frequency of the occlusions and PCBs is being investigated.

4.3.5 Current abundance and survey methodology

In the following section, some of the estimates are of population size and some are of seal counts on ice. There is no easy conversion from one index to the other. All estimates which refer to populations will be explicitly identified. There were a series of Soviet surveys in the Gulf of Finland which estimated population size. For the period 1970–1973, 13 000–13 500 ringed seals were estimated; for a 1982 survey, 3700–4000 animals, and for 1985, 3700–4700. Upon review, these first estimates were felt to be too high (Härkönen *et al.*, 1998) and that the 3700–4700 population estimate should be closer to 1000 animals on ice. Then came the period of very high mortality of 1991.

It is **recommended** that the Soviet data be re-analysed in a manner consistent to other surveys.

Survey results from the Gulf of Finland (Table 4.3.5.1) estimate a couple hundred or fewer ringed seals (on ice). Very good conditions in 1997 gave a slightly higher result.

Table 4.3.5.1. Gulf of Finland ringed seal surveys (on ice).

	1994	1995	1996	1997	1998	1999
Russia	169	169	149	282	75	*
Finland	4	*	*	*	*	141
Total	173	169	149	282	75	141

* = no ice

For the Bothnian Bay, the first surveys were carried out in 1975 (Helle, 1980b) and a decreasing trend was seen up to 1984 (Helle, 1990). Annual counts during the period 1988–1998 showed a significant increase at 5 % per year (Härkönen *et al*., 1998; WP8).

Because of poor ice, there has only been one count of the Gulf of Riga group and the estimate is 1400 (on ice) (WP18).

4.3.6 Current information on by-catches and other human-induced mortality

In Swedish studies, only 10–20 or fewer are directly reported in by-catches mostly from the Bothnian Bay and from fyke nets. The figures in Table 4.3.6.1 are higher because they attempt to take into account some degree of non-reporting.

In Estonian coastal waters, not more than 10 % of the total is ringed seals which would be about 20 animals. Because of breeding distributions, the Latvian coast is expected to have higher counts of by-catch.

Finnish data, mostly from the Gulf of Finland, reported 99 ringed seals for autopsy from 1982–1995. Total by-catch reports are about 30 per year in earlier years and ten per year in recent years. The fraction of ringed seals in these samples has fallen in recent years to 10 %. In an enquiry to fishermen on seal damage to gear and by-catch, 56 % of the by-catch of both grey and ringed seals were found in fyke nets, 24 % in drift nets, and 20 % in other gear. Four animals were reported as by-catch from Polish waters since 1995. No data are available from the Russian area.

The WGs **recommend** that fishermen be encouraged to release live ringed seals when they are found in gear.

Table 4.3.6.1. Data on ringed seal by-catches in fishing gear.

Source	Group	Period	Dominant Gear	Number Reported	Extrapolated Annual Rate	Comment
Finland	Bothnian Bay	1997–1998	Fyke nets	~15	50–60 $year^{-1}$	Drift nets also
Sweden	Bothnian Bay	1996		20–50	?	Rough estimate
Estonia	Gulf of Finland	1994–1999	Fyke nets	2–3	15–20	10 % of total
Estonia	Gulf of Riga	1994–1999	Fyke nets	?	5	10 % of total
Germany	Gulf of Riga	1950–1990s	Fyke nets	5	?	
Poland	Gulf of Riga	1995–1999	Salmon nets	4	?	
Latvia	Gulf of Riga	1997–1998	Fish traps	~4 $year^{-1}$	70–100 $year^{-1}$	~30 % of total

4.3.7 Population status

All three ‘groups’ are depressed as reported above. The most recent estimate (1996) for the Bothnian Bay is 3900 (Härkönen *et al.,* 1998, unpubl.), and it is slowly growing. For the Gulf of Riga, the most recent estimate is for 1996;

the estimate is 1400 and there is no information on trends (Härkönen *et al*., 1998). For the Gulf of Finland, the 1999 estimate is 150–300 and no trend is seen (Härkönen *et al*., 1998, unpubl.). Population status is affected by ice conditions. Environmental conditions and contaminants are felt to be more important than direct human-induced sources of mortality.

4.3.8 Current information on trophic interactions

Study on feeding habits (unpublished Finnish master's study, Stenman and Poyhonen, abstract in WP18).

Stomach samples have been collected since 1986 from approximately 400 individuals (approximately 150 ringed seals). In young seals, herring was the dominant prey in animals caught in drifting salmon nets. No direct information is available concerning whether salmon from these nets showed signs of seal predation. Few adults are caught in these nets. In the Bothnian Bay, again herring dominated and stickleback (*Gasterosteus aculeatus*) were also found. In the Gulf of Finland, herring, smelt, and stickleback were most common, all of which are of high caloric value. Stickleback are known to consume toxic algae, which may in turn affect ringed seals. Invertebrates seem less important in the Baltic than in other areas during the summer, but it is difficult to measure them. Earlier work reported that Crustacea, mainly *Saduria entomon*, were common in the diet during the winter months.

4.4 Harbour Porpoises (*Phocoena phocoena*)

4.4.1 Population discreteness, distribution, and migration

A review of methods for defining population structure was presented in WP16. A wide range of methods was discussed as potential tools for determining population structure, including distribution (including tagging), life history and biological parameters, parasites, ecological factors such as diet and contaminant loads, morphology and genetics (Table 4.4.1.1). The importance of determining population sub-structure of harbour porpoises throughout the North Atlantic, especially in regions affected by fisheries incidental take, was discussed in relation to management measures. Some practical proposals were made for integrating diverse information about populations, for the purpose of evaluating the need to manage putative sub-populations separately. Examples focusing on the North Sea and Baltic Sea areas were used in this discussion, with some reference to other areas. The general conclusion was that information currently available indicated a separation of the Baltic Proper (ICES IIId) from both the Kattegat and inner Danish waters and Skagerrak, as well as the North Sea.

Table 4.4.1.1. Methods testing hypotheses regarding putative sub-populations, and relative importance and limitations.

Method	Priority	Limitation of Method
Distribution ▪ Tagging for movements	Medium/Low	Needs much effort; tells about individuals; does not tell about reproductive (genetic) mixing
Biological parameters ▪ Timing of breeding ▪ Life history parameters ▪ Parasite load ▪ Tooth ultrastructure	Medium/High	Generally stable information, but may be affected by the environment: food supply; pollutants; exploitation that can lead to trends over time; seasonal variations; tells about populations; can be labour intensive
Chemical signals ▪ Organochlorine loads ▪ Heavy metal loads ▪ Isotope load ▪ Fatty acie signatures	Medium	Can provide clear-cut definitions for populations, but may change over time–years for contaminants, but maybe only months for fatty acid signatures; does not tell about reproduction; labour intensive
Morphology ▪ Non-metric skull characters ▪ Morphometrics of skeleton ▪ Tooth ultrastructure	Medium/High	Persistent in individuals; reflects genotype but may be affected by environment and ecology; tells about individuals and populations
Genetics ▪ mtDNA sequencing ▪ mtDNA micro-satelllites ▪ mtDNA RFLP ▪ Allozyme electrophoreis	High	Persistent; tells about individuals and populations; mtDNA is sex-linked; micro-satellites focus on nuclear DNA; allozymes are the phenotypic expression of genotype; all methods together are a very powerful tool

Detailed presentations followed on recent new information available addressing some of the methods mentioned in WP16. A new method using tooth ultrastructure in harbour porpoise to distinguish between putative populations was presented in Information Paper #3. The method was based on the fact that teeth continue growing throughout life and therefore can provide a permanent record of life history events. Nine different characters were identified as potentially useful in the decalcified, sectioned and stained teeth, and scores for each character were compared using Chi-squared analyses for a variety of geographical regions throughout the North Atlantic and also from California in the Pacific. Results indicated that samples from more distant regions were usually more dissimilar, whereas those from adjacent regions were less dissimilar. However, specific investigation of teeth samples within the ASCOBANS region indicated differences between areas within the North Sea, and between the North Sea, Skagerrak, Kattegat and inner Danish waters, and the Baltic Sea.

A morphological study of 242 harbour porpoise cranial measurements and non-metric characteristics from three regions: the German Bight (North Sea); the Skagerrak, Kattegat and Inner Danish waters; and the central Baltic Sea (Arkona sea and waters off eastern Sweden), was presented in WP10. Statistical analyses (ANOVA, Discriminant Analysis and Chi^2-tests) comparing the morphometric skull characters showed significant differences between the porpoises of all three areas. The results of this study, together with those of the tooth analysis above, confirmed the existence of populations in the Baltic different from those in the North Sea, and further indicated differences between the animals from the transition area from the Skagerrak through the inner Danish waters and the central Baltic Sea, respectively, indicating the existence of a separate population in the Baltic Proper. Female harbour porpoises in the cranial study exhibited more powerful statistical results for a separation into discrete populations than males, that might migrate between the population areas.

These recent results do not show support for seasonal migrations as discussed by some authors (Kinze, 1990). However, if previously reported large-scale migrations from the Baltic to adjacent sea areas also apply to the present situation, the suggested population delimitation might be too rigid.

Two papers addressed the levels of heavy metals in tissues of liver, kidney and muscle in harbour porpoises from southwest Greenland, Danish waters and Polish coastal waters (Baltic). WP15 provided information on Cd, Pb, Cu, Zn, Cr, Ni, Mn and Fe levels. Results showed that levels were correlated with age for the specimens studied, and that from the point of view of population discreteness, concentrations were higher in Danish waters than in the Baltic Sea, yet were highest in southwest Greenland. WP14 provided information on Hg and Se levels in liver, kidney and muscle from the same geographical regions, but with smaller sample sizes. While Hg and Se concentrations were linked, there were variations in levels in different organs and tissues, with the highest concentrations in liver and the lowest in muscle. In general, the results supported the findings on other heavy metal concentrations (WP15) and a discrete Baltic population.

4.4.2 Effects of contaminants

New information was provided in WP14 (see Section 4.4.1, above), but Hg is regarded as highly toxic and has been linked to immunosuppression and disease in mammals; no information was provided on pathology in these animals. Lockyer informed the Working Groups that to her knowledge, no significant pathological findings had been reported during the dissections of the Danish and southwest Greenlandic porpoises that could be linked in any way to toxicity.

4.4.3 Health status

Harbour porpoises stranded on German North Sea and Baltic Sea coasts showed decreased nutritional condition and increased pathology of the respiratory system with increased mercury levels (Siebert, 1995).

4.4.4 Reproductive capacity

In general, reproductive parameters in harbour porpoises are well studied (see Section 8), but there remain several aspects that are uncertain: for example, duration of pregnancy, weaning and lactation. There are also several areas and populations for which almost nothing is yet reported. Information on porpoises is almost totally lacking in the Baltic Sea, and although effort is and has been directed there, the low abundance of porpoises makes any study very difficult. However, the information in Section 8 (WP4) provides a basis upon which assumptions can be made for the Baltic region.

WP4 also pointed out the importance of recognizing the limited reproductive capacity of the harbour porpoise species. Because of the marked seasonal nature of the reproductive cycle (Sørensen and Kinze, 1990, 1994), we might anticipate that, although in theory ovulation and pregnancy may be feasible yearly, the likelihood is that the true reproductive interval may vary from one to two years. Lockyer and Kinze (1999) estimate that even if females have a longevity of 20 years, the maximum expected number of young produced in a lifetime might only be 11–12 calves with an age of sexual maturation of 3–4 years, and for most females, perhaps <5 % of the female population, longevity does not exceed 10 years, so that only 5 young might be produced of which not all may be viable.

4.4.5 Current abundance and survey methodology

There was no new information reported on this subject, the most recent information being that in the report of the Working Group on Seals and Small Cetaceans in European Seas, 1–4 April 1997, Stockholm, Sweden (ICES CM 1997/N:1). The Working Groups noted that new information concerning abundance and distributional surveys was essential in order to assess the impact of by-catches. The WGs therefore ***recommended*** that the ASCOBANS Baltic working group be encouraged to complete their work especially on the need for, design and feasibility of a new survey in the Baltic.

4.4.6 Current information on by-catches and other human-induced mortality

Information on by-catches in Danish waters was presented, based on the analyses of Vinther (1999). While independent observer effort was deployed in the Danish bottom-set gillnet fleet in the Baltic Sea between 1992–1998, no by-catches were recorded. By-catches were recorded within the Kattegat and North Sea. In the North Sea area, where most effort had been deployed during the same period, most by-caught porpoises occurred in the cod and turbot fleet and were young juveniles (Lockyer and Kinze, 1999), with the highest numbers in the first and third quarters of the year (Vinther, 1999). Estimates of extrapolated total by-catches were only possible for that particular fishery in the North Sea.

Comparison of historic catch data from the Danish Belt Seas (1940s) with recent by-catch data indicated that the former were taken almost exclusively in the winter months and nearly all comprised large adult animals with a predominance of males. In contrast to both directed take and by-catches, strandings showed a peak of animals in the summer months, influenced by the death of recent neonates.

Recent data on porpoise by-catches off the Polish coast were provided in WP13. It was noted that between 1990–1999, 44 porpoises were recorded by-caught; salmon semi-drift nets were responsible for 41 % (18) of the by-catch and bottom-set nets for cod were responsible for 34 % (15) of the by-catch. Up to 14 % (6) of by-catches were in other bottom-set nets and the remainder in trawls. It was noted that the age distribution of the by-caught animals ranged from 0–6 years, with nearly all animals being in the age group 0–2 years. The highest by-catches generally occurred during the months when the salmon fishery was operational (December–April) within the Puck Bay area.

With the low abundance of Baltic Sea harbour porpoise, any take is of concern (see Section 4.4.7). In Poland, Puck Bay appears to be a locus of harbour porpoise by-catch in Polish bottom gillnet and salmon drift-net fisheries, as based on interviews with fishermen. This effort to obtain by-catch information should be continued. However, fishermen are known to under-report marine mammal takes, so the amount of by-catch in this area should be independently confirmed. The preferred approach would be to place observers onboard fishing vessels; however, vessels in this area are likely too small to carry observers. An alternative approach would be to use a small boat and closely observe nets as they are retrieved.

4.4.7 Current population status

There was no new information reported on this subject, the most recent information being that in the report of the Working Group on Seals and Small Cetaceans in European Seas, 1–4 April 1997, Stockholm, Sweden (ICES CM 1997/N:1). However, all available information indicates that the abundance of porpoises in the Baltic Sea is reduced and at present very low. This small population is subject to an unknown level of by-catches and an estimate of abundance is urgently needed before the status of this population can be evaluated.

The WGs noted that the density of porpoises in the Baltic Sea most likely is very low, and therefore ***recommended*** that survey methodology be given thorough consideration and that an *appropriate* abundance survey be conducted as soon as possible (see Section 4.4.5).

4.4.8 Current information on trophic interactions

Information on the diet of harbour porpoises recovered off the Polish coast was presented in WP13. The important species of fish reported were herring (*Clupea harengus*) at 74 % frequency, sprat (*Sprattus sprattus*) at 58 % frequency, eelpout (*Zoarces viviparus*), cod (*Gadus morhua*), eel (*Anguilla anguilla*), ruff (*Acerina cernua*), and species from two families of fish Gobiidae (58 % frequency) and Ammodytidae. Most of these species have also been reported as prey items (Lockyer and Kinze, 1999) in the areas of the North Sea and inner Danish waters.

5 STATUS OF THE FRESHWATER SEALS OF THE BALTIC REGION

5.1 Saimaa Seal (*Phoca hispida saimensis*)

The following is based on an oral presentation by T. Sipilä, and on Sipilä and Hyvärinen (1998), and the abstract collection from the International Conference on Baltic Seals 1999 (WP18).

The habitat of the Saimaa seal is Lake Saimaa (4 460 km^2, maximum depth: 82 m, mean depth: 17 m), which contains 13 710 islands. About 8000 years ago the Saimaa was isolated from the sea. Saimaa seal is a relict of the glacial period, and the Saimaa and Ladoga seals are the only ringed seals in the world that live in lakes.

The weight of adult Saimaa seals is 45–100 kg (mean weight: 62 kg). Adult Saimaa seals vary in colour, ranging from dark to pale animals, but all colour morphs have regular ringed patterns on the fur. Some seals with a reddish face and breast have been found in southern Saimaa. The lanugo of Saimaa seal pups is grey. The pups are born in late February, and lactation lasts for 7–9 weeks. Mating occurs during the lactation period, towards the end of March or in early April. Breeding lairs are located along the shorelines of islands sand islets where wind-driven snow accumulates. A typical lair is a snow cave on the ice, close to large stones or rocks. Mature females seem to avoid each other when they select breeding lairs, and they seem to be faithful to their lair site over years. Human-induced disturbance has an impact on the breeding sites, and seals avoid areas close to buildings and roads. Saimaa seals usually haul out solitarily or in pairs along shorelines during summer and fall.

Hunting statistics from Lake Saimaa showed a total hunt of 247 seals in the period 1893–1905 (annual mean: 19 seals); 126 seals were taken in the period 1909–1916 (annual mean: 16 seals) and 288 seals were caught in the period 1927–1947 (annual mean: 14 seals). Seal hunting became prohibited by law in 1955, and the Saimaa seal is included in the IUCN Red Data Book classified as endangered.

The population size was estimated to be approximately 700 seals in 1900. In 1966, the population was estimated at about 400 animals (minimum: 250 seals), in 1971 about 250 (maximum: 400 animals), in 1981 between 160–180 seals, and in 1998 and 1999 between 200–220 seals.

The sex ratio in the population is 1:1. The age of sexual maturity for Saimaa seals is four years. The numbers of mature females are 50–55 and the birth frequency is 70–80 %, which yields an annual pup production of about 40 pups. The growth rate for the population is assumed to be positive, but less than 2 % per year.

The Saimaa seal usually eats only smaller specimens of the 33 fish species that are found in the lake. Vendace (*Coregonus albula*) and smelt (*Osmerus eperlanus*) are the most important prey species for the Saimaa seal. In years when vendace are scarce, other small fish such as whitefish (*Coregonus lavaretus*), perch (*Perca fluviatalis*), roach (*Rutilus rutilus*) and burbot (*Lota lota*) are eaten.

High concentrations of mercury in the Saimaa seal were measured in the 1960s and 1970s, and it is possible that mercury pollution reduced pup production during that period in the southern part of the lake. High mercury concentrations in liver, and especially in the muscle of weaned seal pups, are thought to have contributed to reducing their numbers by half during the last two decades. However, no clear connection has been found between the incidence of still-births and mercury pollution in the 1980s.

DDT concentrations have been reduced significantly in recent decades in Lake Saimaa, but no clear reduction has been seen in PCB concentrations in the Saimaa seal. However, there are major differences in concentrations of different contaminants in various parts of Lake Saimaa. The PCB concentrations in blubber of Saimaa seals are about three times the levels found in Ladoga seals but several times lower than in Baltic ringed seals. The DDT concentrations in blubber are between 3 to 4 times lower in Saimaa seals compared with Baltic ringed seals.

The most common cause of human-induced mortality in Saimaa seals was drowning in recreational fishing gear (mainly gillnets) (53 %). During May–June there are approximately 500 km of gillnets in the lake every night. The high mortality of seals due to incidental catches in gillnets seems to be the most important reason for the low growth rate of the Saimaa seal population.

The proportion of still-born and pups found dead in lairs was high (39 %). Unstable lairing conditions such as variations in the water levels could be important for lair mortality. Disturbance during the lactation period by humans, dogs and foxes could also be important for pup mortality. Disturbance might be even more important in the future if the population will increase.

The WGs were concerned that the small population size itself is an important threat to the viability of this sub-species. Further, the WGs noted that levels of by-catch mortality were high also for adult reproductive seals. It was agreed that it is most important to reduce the mortality of young adult females, and that a reduction in adult mortality might be obtained by a change in fishing practice. It was also questioned whether the methods used to estimate the population growth rate could discriminate between slightly positive and slightly negative growth rates. This implies that a negative growth rate cannot be excluded at the present time. The WGs ***recommended*** reduction of mortality in the reproducing segment of the population as an effective contribution to the short-term recovery of the Saimaa seal. Further, the WGs noted that maintaining the environmental quality through a sound management of the Lake Saimaa habitat might contribute to the long-term viability of the population**.**

The WGs were informed about plans to move seals from the central parts of the lake to the southwestern parts in order to increase the numbers of seals in that area. Some WG members commented that in light of the small population size, translocation of animals may be associated with high risk, and that the chance of success is unknown.

5.2 Ladoga Seal (*Phoca hispida ladogensis*)

The following is based on oral presentations by R. Sagitov and T. Sipilä, and on Sipilä and Hyvärinen (1998), and the abstract collection from the International Conference on Baltic Seals, 1999 (WP18). The habitat of the Ladoga seal is Lake Ladoga. Covering an area of 17 891 km^2, Lake Ladoga is the biggest lake in Europe (max. depth: 230 m, mean depth: 51 m) and contains 660 islands. About 9000 years ago the Ladoga became separated from the sea.

The weight of adult Ladoga seals is 32–56 kg (mean 47 kg). The colour is mainly dark with irregular, light ringed patterns. The age of sexual maturity is 5–6 years. Normally, pups are born with white lanugo, although some pups have been found that have black hairs in the natal fur. Pups are born in caves in snow-drifts on the ice in late February. The lactation period lasts for 7–9 weeks. Mating occurs during the lactation period, at the end of March or at the beginning of April. There are two main breeding areas: one in the northern part of the lake, where the breeding occurs in nearshore waters, and the other in the middle part of the lake, 40–60 km from the shore. Ladoga seals haul out during summer and fall in herds up to 300 animals mainly in the northern parts of the lake. They are known to be very vocal when they are hauled out.

Hunting statistics in northern Ladoga showed a total hunt of 15 236 seals in the period 1924–1936, with an annual mean take of 952 seals. Hunting became prohibited by the state in 1980, and the seal is included in the Red Data Book of Russia, and listed as endemic species for East Fennoscandia and Karelia. In 1996, it was included in the IUCN Red Data Book classified vulnerable. The population size estimates in 1970–1980 varied from 3000 to 20 000 seals. In 1977 airborne censuses were in the range of 3500–4700 seals, and in 1993 airborne estimates were approximately 5000 seals.

Lake Ladoga contains 48 fish species. The Ladoga seal eats mainly smelt, vendace, ruffe (*Gymnocephalus cernuus*), burbot, three-spined stickleback (*Gasterosteus aculeatus*), perch, roach, whitefish, trout (*Salmo trutta*) and four-horn sculpin (*Triglopsis quadricornis*).

Concentrations of cadmium and lead in the tissues of the Ladoga seal are reported to be low. However, concentrations of mercury in liver, kidney, muscle, and hair of adults and in particular in lanugo of pups are elevated and at the same levels as in Saimaa seals. The concentrations of organochlorines in blubber of Ladoga seals are reported to be significantly lower than those in Baltic and Saimaa seals.

In the northern breeding areas of Lake Ladoga, in some years about 15 % have been attacked by wolves or wild dogs. The impact on breeding success is not known, but the overall mortality caused by natural predators is assumed to be insignificant.

Incidental catches in commercial fisheries and direct killing by fishermen are assumed to be the main immediate threats to the Ladoga seal. The commercial fishery (mainly gillnets) and fishermen kill between 200 and 400 seals every year. Intermediate potential threats include episodic mass mortalities, habitat degradation including pollution, depletion of prey populations, disturbance, and changes in the physical environment. Long-term threats also include climate changes and depletion in genetic diversity.

Plans for further conservation, research and monitoring of the Ladoga seal population were presented to the WGs. The conservation measures included, among others, modification of fishing gear, and restricted admission to certain haul-out sites in the Valaam archipelago. Plans for research and monitoring were focused on estimation of population size, studies of population structure (DNA analysis), migration patterns (telemetry), monitoring of by-catches and concentrations of mercury in seal tissue.

The WGs acknowledged the plans for conservation measures and further research and monitoring, and encouraged collaborative efforts for funding and implementation of these plans.

6 REVIEW PROGRESS IN STUDIES OF MARINE MAMMAL HABITAT REQUIREMENTS

Härkönen presented a study (WP6; Information Paper #1) on habitat use in freeze-branded harbour seals at the west coast of Sweden.

The WGs referred to the discussion of marine mammal habitat use in the 1999 report of the WGMMHA and reiterated the importance of incorporating information on segregation by sex and age in haul-out groups of seals when designing studies of harbour seals.

7 STATUS OF THE RESEARCH PROGRAMME ON CAUSE-EFFECT RELATIONSHIPS BETWEEN CONTAMINANTS AND POPULATION-LEVEL EFFECTS IN SEALS

The Chair of WGMMHA presented WP1 on progress in the intersessional work to establish an ICES research programme on pollution in pinnipeds as developed by the WGMMHA in 1999.

The WGMMHA 1999 identified an editing group (Reijnders, Hall and Bjørge) for furthering the research plans. This group met in Texel, The Netherlands, in November 1999 to edit a project proposal to be submitted for EU funding. In order to meet the specifications (with regard to budget and number of participants) in the call for applications, only a part of the WGMMHA proposal could be included in the funding proposal. The editing group therefore followed the guidelines provided by WGMMHA to identify a core programme. It was decided that the application for EU funding should be limited to studies of one species and a maximum of five populations, captive studies at one institute, pathological studies at one institute, and finally that all chemical analyses should be carried out at one institute. It was further decided that the number of participants should be limited to 7–9. Relevant participants for the project were identified and invited to meet in Texel, 1–3 February 2000, to complete the proposal.

The specific aims of the submitted proposal were to:

- determine the population dynamics, health status, habitat use and diet, tissue concentrations and kinetics of pollutants in harbour seals (*Phoca vitulina*) inhabiting five areas representing a gradient of pollution;
- develop and validate a set of functional responses to pollutant exposure in captive animals and utilize these in free-living populations in a gradient of pollution;
- combine the results obtained to develop a set of interrelated models aimed at providing the basis for advice for management of the harbour seals and their habitats in European coastal marine ecosystems.

The harbour seal was chosen as the model species because it is a common top predator in large parts of coastal Europe, and it is a resident species inhabiting a significant gradient of pollution within this area. Five populations were selected for the study: the Dutch and German Wadden Sea, Skagerrak-Kattegat, Moray Firth, and Central Norway. These were chosen because they represent a pollution gradient, and the relevant background information on demography and time series of population dynamics is available. The proposal is an innovative approach to addressing the cause-effect relationships linking environmental pollutants to population-level effects in a top predator. The project includes thorough studies of habitat use and foraging, pollutant levels in predator and prey species at the actual foraging grounds, current health, demography and trend analyses in five free-living populations in a gradient of pollution, development and validation of biomarkers (indicators of functional response in reproduction, immune and endocrine systems) in captive seals and application in free-living seals. The results will be used to establish a set of interrelated models. A holistic conceptual model will link sub-models ranging from spatial GIS models of exposure to predictive mathematical risk-assessment models that will indicate likely effects on individuals and populations at various levels of exposure.

Participating institutions are: Alterra, Netherlands; Institute of Marine Research, Norway; Sea Mammal Research Unit, University of St. Andrews, UK; University of Kiel, Germany; Swedish Museum of Natural History, Stockholm, Sweden; Netherlands Institute for Sea Research, Netherlands; University of Aberdeen, UK; EcoMare, Netherlands; The International Council for the Exploration of the Sea, ICES.

The proposal was submitted to the EU on 15 February 2000.

8 LIFE HISTORY STUDIES

Reproductive parameters for harbour porpoises were reviewed throughout their range in the North Atlantic and Northeastern Pacific in WP4. The area of the North Atlantic included 14 putative populations/sub-populations of harbour porpoise. Most information was based on studies of carcasses derived from a combination of directed catches, by-catches and strandings. All these sources are valuable for providing biological information, but each carries some bias when it comes to interpretation of parameters. Other biases that can affect assessment of reproductive parameters are trends over time. Information on reproduction from WP4 is presented in Table 8.1, where usual ranges of values are provided based on different regions and/or populations.

There is general uniformity in reproductive parameters among populations and areas. Age at sexual maturation falls between 3–4 yr for both sexes; age at first parturition is probably 4–5 yr; age at first ovulation is > 3 yr; ovulation rates fall in the range 0.66–1.01 corpus per year, and the reproductive interval is 0.99–1.57 yr; pregnancy rates are generally in the range 0.74–0.98 per year, meaning that not all females produce a calf every year; there is a seasonal breeding/mating in the period June to August; gestation lasts 10–11 months; parturition generally occurs between mid-May to mid-July; lactational duration is uncertain, but is probably at least 8 months; size at birth is usually in the range 65–70 cm with a maximum size of ca. 80 cm. Sex ratio is biased in favour of males throughout life: 1.1 males : 1.0 females in the foetal stage, 1.4 males : 1.0 females in year 1, and a slight excess of males in later life (1.1–1.2 males: 1.0 females).

Table 8.1. Summary of harbour porpoise reproductive parameters.

Reproductive Parameters	
Age-related	• Age at sexual maturation: 3–4 yr usually for both sexes • Age at first parturition: probably 4–5 yr • Age at first ovulation: > 3 yr
Reproduction	• Ovulation rates / reproductive interval: 0.66–1.01 corpus per yr; 0.99–1.57 yr • Pregnancy rates: most likely range 0.74–0.98 per yr • Seasonal breeding / mating: June to August • Gestation period: 10–11 months • Seasonal parturition: generally mid-May to mid-July • Lactational duration: uncertain, but probably 8 months minimum
Sex-related	• Foetal sex ratio: 1.1 males : 1.0 females (Lockyer and Kinze, 1999) • Post-natal sex ratio: 1.4 males : 1.0 females (year 1); slight excess of males in later life (1.1–1.2 males : 1.0 females) (Lockyer and Kinze, 1999)
Size-related	• Neonatal size: most likely range 65–70 cm; maximum size: probably 80 cm • Length at sexual maturity: variable with population, but usually • 140–147 cm for females, • 130–135 cm for males • Foetal growth: uncertain growth model; depends on validity of embryonic diapause • Size / age at weaning: ca. 115 cm? but > 90 cm; > 8 months, but entirely independent feeding at approximately 10 months?

9 REVIEW OF PROGRESS AND NEW TECHNIQUES IN MARINE MAMMAL DIETARY STUDIES

R. Mohn presented (WP17) 'Likelihood analysis of grey seal-cod predation of the eastern Scotian Shelf'. The paper summarized available data and reviewed several simple models (constant, proportional and compensated models). Likelihood analyses were used to discriminate among the models and to define the relative importance of the fish survey and diet data.

On the eastern Scotian Shelf, large cod and grey seals have been identified as the two most significant predators. Overfishing removed large cod, so presently grey seals are the most important predators. Satellite tagging of Sable Island grey seals in the period 1995–1998 (approximately 20 000 observations) provided year-round distribution information. Approximately 75 % (150 000 animals) of the grey seal population in eastern Canada is from Sable Island. Diet composition based on analysis of stomach contents and scats in the period 1991–1997 showed that sandlance (*Ammodytes* sp.) dominated the diet. Cod contributed on average about 12 % to the diet throughout the year. The cod eaten were mainly 15–35 cm in length, which was in the lower part of the range (15–60 cm) based on cod length distribution from survey trawl hauls in the Sable Island area.

Depending on the model, annual seal consumption of cod was estimated to be between 10 million and 60 million individuals in recent years. The likelihood analysis showed that compensated and proportional models gave better fits than the constant model. The average grey seal diet fitted better in the models than the annual diet. Results from the models suggest that the predation by grey seals seemed to have a significant impact on the growth of the cod stock in the 1990s in Sable Island waters. These preliminary results suggest that this method may be useful in developing trophic dynamic models of seal-fish interactions. Presently, the data are insufficient to define a dynamic model for this area.

G. Waring provided a brief review of two papers. The first was entitled 'Protocol for the scientific evaluation of proposals to cull marine mammals' (Anon., 1999). Several information requirements contained in the protocol pertain to aspects of the TORs of the WGMMPD. These include ecological information on marine mammals (distribution, population size, per capita food consumption and diet, total food consumption and population dynamics), and two-way ecological interactions with fisheries. The report was distributed for informational purposes, and to highlight the need for the WGMMPD to further develop a complete database on marine mammal food habits. Further discussion on this project will be held via correspondence.

The second paper, entitled 'Dietary studies of marine mammals using stable carbon and nitrogen isotopic ratios of teeth' (Walker and Macko 1999), involved pinnipeds and small cetaceans. The importance of the paper was documenting the utility of using teeth from a variety of marine mammals to examine trophic feeding levels. Teeth are easily collected from stranded and by-caught animals, and this technique may be a practical way to evaluate trophic feeding levels for species across geographic regions (e.g., to examine the paradigm that pilot whales feed almost exclusively on squid across the Atlantic).

10 FUTURE ACTIVITIES OF THE WGMMHA AND THE WGMMPD

WGMMHA and WGMMPD held joint discussions on future activities including: meeting timing and frequency, utility of joint meetings, and feasibility of combining the Working Groups. Overall, there was consensus on changing meeting dates from February/March to a late November–early December period. The major justifications pertain to timing of field programmes, national agency operating year, and numerous scientific meetings scheduled during the winter/spring period. The participants supported the concept of joint sessions, particularly regarding requests to ICES for scientific reviews (i.e., HELCOM request for review of Baltic marine mammals). The participants noted that it would have been extremely difficult to partition contributions to the present request between two separate working group sessions. Further, several members who regularly attend working group meetings are their national nominees to both WGMMHA and WGMMPD. Regarding the present structure and terms of reference for the two marine mammal working groups, WGMMPD is scheduled to meet via correspondence during the next year. The next meeting of the WGMMHA will be decided when the funding of the research proposal for studies of effects of contaminants in seals is known.

Discussions regarding the utility of combining the two WGs focused on several issues. First, as previously stated, several regularly participating individuals are members of both Working Groups. It is a burden for these individuals to attend two separate meetings, even when the WGs have held overlapping sessions (i.e., 1999 meetings in Copenhagen). Also, a principal justification for establishing two WGs with more specific TORs at the 1997 ICES Annual Science Conference (i.e., transformation of existing WGSEAL) was to attract more marine mammal specialists to WG meetings. Unfortunately, this has not happened because relatively few national members attend the WG sessions. Although the Chairs of WGMMHA and WGMMPD have invited non-member 'experts' to attend WG meetings, funding considerations usually preclude their participation. The utility of combining the two WGs, while maintaining the principles applicable to each WG, is to ensure an adequate number of participants at future meetings. Additionally, participants agreed that agendas for future meetings of a combined WG could be structured to contain shorter duration components to attract more specialists. For example, during a five-day WG meeting to address habitat issues, as justified in the remit of WGMMHA, a shorter (1–2 day) meeting on habitat impediments to population growth and expansion (i.e., grey seals) is justified under the remit of WGMMPD.

11 OTHER BUSINESS

11.1 Plans for Reintroduction of Grey Seals in German Baltic Waters

Grey seals and common seals were eliminated from the German part of the Baltic between 1850 and about 1930. They have been protected since 1955, but no recovery has occurred. Since 1990, five to eight sightings and strandings have been recorded annually (WP11).

In order to assess the chances of a successful re-introduction to the German Baltic, a series of questions have been formulated and certain issues have been addressed. In spite of reductions in contaminant levels in the Baltic a natural colonization of the area is considered very unlikely for a very long time since the necessary population pressure from the northern Baltic population is lacking. The grey seals' strong affinity to their home areas is further preventing them from moving to the southern Baltic coast. Grey seals did occur naturally in the area, and there is a popular interest to see grey seals return to the area again. Food resources are considered to be sufficient, and the creation of natural protected zones along the German coast is thought to be sufficient for a small population of grey seals (100–200 animals) (WP 11).

It was assumed that herring will be the main prey species over large periods of the year. The herring is currently abundant, while economically it is not worthwhile to fish the complete quota. In Finland, herring is an important prey species in juvenile seals. Besides herring, cod, flatfish and sandeel may contribute to the diet to a considerable extent. The overall impact of a small grey seal population (see above) on the stocks of fish species of economic value is expected to be insignificant.

The WGs expressed concerns about interactions with fishermen. Possible interactions involve incidental catch, gear damage and damage to catch, as recorded from other jurisdictions. Schwartz reported that in Germany the approach to mitigate conflicts like these employs a combination of special agreements with local fishermen and governmental compensation money for verifiable negative impacts.

Increases in codworm (*Pseudoterranova decipiens*) are thought to be negligible because levels of this parasite are low in other regions of the Baltic, possibly owing to the absence of intermediate hosts. Schwarz pointed out that juvenile grey seals will be held in enclosures for several months before their release, thus performing a sort of quarantine, which reduces the chances of introducing diseases.

It was suggested that researchers dealing with introductions or translocations of Hawaiian Monk seals and sea otters be contacted in order to appreciate some of the difficulties associated with this exercise.

The WGs noted that a similar proposal was developed in Poland and this proposal was presented to the WGSEAL in 1997.

11.2 HELCOM Plans to Initiate a Protection Plan for Harbour Porpoises in the Baltic

The meeting of WGMMHA and WGMMPD received a letter from the HELCOM Secretariat announcing that HELCOM is considering to initiate a project on protection of the harbour porpoises in the Baltic. It was indicated that reduction of by-catch mortality of porpoises in gillnet fisheries and establishment of protected areas may be important aspects of this activity. The joint meeting of the WGMMHA and WGMMPD welcomed these plans and looks forward to receiving information on the progress.

12 RECOMMENDATIONS

12.1 WGMMHA

The **Working Group on Marine Mammal Habitats** [WGMMHA] (Chair: Dr A. Bjørge, Norway) will meet at ICES Headquarters in Copenhagen in March 2001 to:

a) provide a synthesis of the North Sea populations of marine mammals, including consideration of species that have declined or are threatened from human activities;
b) provide a synthesis of the health status of marine mammals in the North Sea in relation to the quality of their habitat;
c) in liaison with WGECO and SGEAM, provide recommendations for appropriate Ecological Quality Objective (EcoQO) indices for marine mammals based on a) and b), and develop a proposal for appropriate EcoQOs for North Sea marine mammal populations;
d) prepare provisional estimates for the current levels, reference levels, and target levels for the EcoQO indices identified in c);
e) review progress in studies of marine mammal habitat requirements, particularly in relation to exposure to contaminants;
f) explore possibilities for furthering the research programme on cause-effect relationships between contaminants and population level effects in seals;
g) adopt a population simulation model whereby the population level effects of environmental impact may be assessed.

Justifications: items a), b), c) and d) are justified by the request from OSPAR on advice for Ecological Quality Objectives (EcoQOs) for marine mammals in the North Sea; items e), f) and g) are justified by the ICES Five-Year Science Plan.

12.2 WGMMPD

The **Working Group on Marine Mammal Population Dynamics and Trophic Interactions** [WGMMPD] (Chair: Dr G. Waring, USA) will work by correspondence until summer 2001 to:

a) develop a comprehensive database on North Atlantic marine mammal diet composition that can be used by the ICES community to evaluate two-way trophic interactions between marine mammals and fisheries;
b) prepare for a meeting in late autumn 2001 to: review current information on techniques and methodology on seal abundance, particularly grey seals and harbour seals, including stock structure, census (methodologies, techniques and biases), population growth rates and trends, aging techniques, mortality, consumption models, and habitat requirements (with WGMMHA).

Justifications: items a) and b) are justified by the ICES Five-Year Science Plan.

13 REFERENCES

Anonymous. 1999. Protocol for the scientific evaluation of proposals to cull marine mammals. Report of the Scientific Advisory Committee of the Marine Mammals Action Plan, October 1999. UNEP.

Bergman, A. 1999. Health condition of the Baltic grey seal (*Halichoerus grypus*) during two decades. APMIS, 107: 270–282.

Bergman, A., and Olsson, M. 1986. Pathology of Baltic grey and ringed seal females with special reference to adrenocortical hyperplasia: Is environmental pollution the cause of a widely distributed disease syndrome? Finnish Game Research, 44: 47–62.

De Swart, R., Ross, P., Vedder, L., Timmerman, H., Heisterkamp, S., van Loveren, H., Vos, J., Reijnders, P., and Osterhaus, A. 1994. Impairment of immune function in harbor seals (*Phoca vitulina*) feeding on fish from polluted waters. Ambio, 23(2): 155–159.

Goodman, S.J. 1998. Patterns of extensive genetic differentiation and variation among European harbour seals (*Phoca* *vitulina vitulina*) revealed using mitochondrial DNA polymorphisms. Mol. Biol.Evol., 15: 104–118.

Härkönen, T., Hårding, K.C., and Lunneryd, S.G. 1999. Age- and sex-specific behaviour in harbour seals *Phoca vitulina* leads to biased estimates of vital population parameters. J. Applied Ecol., 36: 825–841.

Härkönen, T., and Heide-Jørgensen, M-P. 1991. The harbour seal *Phoca vitulina* as a predator in Skagerrak. Ophelia, 34(3): 199–207.

Härkönen, T., Stenman, O., Jussi, M., Jussi, I., Sagitov, R., and Verevkin, M. 1998. Population size and distribution of the Baltic ringed seal (*Phoca hispida botnica*). *In* Ringed Seals. Ed. by Lydersend and M.P. Heide-Jorgensen. NAMMCO Scientific Publications, 1: 167–180.

Harwood, J. 1978. The effect of management policies on the stability and resilience of British grey seal populations. J. Appl. Ecol., 15: 413–421.

Helle, E. 1980a. Lowered reproductive capacity in female ringed seals (*Phoca hispida*) in the Bothnian Bay, northern Baltic Sea, with special reference to uterine occlusions. Ann. Zool. Fennici, 17: 147–158.

Helle, E. 1980b. Aerial census of ringed seals (*Phoca hispida*) basking on the ice of the Bay of Bothnia, Baltic. Holarctic Ecology, 3: 183–189.

Helle, E. 1990. Norppakannen kehitus Peramerella 1980 – luvulla. Suomen Riista, 36: 31–36. (In Finnish.)

Kinze, C.C. 1990. The Harbour Porpoise (*Phocoena phocoena* L.): Stock identification and migration patterns in Danish and adjacent waters. Ph.D. Thesis, University of Copenhagen.

Lockyer, C., and Kinze, C. 1999. Status and life history of harbour porpoise, *Phocoena phocoena*, in Danish waters. Working paper submitted to ICES Working Group on Marine Mammal Habitats, March 1999, Copenhagen, ICES/WGMMHA/99/WP19. 39 pp.

Lohman, S., Folkow, L.P., Blix, A.S., Olsson, M. and Seljelid, R. 1998. Physiological and immunological effects of PCB-exposure in harp seal (*Phoca groenlandica*). Abstract, WMMSC, Monaco, January 1998.

Mortensen, P., Bergman, A., Bignert, A., Hansen, H.-J., Härkönen, T., and Olsson, M. 1992. Prevalence of skull lesions in harbor seals (*Phoca vitulina*) in Swedish and Danish museum collections: 1835–1988. Ambio, 21: 520–524.

Nyman, M., Raunio, H., Pelkonen, O., and Helle, E. 1998. Elevated levels of cytochrome P4501A (CYP1A) in ringed seals from the Baltic Sea. Aquatic Toxicology, 43: 41–50.

Reijnders, P. 1986. Reproductive failure in common seals feeding on fish from polluted coastal waters. Nature, 324: 456–457.

Seinä, A., and Palosuo, E. 1996. The classification of the maximum annual extent of ice cover in the Baltic Sea 1720–1995. Meri, 27.

Siebert, U. 1995. Analyse des Quecksilbergehaltes in Organen von Kleinwalen aus deutschen Gewässern der North- und Ostsee und seine möglichen Beziehungen zu Erkrankungs- und Todessursachen. Ph.D. Thesis, University of Giesen, Germany.

Söderberg, S. 1972. Sälens födoval och skadegörelse på laxfisket i Östersjön. Svenska Ostkustfiskarenas Centralförbund. Stockholm, Sweden. (In Swedish.)

Sørensen, T.B., and Kinze, C.C. 1990. Reproduction and growth in Danish harbour porpoises (*Phocoena phocoena* (L.)). Document IWC/SC/42/SM 32, presented to the Scientific Committee of the International Whaling Commission, Noordwijkererhout, Netherlands, June 1990.

Sørensen, T.B., and Kinze, C.C. 1994. Reproduction and reproductive seasonality in Danish harbour porpoises, *Phocoena phocoena*. Ophelia, 39(3): 159–176.

Stanley, H.F., Casey, S., Carhahan, J.M., Goodman, S., Harwood, J., and Wayne, R.K. 1996. Worldwide patterns of mitochondrial DNA differentiation in the harbour seal (*Phoca vitulina*). Mol. Biol. Evol., 13: 368–382.

Vinther, M. 1999. By-catch of harbour porpoise (*Phocoena phocoena* L.) in the Danish set-net fisheries. J. Cetacean Res. Managt, 1(2): 123–135.

Walker, J.L., and Macko, S.A. 1999. Dietary studies of marine mammals using stable carbon and nitrogen isotopic ratios of teeth. Marine Mammal Science, 15: 314–334.

Westerling, B., and Stenman, O. 1999. Pathology of seals from the Finnish coastal waters in the years 1982–1995. Int. Conf. on Baltic Seals. 18–21 Nov. 1999. Parnu, Estonia. 2 pp.

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ANNEX 2: AGENDA

Joint Meeting of the WGMMHA and the WGMMPD

28 February to 3 March 2000, Helsinki, Finland

1. Introduction and meeting arrangements
2. Appointment of rapporteurs
3. Terms of Reference
4. Evaluation of the populations of grey seals (*Halichoerus grypus*), harbour seals (*Phoca vitulina*), ringed seals (*Phoca hispida botnica*) and harbour porpoises (*Phocoena phocoena*) in the Baltic Sea
    - 4.1 Grey seals *Halichoerus grypus*
        - 4.1.1 Population discreteness, distribution and migration
        - 4.1.2 Effects of contaminants
        - 4.1.3 Health status
        - 4.1.4 Reproductive capacity
        - 4.1.5 Current abundance and survey methodology
        - 4.1.6 Current information on by-catches and other human-induced mortality
        - 4.1.7 Current population status
        - 4.1.8 Current information on trophic interactions
    - 4.2 Harbour seals *Phoca vitulina*
        - 4.2.1 Population discreteness, distribution and migration
        - 4.2.2 Effects of contaminants
        - 4.2.3 Health status
        - 4.2.4 Reproductive capacity
        - 4.2.5 Current abundance and survey methodology
        - 4.2.6 Current information on by-catches and other human-induced mortality
        - 4.2.7 Current population status
        - 4.2.8 Current information on trophic interactions
    - 4.3 Ringed seals *Phoca hispida botnica*
        - 4.3.1 Population discreteness, distribution and migration
        - 4.3.2 Effects of contaminants
        - 4.3.3 Health status
        - 4.3.4 Reproductive capacity
        - 4.3.5 Current abundance and survey methodology
        - 4.3.6 Current information on by-catches and other human-induced mortality
        - 4.3.7 Current population status
        - 4.3.8 Current information on trophic interactions
    - 4.4 Harbour porpoises *Phocoena phocoena*
        - 4.4.1 Population discreteness, distribution and migration
        - 4.4.2 Effects of contaminants
        - 4.4.3 Health status
        - 4.4.4 Reproductive capacity
        - 4.4.5 Current abundance and survey methodology
        - 4.4.6 Current information on by-catches and other human-induced mortality
        - 4.4.7 Current population status
        - 4.4.8 Current information on trophic interactions
5. Status of the freshwater seals of the Baltic region
    - 5.1 Saimaa seal *Phoca hispida saimensis*
    - 5.2 Ladoga seal *Phoca hispida ladogensis*
6. Review progress in studies of marine mammal habitat requirements (WGMMHA)
7. Status of the research programme on cause-effect relationship between environmental contaminants and population-level effects in seals (WGMMHA)

AGENDA (continued)

8. Life history studies (WGMMHA)
    - 8.1 Review progress in development of new techniques and methodology
    - 8.2 Discussion of potential collaborative projects and possibilities for funding
9. Review progress and new techniques in grey seal and harbour seal population studies (WGMMPD)
10. Review progress and new techniques in marine mammal dietary studies (WGMMPD)
11. Future activities of the Working Group on Marine Mammal Habitats and the Working Group on Marine Mammal Population Dynamics and Trophic Interactions
12. Recommendations
13. Other business
14. Adoption of report

ANNEX 3: POPULATION AND BY-CATCH DATA FOR THE BALTIC SEA AREA

Explanatory Footnotes

1 1989–1994 data were extracted from Appendix Table 3 of the Report of the Study Group on Seals and Small Cetaceans in European Seas, ICES CM 1996/N:1. The 1996–1998 data are minimum estimates based on information presented at the joint WG sessions.

2 1994–1999 by-catches are approximations based on limited interviews of fishermen (see WP18).

3 1992–1994 population data and 1989–1994 by-catch data were extracted from Appendix Table 3 of the Report of the Study Group on Seals and Small Cetaceans in European Seas, ICES CM 1996/N:1. The1990 population estimate and 1998 data were provided at the joint WG sessions.

4 The 1979–1990 data were extracted from Appendix Table 1 of the Report of the Study Group on Seals and Small Cetaceans in European Seas, ICES CM 1996/N:1. The 1991–1998 data were provided at the joint WG sessions.

5 The 1979–1996 population data were extracted from Table 3 of Harkonen *et al*. (1998), Population size and distribution of the Baltic ringed seal (***Phoca hispida botnica).*** NAMMCO Sci. Pub., Vol. I, pp. 167–180.

6 By-catch data were extracted from Appendix Table 2 of the Report of the Study Group on Seals and Small Cetaceans in European Seas, ICES CM 1996/N:1. The 1991–1998 data were provided at the joint WG sessions.

7 See information presented in Table 4.3.6.1.

A. Single count of grey seals. 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 for the entire Baltic based on a population model (WP7).

C. These represent the total number of grey seals counted on the Swedish Baltic coastline in 1997–1998.

D. (a) Estimate is based on summer counts in Russian waters of the Gulf of Finland. (b) Number represents the maximum count of seals hauled out during the molt in Estonian coastal waters.

E. Estimates of abundance based on aerial survey of ringed seals hauled out on ice during molt.

F. Survey methods not clearly delineated, see Härkönen *et al*. (1998), footnote 5 above.

G. Estimates are based on a re-analysis of the data, see Härkönen *et al*. (1998), footnote 5 above.

Table A3.1. Summary of available information on grey seal population size and by-catch in the Baltic.

Year[1]	Estimate	Method	Comments	Reported Catch	By-Catch[2]
1989					73
1990					70
1991					123
1992	876	A			
1993					
1994					300
1995					300
1996	5500	B			400
1997	3200–3300	C	Swedish Baltic coastline only		400
1998					400
1999	400–500 (a) 1417 (b)	D			400

Table A3.2. Summary of available information on harbour seal population size and by-catch in the Baltic.

BALTIC

Year[3]	Estimate	Method	Comments	Reported Catch	By-Catch
1989					8
1990	224				5
1991					10
1992	367	A+B	120 in Denmark		
1993	269	A+B	Does not include Denmark		
1994	379	A+B	209 in Denmark		7–8
1995					
1996					
1997					
1998	578	A+B	270 in Denmark (Kalmarsund)		'few'

KATTEGAT/SKAGERRAK

Year[4]	Estimate	Method	95 % Confidence Limits	Reported Catch	By-Catch
1979	2350	A			
1980	2825	A			
1981	3100	A			
1983	3800	A			
1984	3975	A			
1985	5275	A			
1986	5700	A			
1988	2901	A	2497–3305		
1989	3146	A	2823–3469		
1990	2820	A	2247–3393		
1991	4058	A	3233–4884		
1994	5557	A	4656–6459		
1996	6283	A	5930–6636		
1998	8893	A	6579–11 207		'few'

Table A3.3. Summary of available information on ringed seal population size and by-catch in the Baltic.

BALTIC – BOTHNIAN BAY

Year[5]	Estimate	Method	95% Confidence Limits	Reported Catch	By-Catch[6]
1975	3000	E			
1978	3280	E			
1984	2000	E			
1988	2033	E			
1989	2191	E			
1991	2778	E			24
1993	2862	E			24
1995	2246	E	1566–2926		
1996	3954	E	2176–5732		15–60[7]
1997					15–60
1998					15–60

BALTIC – GULF OF FINLAND

Year[5]	Estimate	Method	95% Confidence Limits	Reported Catch	By-Catch[7]
1970	5000	E+F			
1973	8200	E+F			
1979	1600	E+F			
1979	793	E+G			
1982	3700–4000	E+F			
1985	2000+	E+F			
1992	89	E			
1993	150	E			
1994	173	E			15–20
1995	169	E			15–20
1996	149	E			15–20
1997	282	E			15–20
1998	75	E			15–20
1999	141	E			15–20

BALTIC – GULF OF RIGA AND ESTONIAN WEST COAST

Year[5]	Estimate	Method	95 % Confidence Limits	Reported Catch	By-Catch[6]
1970	4500	E+F			
1977	1000–1500	E+F			
1979	450–500	E+F			
1979	215	G			
1994	680	E	340–1120		56
1996	1407	E	817–1997		15–30
1997					70–100
1998					70–100

ANNEX 4: WORKING PAPERS

WP1 Bjørge, A. Status of furthering the project on contaminants in pinnipeds proposed by the WGMMHA 1999.

WP2 Sjöberg, M. Behaviour and movements of the Baltic grey seal. Implications for conservation and management.

WP3 Sipilä, T., Medvedev, N., Kunnasranta, M., Bogdanov, V., and Hyvärinen, H. Present status and recommended conservation actions for the Ladoga seal (*Phoca hispida ladogensis*) population.

WP4 Lockyer, C. An overview of reproduction in harbour porpoises.

WP5 Härkönen, T., Hårding, K., and Heide-Jørgensen, M.-P. Impact of initial conditions on estimates of growth rates: recovery of European harbour seals after the 1988 epizootic.

WP6 Härkönen, T., and Harding, K. Consequences of spatial structure of harbour seals on population dynamics, ecology, epidemiology and genetics.

WP7 Härkönen, T., and Hårding, K. History of colonisation and recent trends in seal populations in the Baltic.

WP8 Härkönen, T., Olsson, M., and Hårding, K. Population effects of decreased fertility rates in Baltic ringed seals after 1960.

WP9 Härkönen, T., Jüssi, M., Hårding, K., and Jüssi, I. Distribution and diving behaviour of satellite tagged ringed seals (*Phoca hispida botnica*) in Estonian coastal waters of the Baltic Sea.

WP10 Huggenberger, S., Benke, H., and Kinze, C.C. Geographical variations of the harbour porpoise (*Phocoena phocoena* L.) populations in the North and Baltic Seas using morphometric comparisons

WP11 Schwarz, J. Status of the grey seal (*Halichoerus grypus*) in the German Baltic—considerations on the chances of a successful re-introduction.

WP12 Kuklik, I., and Skora, K.E. Recent data on distribution and by-catch of seals in Polish Baltic waters.

WP13 Kuklik, I., and Skora, K.E. Recent data on distribution, by-catch and food of harbour porpoises in Polish Baltic waters.

WP14 Szefer, P., Zdrojewska, J., Lockyer, C., Ciesielski, K., Skora, K.E., and Kuklik, I. Mercury and selenium in liver, kidney and muscle of harbour porpoise *Phocoena phocoena* from the Southern Baltic Sea, and coastal waters of Denmark and Greenland.

WP15 Szefer, P., Zdrojewska, I., Jensen, J., Lockyer, C., Skora, K.E., Kuklik, I., and Malinga, M. Intercomparison studies on distribution and co-associations of heavy metals in liver, kidney and muscle of harbour porpoise *Phocoena phocoena* from the Southern Baltic Sea and coastal waters of Denmark and Greenland.

WP16 Lockyer, C. A review of methods for defining population structure in the harbour porpoise, *Phocoena phocoena*, with special reference to the North and Baltic Seas.

WP17 Mohn, R. Likelihood analysis of grey seal-cod predation of the eastern Scotian Shelf.

WP18 Anon. Agenda, abstracts and list of participants. International Conference on Baltic Seals. Pärnu, Estonia, 18–21 November 1999.

WP19 Jüssi, M. Breeding habitat preference and reproduction success of Baltic grey seal (*Halichoerus grypus*).

WP20 Hiby, L., Watkins, J., Helander, B., and Lundberg, T. Abundance, distribution and movement estimates for grey seals in the Swedish coastal waters, based on photo-identification data.

ANNEX 5: INFORMATION PAPERS

1 Härkönen, T., Hårding, K.C., and Lunneryd, S.G. 1999. Age and sex-specific bahaviour in harbour seals *Phoca vitulina* leads to biased estimates of vital population parameters. J. Appl. Ecol., 36: 825–841.

2 Sipilä, T. 1990. Lair structure and breeding habitat of the Saimaa ringed seal (*Phoca hispida saimensis* Nordq.) in Finland. Finnish Game Res., 47: 11–20.

3 Lockyer, C. 1999. Application of a new method to investigate population structure in the harbour porpoise, *Phocoena phocoena*, with special reference to the North and Baltic Seas. J. Cetacean Res. Manage. 1(3): 297–304.

4 Sipilä, T., and Hyvärinen, H. 1998. Status and biology of Saimaa (*Phoca hispida saimensis*) and Ladoga (*Phoca hispida ladogensis*) ringed seals. NAMMCO Scientific Publications, 1: 83–98.

5 Hyvärinen, H., Sipilä, T., Kunnasranta, M., and Koskeal, J.T. 1998. Mercury pollution and the Saimaa ringed seal (*Phoca hispida saimensis*). Marine Pollution Bulletin, 36(1): 76–81.

6 Kokko, H., Lindström, J., Ranta, E., Sipilä, T., and Koskela, J. 1998. Estimating the demographic effective population size of the Saimaa ringed seal (*Phoca hispida saimensis* Nordq.). Animal Conservation, (1998) 1: 47–54.

7 Sipilä, T., Medvedev, N.V., and Hyvärinen, H. 1996. The Ladoga seal (*Phoca hispida ladogensis* Nordq.). Hydrobiologia, 322: 1193–1198.

8 Hårding, K.C., and Härkönen, T.J. 1999. Development in the Baltic grey seal (*Halichoerus grypus*) and ringed seal (*Phoca hispida*) populations during the 20th century. Ambio, 28(7): 619–627.

9 Koistinen, J., Stenman, O., Haahu, H., Suonperä, M., and Paasivirta, J. 1997. Polychlorinated diphenyl ethers, dibenzo-*p*-dioxins, dibenzofurans and biphenyls in seals and sediment from the Gulf of Finland. Chemosphere, 35(6): 1249–1269.

#10 Waring, G.T., Palka, D.L., Clapham, P.J., Swartz, S., Rossman, M.C., Cole, T.V.N., Hansen, L.J., Bisack, K.D., Mullin, K.D., Wells, R.S., Odell, D.K., and Barros, N.B. 1999. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments—1999. NOAA Technical Memorandum NMFS-NE-153. 196 pp. Available from NMFS, NEFSC, 166 Water St., Woods Hole, MA 02543, USA.