COOPERATIVE RESEARCH REPORT

No. 148

PART 1

REPORT OF THE ICES WORKING GROUP ON SEALS IN THE BALTIC

ICES Headquarters; 20-21 April 1983.
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PART 2

REPORT OF THE ICES WORKING GROUP ON HARP AND HOODED SEALS IN THE GREENLAND SEA

ICES Headquarters, 9-13 September 1985

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PREFACE

This number presents the reports of two ICES Working Groups set up by the Council to appraise the state of seal stocks in the Baltic and Greenland Sea areas, respectively.

The Working Group on Baltic Seals was established at the 70th Statutory Meeting in 1982 in response to a request by the Helsinki Commission for information and advice on the state of these stocks in relation to possible effects of pollution. The report is presented in Part 1.

The Working Group on Harp and Hooded Seals in the Greenland Sea was established at the 72nd Statutory Meeting in 1984 to handle a request for advice by the Norwegian Government. Its report is presented in Part 2.

PART 1

REPORT ON THE ICES WORKING GROUP ON SEALS IN THE BALTIC

CONTENTS

1 INTRODUCTION AND TERMS OF REFERENCE

In response to a request from the Helsinki Commission and the International Baltic Sea Fishery Commission, the ICES Council recommended at its 70th Statutory Meeting in 1981 that a Working Group on Baltic Seals be established to:

i) Consider what changes are likely in the size of the seal populations in the Baltic over the next years.

ii) Evaluate evidence on the connection between high levels of PCBs, DDT and other pollutants in seals and their reproductive success.

iii) Consider the possible effects of changes in pollutants in the Baltic on the conclusion under (i).

iv) Advise on what steps should be taken to preserve the existence of all Baltic seal populations and to improve their habitat.

The Working Group met at ICES Headquarters in Copenhagen from 20-21 April 1983 and at the British Antarctic Survey building in Cambridge, UK from 1-3 October 1985, with Dr J. Harwood as Chairman. The Chairman and Dr Boyd acted as rapporteurs. The agendas are given in Appendix A and the participants at each meeting in Appendix B. A list of the working papers submitted to the meetings is given in Appendix C, copies of which may be obtained from their authors.

This report is based primarily on the deliberations of the Working Group at its second meeting, augmented with pertinent information from the first meeting.

2 SPECIES AND AREAS COVERED

Three species of seal now occur in the Baltic: the ringed seal (Phoca hispida), the grey seal (Halichoerus grypus) and the harbour seal (Phoca vitulina). Although there are historical records of the harp seal (Phoca groenlandica) being seen in the Baltic, there have been no regular sightings for hundreds of years.

The Working Group decided to consider the seal populations occurring in the Baltic Sea and the Kattegat-Skagerrak area separately. It did not consider the ringed seal populations of Lake Saimaa and Lake Ladoga. Although the river systems of these lakes do lead into the Baltic, the Group believed that there was no significant interchange of individuals between them and the Gulf of Finland. The locations of all the sites referred to in the Report are shown in Figure 1 (p. 14).

3 THE STATUS OF BALTIC SEAL STOCKS

3.1 Levels of Hunting

3.1.1 Historical catches

All three species of seal were hunted in the Baltic during the nineteenth century but catches declined at the end of the century, probably because of overhunting. However, bounty schemes were introduced in Denmark in 1889, in Sweden in the 1890s, and in Finland in 1909. The scheme was intended to increase fisheries yields by reducing the seal populations and was, in fact, recommended by ICES in 1909. Bounty payments were abolished in 1927 by Denmark, in 1974 by Sweden, and in 1976 by Finland.

Although the species and approximate age of each seal killed was recorded, these identifications are not entirely reliable. However, between 1963 and 1974 a jaw from each seal taken in Sweden was supplied to the Swedish Museum of Natural History and it has been possible to correct some of the hunters' identifications.

In Finland, about 70% of the catch was ringed seals (Helle, 1979). The same was true in the Swedish Baltic until 1935, but from that time onwards approximately equal numbers of grey and ringed seals were killed (Almkvist et al., 1980). In the southwestern part of the Baltic (including Øresund, the Belts, the southeastern archipelago of Denmark, and Bornholm), grey seals made up 86% of the total catch of seals in 1980; however, in 1919-1927 less than 50% of the catch was grey seals. In the Kattegat proper it appears that grey seals were reduced to very low numbers at the end of the 18th century and more than 90% of the kill was harbour seals. Only 45 ringed seals were killed in Danish waters between 1890 and 1927.

The average age of the animals killed has varied. Until the Second World War many ringed seals were taken at their breeding lairs in the Gulf of Finland using specially trained dogs. However, this stopped after the war and most seals were killed when they were basking on the ice. Some seals were also taken in a net fishery in the Bothnian Bay. Pups, or young of the year, made up about 20% of the Finnish catch of ringed seals between 1956 and 1975 (Helle, 1979).

Although some grey seals were shot at haul outs along the coast, most of the hunting was on the breeding grounds and a very high proportion of the catch was of mothers and their pups. Between 1932 and 1939 two-thirds of all the grey seals taken by Sweden and Finland were less than one year old (Almkvist et al., 1980). Approximately 45% of the Finnish catch between 1956 and 1975 was of juvenile animals (Helle, 1979),

Catches of both ringed seals and grey seals were high between 1910 and 1920, averaging about 19,000 per year in total. They were lower between 1920 and 1940, but still exceeded 15,000 in some years. Catches declined markedly after the Second World War, apart from a brief increase around 1964 when the value of the bounty in Finland was doubled (Helle, 1979). This decline was not due to a decrease in the number of hunters applying for bounties. Between 1956 and 1975, approximately 900 ringed seals and 400

grey seals were taken each year in Finland; approximately 300 of each species were taken in Sweden.

In the western part of the Baltic around 15,000 grey and harbour seals were killed between 1889 and 1927. In the Kattegat proper, 17,000 seals - mostly harbour seals - were killed in the same period. Catches in the Kattegat proper and the western Baltic fell from a yearly average of 1,175 between 1890 and 1912 to 188 in the period 1919-1926. According to the Danish bag records, 500 seals on average were killed each year in Danish waters between 1941 and 1961. This fell to 200 between 1971 and 1976. During these periods, around 40% of the seals were killed in the Kattegat and 10% in the western part of the Baltic.

3.1.2 Current catches

The Working Group was informed by Helle that approximately 100-150 ringed seals are now shot in the Finnish Gulf of Bothnia each year and that this number is declining. A few dozen ringed seals are still taken in the Gulf of Finland. Grey seals are completely protected in Finland and the USSR.

All seals are now protected from hunting in Sweden but fishermen are allowed to shoot seals in the immediate vicinity of their nets if the seals appear likely to cause damage. There are no estimates of the numbers of seals killed in this way. In Denmark, all seals are also protected. However, fishermen can apply for licences to protect their nets, and approximately 30 harbour seals are shot under these licences every year.

3.2 Historical Population Size

3.2.1 Population size in 1900

Almkvist (1982) estimated that there must have been several hundred thousand ringed seals in the Baltic in 1900 because over 100,000 animals were killed between 1910 and 1920, and over 20,000 were killed in some years.

Approximately 30% of the seals taken in Finland and Sweden before 1935 were grey seals. It is probable that the proportion of females and pups in this catch was even higher than for ringed seals. Thus, there may have been about 100,000 grey seals in the Baltic in 1900. The situation in the Kattegat is even less clear. Grey seals were traditionally hunted on Anholt until the end of the nineteenth century, but the hunt was carefully regulated by the local inhabitants. However, when the bounty scheme was introduced, up to 1,500 seals were killed each year in Danish waters (including the Danish Wadden Sea). It is not known how many of these were grey seals, nor is it possible to estimate the size of the population in 1900.

At the beginning of this century, up to 360 harbour seals were taken each year on the west and southeast coasts of Sweden. An unknown number of seals were also taken along the German Baltic coast and in Poland. As noted above, up to 1,500 seals were taken each year in Danish waters; this figure includes harbour seals

taken in the Baltic, the Kattegat-Skagerrak area, and the Danish Wadden Sea. Unfortunately, the location of these catches is not known, and it is impossible to make separate estimates of the sizes of the Baltic and Kattegat populations in 1900. However, the ages of a sample of harbour seals taken in Danish waters in 1889-1890 were determined. Eighty-five percent of these animals were pups; Heide-Jørgensen (1980) has used this to estimate that approximately 3,000 pups were born each year at this time; this is equivalent to a total population of 10,000-15,000.

3.2.2 Changes in distribution

At the beginning of this century, ringed seals were hunted along the east coast of Sweden as far south as Stockholm, but these catches declined from 1910 to 1950 and ringed seals are no longer seen in this area. Similarly, ringed seals are seen much less frequently than in the past in the southwest archipelago of Finland.

Grey seals have disappeared from a number of traditional sites in Sweden, most noticeably from Harstena, where tens of thousands of grey seals used to haul out (Almkvist, 1982).

At one time, harbour seals were found throughout much of the southern Baltic, in the Skagerrak and the Kattegat. This is no longer the case. Harbour seals are now rare in Gotland, where they used to be seen frequently, and are not seen at all in Poland or along the Baltic coast of Germany.

3.3 Current status

3.3.1 Ringed seals

The only time when ringed seals can be readily counted is during late April or early May, when animals can be seen basking on what remains of the winter ice. Helle (1980) carried out low-level aerial surveys in the Bothnian Bay in 1975 and 1978, and used line-transect techniques to estimate seal density along the survey line. He calculated that there were 3,000 ringed seals hauled out in the Bothnian Bay each year. Soviet scientists carried out an aerial survey of suitable ringed seal habitats in the Soviet waters of the Gulfs of Riga and Finland in the spring of 1982. From this survey, Tomorosov and Esipenko (1986) estimated a population of 3,700-4,000 ringed seals in the Gulf of Finland. Stenman reported that, in recent years, no more than 100 ringed seals had been counted in April on the Finnish side of the Gulf of Finland. A minimum estimate of the current size of the Baltic ringed seal population is 6,000-7,000 animals; however, allowing for the fact that only a proportion of the population will be basking on the ice at any one time (Smith, 1973; Finley, 1979), the true figure is more likely to be between 7,000 and 12,000.

An aerial survey of ringed seals in the Bothnian Bay had been conducted by Finland in the spring of 1984. Approximately 2,000 seals were estimated to be on the ice (Helle, 1986); this was substantially less than the estimate of 3,000 from a survey conducted in 1975 and discussed at the first meeting of the Working Group. However, the Working Group noted that, without a value for the standard deviation of these estimates and without estimates of day-to-day and year-to-year variations in the proportion of the population resting on the ice at any one time, it was not possible to conclude whether there had been a real decline in the ringed seal population in this area.

3.3.2 Grey seals

Studies of the size of the Swedish grey seal population have been continued by Helander and Sjöåsen using local observers who regularly count the numbers of seals hauled out in their area from the shore or from boats. Although such counts will almost certainly underestimate the number of seals in a particular area, they are more effective than aerial surveys and provide a good index of distribution and abundance. In all areas there are wide fluctuations in the number of seals counted; however, in the area south of Åland the largest number of seals is seen in May-June. North of Åland there is no clear peak but there is some evidence of an increase in numbers in September. This coincides with the opinion of old seal hunters that there is a northward migration of grey seals in the summer. In the period 1975-1979, between 500 and 950 seals were counted each year in the area south of Åland, and 130-270 in the northern area. Since 1980, 500-800 animals have been counted in the south and 130-330 in the north.

These figures provide no evidence of a change in the size of the Swedish grey seal population. However, there does appear to have been a northerly shift in the distribution. Grey seals are no longer seen hauled out at localities in the south which were used regularly in the 1960s, whereas the number hauled out at some northern sites has increased substantially. However, these figures must be interpreted with caution because some new seal sanctuaries have been established recently in northern Sweden; as a result, the seals in these areas are less shy and more easily counted. They may also spend more time hauled out and the apparent increase in the north may be simply due to a change in behaviour. The combined counts suggest that there are about 1,150 animals of adult size in Sweden. This figure would normally be considered as a minimum estimate, but it is possible that some animals have been counted twice - first in the south and later in the north.

In Finland, the number of grey seals seen in summer has increased. However, the Working Group noted that this could be due to a minor change in distribution rather than a real increase in the size of the Baltic seal population. Up to 500 seals have been counted in the Åland area, and over 150 on the Finnish side of the Gulf of Finland. About half of the Åland population is probably also included in the Swedish counts.

The Soviet population of grey seals in the Gulf of Finland and Gulf of Riga is estimated to be 200-300 animals (Tomorosov and Esipenko, 1986). It was noted that some of these animals were probably also included in the Swedish counts.

These surveys together suggest that the total population of grey seals in the Baltic is approximately 2,000.

3.3.3 Harbour seal

Since 1975, there have been increases in the numbers of harbour seals hauled out in the southern part of the Swedish Baltic proper, particularly in the Øland and Øresund areas. In these areas, about 20% of the animals are pups, which suggests that the reproductive rate in this population is now at a normal level for harbour seals. However, the harbour seal is still rare in the Baltic with a total population of around 200 animals. The establishment of seal sanctuaries in Swedish waters during the period covered by these results may have influenced the behaviour of the seals and made them easier to count.

On the Swedish west coast (outside the Baltic) the population in the north has stabilized but it is still increasing in the south. About 2,500 animals are found on the west coast (Härkönen, 1985).

The harbour seal population, as indicated by direct counts, has increased throughout Denmark. Animals are now frequently observed in areas, such as the western Baltic, where they were seen only occasionally in the previous 40 years.

4 RECENT CHANGES IN POPULATION PARAMETERS

4.1 Fecundity

4.1.1 Evidence of recent changes in fecundity

Helle (WP2) presented data from 36 female ringed seals shot in the Bothnian Bay during 1980-1985. 19% of these animals had occlusions. This was substantially less than the percentage of occlusion found in previous samples, but there were differences in the age structures of the two samples. However, when a correction for this was made, the difference in the percentage of animals with occlusions was still statistically significant. However, the Working Group noted that the proportion of animals with occlusions appeared to have declined by a similar amount in all the age classes in the 1980-1984 samples. This was unexpected because the development of occlusions is believed to be irreversible and, therefore, the proportion of animals with occlusions in the older age classes should have remained constant. It was possible that some of the observed difference was due to differential sampling of affected animals in the two periods. Helle also noted that 24% of the 1980-1984 samples were animals less than four years old, whereas only 2% of the animals shot in 1977-1979 were this young. This might indicate an increase in fecundity in the population.

Autopsies carried out on grey and ringed seals found dead along the Swedish coast indicated that very few of these animals had evidence of normal pregnancies (Bergman and Olsson, 1986). Sample sizes were too small to indicate any trends, but observations of relatively young animals that are chronically sick or have recently developed occlusions indicate that problems are still occurring.

4.1.2 Possible effects of environmental contaminants

Baltic grey and ringed seals appear to be suffering from a disease syndrome. Impairment of reproduction is only one symptom of this, but others are: regional loss of hair and hyperkeratosis, ulceration and perforation of the gut wall at sites of hookworm infestation, renal glomerulopathy and adrenocortical hyperplasia (Bergman and Olsson, 1986), severe loss of teeth, malformation of the jaw, and loss or deformation of claws and digits (Olsson, pers. comm.). Female grey seals found in Sweden (Bergman and Olsson, 1986) and Finland (Stenman, WP4) also suffer from uterine leiomyomas (benign tumours of the myometrium). These symptoms are not known to occur in this combination and with such severity in other seal populations. The Working Group stressed the importance of a thorough search for evidence of this syndrome in seals from areas outside the Baltic.

The Swedish findings suggest that there has been disruption of both the endocrine and immune systems of Baltic seals. Such symptoms are not characteristic of the effects of heavy metals, and levels of heavy metals in the Baltic are not particularly high. However, organochlorine compounds in general, and PCBs in particular, are known to have effects of this sort on a number of mammalian species. Recent studies on captive harbour seals (Reijnders, WP3) fed either on "clean" mackerel from the North Atlantic or on "polluted" flatfish from the Wadden Sea (which have higher levels of organochlorines) have shown that significantly fewer pups were born to the group fed on "polluted" fish. The effect was not on ovulation, but appeared to occur at the time of embryonic implantation. Circulating levels of oestradiol in the non-pregnant group were lower than in the pregnant animals. Further tests have to be carried out to see if the levels in the non-pregnant, "clean" group were different from those in the "polluted" group.

Although seals from the Baltic have higher average levels of organochlorines in their blubber than those found anywhere else except the Wadden Sea, individual animals with similar levels had been found in the UK. None of these animals, nor those from the Wadden Sea, have shown the gross pathological anomalies observed in the Baltic animals, although the reproductive rate of the Wadden Sea animals has been reduced. However, levels of organochlorines in fish from the Baltic have been substantially higher than elsewhere. The Working Group noted that the daily or seasonal intake of organochlorines could well be more critical to an animal's health than the residues accumulated in its tissues.

The usefulness of measuring residue levels in depot tissue, particularly blubber, was discussed. Data from harbour porpoises captured incidentally by Danish fisheries (Clausen and Andersen,

1985) indicated that organochlorine levels in the blubber of young animals increase until puberty, they then remain approximately constant in females but continue to increase in males. This is presumably because breeding females pass some of their contaminant burden to their young. Similar changes are seen in Danish harbour seals, although the results are more variable and the sample sizes much smaller. These results imply that non-reproducing female seals, such as those with uterine occlusions, may also accumulate organochlorines and will, therefore, have higher levels than animals which are reproducing normally. Thus, levels in the blubber of adult animals are likely to be highly variable and difficult to interpret. Levels in animals found dead are also highly variable. The most useful group to study may, therefore, be animals up to three years old which drown in nets.

The Working Group also noted that most intercalibration exercises on the measurement of organochlorine levels conducted through ICES had used material from fish. Because of its high fat content, seal blubber poses particular problems for extraction and the analysis of residues. The Working Group recommended a small intercalibration exercise using seal blubber. Standardization of the methods used to sample tissue, extract fat and interpret spectrograph peaks was necessary.

The Working Group concluded that it seemed most likely that organochlorine pollution was in some way responsible for the disease syndrome seen in Baltic seals. PCBs appeared to be the most likely cause, but these might be acting synergistically with DDT and an effect due to toxophenes or dioxins could not be ruled out. However, it was possible that infections and stress due to disturbance (see Section 4.1.3) could also be involved in the disease complex. The postulated action of these effects is shown in Figure 2.

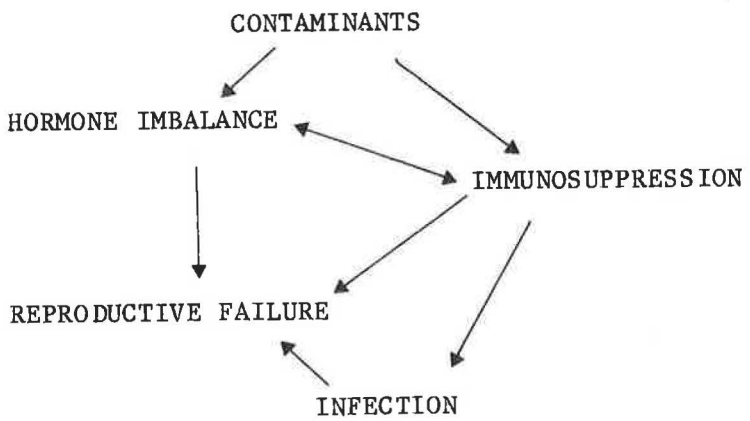

Figure 2. Postulated effects of organochlorine contaminants on reproduction in Baltic seals.

4.1.3 Possible effects of disturbance

The Working Group considered the possibility that noise created by icebreakers might interfere directly with reproduction in ringed and grey seals by disrupting mating behaviour. However, it noted that any such effect must have been relatively minor because the increase in icebreaker traffic throughout the winter in the Bothnian Bay had not occurred until the 1970s, and reproductive failure had already started to occur by this time. In addition, a decline in seal numbers has occurred in areas where there is virtually no icebreaker traffic. However, the effect of recent increases in icebreaker traffic needs to be investigated.

4.2 Survival

The Working Group identified three possible sources of additional juvenile mortality for Baltic seals:

i) Desertion of pups due to disturbance. No estimates of desertion rate, and its relation to disturbance, were available.

ii) Accidental entanglement in fishing gear. The Group noted that 20 out of 100 grey seals tagged as pups in the Baltic had been recovered drowned in fishing nets within six months of tagging (Almkvist et al., 1980). This was a high rate of incidental mortality; by contrast, less than 2% of grey seals tagged in the UK were recovered in fishing gear (McConnell et al., 1984);

iii) Destruction of ringed seal lairs by icebreakers. This was considered by the Group to be a minor effect.

The Working Group also noted that the development of the disease syndrome identified in Baltic seals must have increased the mortality rate for juvenile and adult animals.

5 PREDICTED CHANGES IN THE SIZE OF BALTIC SEAL POPULATIONS

5.1 Trends in Contaminant Levels

Sweden has been monitoring the levels of organochlorine in young herring collected in the same area each year since 1968. Since 1978, there has been a decline in PCB and DDT levels in the Bothnian Bay and the Baltic proper, but levels of PCBs in the Bothnian Sea have not declined (Olsson and Reutergårdh, 1982). A decreasing trend is also seen in DDT and PCB levels in the eggs of guillemots (Uria aalge) from the Baltic proper. Helle presented a review of data from different sources which seemed to show that the levels of PCBs in the blubber of seals from the Bothnian Bay had also varied in the same way. However, the Working Group noted that the observations of chronically sick animals and seals with recently developed occlusions (reported in Section 4.1.1) indicated that current levels of contaminants still appeared to be affecting the seal populations.

5.2 Trends in Seal Numbers

The Working Group was unable to make any firm prediction about future changes in seal numbers. However, it noted that the deliberate killing of grey and ringed seals by fishermen in Sweden and of ringed seals by hunters in Finland was probably a significant mortality factor. A halt to this killing would improve the chances for recovery of the seal populations in these areas. The Group also drew attention to its previous conclusion that any recovery of these populations would be slow because of the high proportion of sterile animals. At present, the distribution of haul out sites and sanctuaries used by grey seals in Sweden appears to be closely linked with the distribution of cod. If, as seems possible, there are changes in the abundance of cod stocks in the future, the distribution of the seals may also change and a rapid relocation of the sanctuaries would be necessary to maintain protection.

6 CURRENT CONSERVATION MEASURES

In Denmark, all species of seal have been protected since 1977. In the USSR, grey seals have been protected since 1975 and ringed seals since 1980. In Sweden, all seals are generally protected but fishermen are permitted to kill seals around their nets. In Finland, grey seals are completely protected but ringed seals can be hunted in the Finnish Sea area (excluding Åland) between 20 March and 10 June. There is no formal protection for seals in international waters, but it is illegal to import skins into the countries of any of the signatories of the Gdansk Convention.

Sweden and Denmark have established a network of seal sanctuaries (see Figure 1). The regulation of the Swedish sanctuaries varies from place to place, but in all of them admittance over a radius of between one km and one nautical mile is forbidden for at least part of the year, although fishermen are allowed to pass through the areas on the way to their fishing grounds. Research is possible with special permission, but fishermen are not allowed to kill seals within the sanctuaries. In some areas over-flying by aircraft is forbidden. In Denmark, there are four sanctuaries in the Kattegat and two in the western part of the Baltic. At present, there are no sanctuaries in Finland, but one has been proposed as part of a 400 km^2 marine park on the north shore of the Gulf of Finland. This is the second most important area for grey seals in Finland. Within the sanctuary, hunting of ringed seals will be prohibited; fishing and other forms of hunting will be restricted.

7 FUTURE RESEARCH REQUIREMENTS

The following research programmes were considered to have high priority:

1) A continuation of regular national surveys, particularly those for grey seals. Further attempts at international coordination would be valuable.

2) Annual aerial surveys for ringed seals in the Bothnian Bay over a five to ten year period to provide an indication of the variability in the number of animals on the ice.

3) More experimental work on the effects of contaminants on physiological processes in seals and related species. A search for evidence of the occurrence of any specific effects identifed by these experiments in wild populations would also be valuable.

4) A general pathological survey to investigate the level of incidence of the symptoms of the disease syndrome observed in Baltic seals in other seal populations, particularly those in areas with relatively low environmental contaminant levels. Such a survey should include an investigation of the potential role of infections in the development of the symptoms.

5) Work to identify the presence of other toxic organic compounds in the Baltic.

6) Investigations of the effects of sampling procedures on estimates of contaminant levels in seals.

7) Studies of the effects of disturbance on maternal and reproductive behaviour of seals.

8 FUTURE ACTIVITIES OF THE GROUP

The Group considered that it would not be useful for it to meet again until the intercalibration exercise recommended below had been conducted and until more data on contaminant levels and the incidence of the disease syndrome outside the Baltic were available.

9 RECOMMENDATIONS

The Working Group recommends:

1) That ICES, through the ACMP, coordinates an intercalibration exercise on the measurement of levels of organochlorines in seal blubber;

2) That national laboratories which have access to live or dead seals should be encouraged to look for the occurrence of the symptoms of the disease syndrome which has been observed in Baltic seals. These symptoms are described in Section 4.1.1 and Bergman and Olsson (1986). Such investigations should, if possible, be carried out in collaboration with a trained pathologist.

3) That ICES pass on to the Helsinki Commission and the International Baltic Sea Fishery Commission the advice that:

i) All deliberate killing of seals in the Baltic should be halted temporarily until the populations have recovered. If killing is continued it should be licensed so that the number of animals killed each year can be regulated and kept at a low level.

ii) Existing and proposed seal sanctuaries in Sweden, Denmark and Finland should be maintained. There should be a facility for establishing new sanctuaries if the distribution of seals changes in response to changes in their food supply.

10 OTHER BUSINESS

Olsson reported that two pups had been born to the small group of grey seals kept in the grounds of a nuclear power station near Uppsala. These pups had now been released in the southern Baltic.

11 LITERATURE CITED

Almkvist, L. 1982. Baltic marine mammals - a status report. ICES, Doc. C.M.1982/N:16.

Almkvist, L., Olsson, M. and Söderberg, S. 1980. Sälar i Sverige. Svenska Naturskyddsföreningen, Stockholm. 80 pp.

Bergman, A. and Olsson, M. 1986. Pathology of Baltic grey seal 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.

Clausen, B. and Andersen, S. 1985. Health status of harbour porpoise (Phocoena phocoena) from Danish waters. ICES, Doc. C.M.1985/N:10.

Finley, K. 1979. Haul-out behaviour and densities of ringed seals (Phoca hispida) in the Barrow Strait, NWT. Can.J.Zool. 57:1985-1997.

Härkönen, T. 1985. Västkustens knubbsälar;redogörelse för budgetåret 1984-1985.

Heide-Jørgensen, M.P. 1980. Sælbestandene i de danske farvande - Status over den danske dyre- og planteverden. Miljøministeriet, 292-306.

Helle, E. 1979. Structure and numbers of seal populations in the northern Baltic Sea: a study of Finnish bounty statistics, 1956-1975. Aquilo., Ser.Zool., 19.

Helle, E. 1980. Aerial census of ringed seals (Pusa hispida) basking on the ice of the Bothnian Bay, Baltic. Holarctic Ecol., 3:183-189.

Helle, E. 1986. The decrease in the ringed seal population of the Gulf of Bothnia in 1975-84. Finnish Game Research, 44:28-32.

McConnell, B.J., Curry, M.G., Vaughan, R.W., and McConnell, L.C. (1984). Distribution of grey seals outside the breeding season. IN: Interactions Between Grey Seals and Fisheries. NERC.

Olsson, M. and Reutergårdh, L. (1982). Seventeen year trend studies of DDT and PCB pollution of the Swedish aquatic environment.Årsrapport 10. Kommitten för Bottniska Viken.

Smith, T.G. 1973. Population dynamics of the ringed seal in the Canadian eastern Arctic. Fish.Res.Bd. Can.Bull., 181: 1-55.

Tomorosov, D.D. and Esipenko, A.G. (In press.) The abundance of ringed and grey seals in the Gulf of Riga and Finland. Finnish Game Research, 44:33-6.

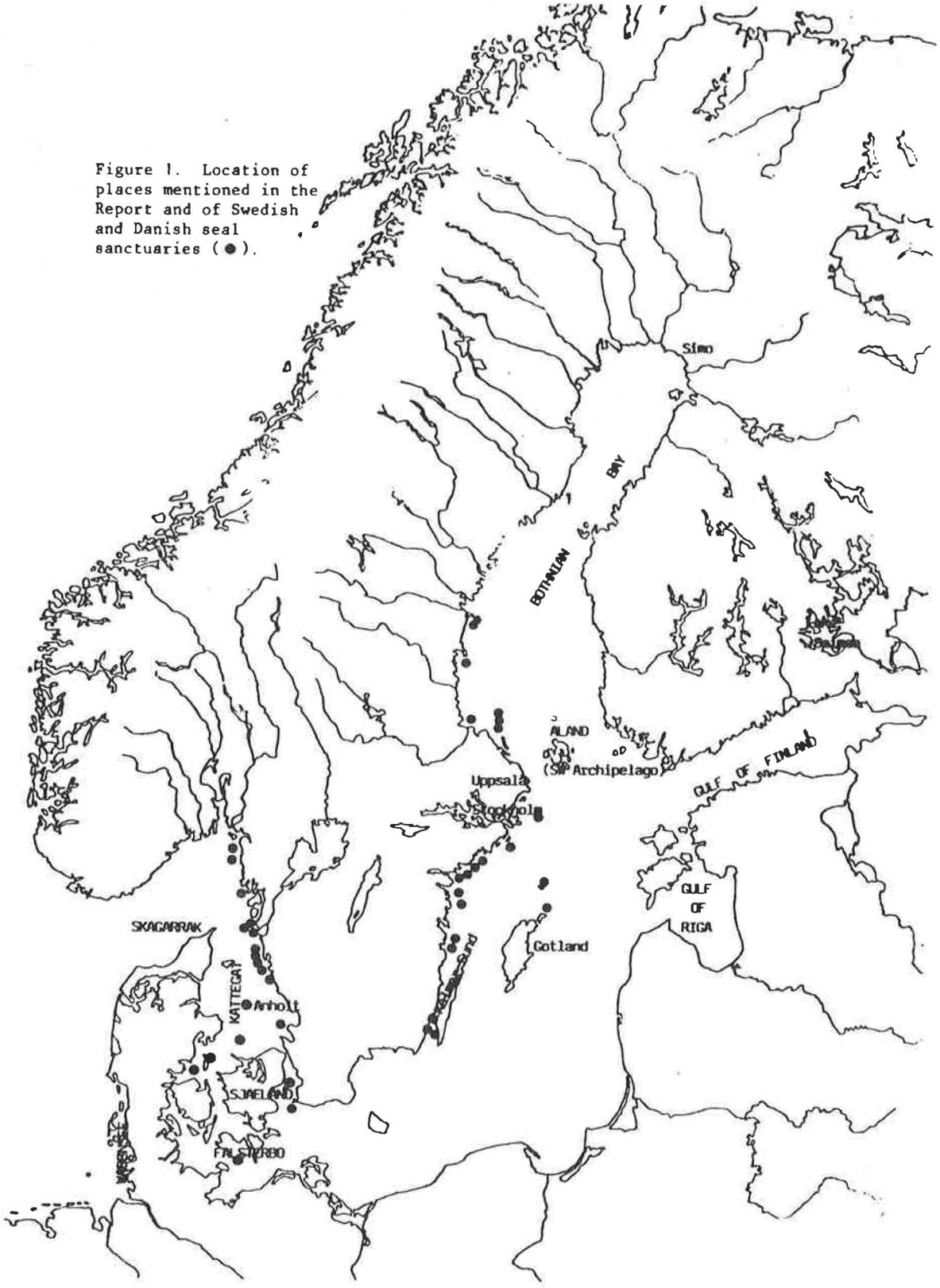

Figure 1. Location of places mentioned in the Report and of Swedish and Danish seal sanctuaries (●).

APPENDIX A.

AGENDAS

1983 MEETING

1. Introductory remarks

2. Past changes in the the size of the Baltic seal population

3. Recent changes in population parameters

   3.1 Reproduction
      3.1.1 Effects of pollution
      3.1.2 Effects of disturbance
   3.2 Survival

4. Predicted changes in the size of Baltic seal populations

   4.1 With no change in the environment
   4.2 If appropriate changes are made

5. Recommendations for the conservation of Baltic seal stocks

1985 MEETING

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7. Recent changes in population parameters

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      7.1.2 Possible effects of environmental contaminants
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9. Future research requirements

10. Publications

11. Future activities of Working Group

12. Recommendations

13. Any other business

14. Adoption of report.

APPENDIX B

LIST OF PARTICIPANTS

1983 Meeting

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APPENDIX C

WORKING PAPERS PRESENTED TO THE MEETINGS

1983 Meeting

WP1	J. Harwood	Future trends in Baltic seal populations.
WP2	M.-P. Heide-Jørgensen	"Monitoring seal stocks in the Kattegat - with an appendix on the seal herds in the Øresund and the western Baltic.
WP3	P.J.H.Reijnders	Man-induced environmental factors in relation to fertility changes in pinnipeds.

1985 Meeting

WP1	I.L.Boyd	An assessment of the physiology of infertility in Baltic seals with reference to environmental pollution.
WP2	E. Helle	Occurrence of uterine occlusions in the ringed seal population in the Gulf of Bothnia, 1975-1985.
WP3	P.J.H.Reijnders	Lowered reproduction in harbour seals in relation to interference of hormonal regulation by pollutants.
WP4	O. Stenman	To inform the ICES Working Group on Baltic seals.

PART 2

REPORT OF THE ICES WORKING GROUP ON HARP AND HOODED SEALS IN THE GREENLAND SEA

CONTENTS

1 TERMS OF REFERENCE

At the 72nd Statutory Meeting of ICES in Copenhagen 1984 it was decided to establish a Working Group on Harp and Hooded Seals in the Greenland Sea with the following terms of reference (C.Res. 1984/2:4:18):

The Working Group will meet to:

"(i) assess the stock size and pup production of harp and hooded seals;

(ii) consider sustainable yields at present stock sizes and in the long term under varying options of age compositions in the catch;

(iii) consider effects of recent changes in the food supply and the possible interaction with other marine living resources in the area;

(iv) review the available data to assess the state of the stocks and give proposals for future research programmes;

(v) give advice on catch options for the sealing season 1986.

The possibility of coordination with NAFO should be investigated as appropriate."

Concerning the last item, the Standing Committe on Fishery Science of NAFO (STACFIS) at a meeting in January 1985 offered the following comments (NAFO SCS Doc. 85/I/2, p.16):

> "STACFIS noted that a permanent ICES Working Group on Harp and Hooded Seals in the Greenland Sea has been established, and agreed that liaison and cooperation with this Working Group would be of benefit to seal stock assessments and the planning of coordinated research within the NAFO Scientific Council. In order to achieve this, STACFIS proposes that a procedure should be established to exchange reports of special NAFO Scientific Council meetings on seals and reports of ICES Working Group meetings on a regular basis through the Secretariats of the two organizations. STACFIS also proposes that joint meetings should be considered in order to further improve coordination of future assessments and research related to harp and hooded seals in the North Atlantic"

and NAFO's Scientific Council endorsed this recommendation, using the following wording (NAFO SCS Doc. 85/I/2, p.6):

"Since the terms of reference of this ICES Working Group have much in common with corresponding work on harp and hooded seals in the Northwest Atlantic, the Council considered it advantageous that both organisations coordinate their work. In this respect, the Council agreed that the feasibility of joint meetings of the respective working groups or the establishment of a joint ICES/NAFO working group should be considered and a firm proposal developed at the June 1985 Meeting for consideration by ICES at its Statutory Meeting in October 1985".

2 MEETING ARRANGEMENTS

The Working Group, chaired by F O Kapel, and comprising scientists from Canada, Denmark, Norway and the United Kingdom, met at ICES headquarters from 9 to 13 September 1985. A list of participants is given in Appendix I.

The Working Group reviewed the relevant scientific information on harp and hooded seals in the Greenland Sea contained in published papers and other available documents, including those presented at this meeting. The Agenda adopted for the meeting is given in Appendix II, and the papers referred to are listed in Appendix III.

3 SEALS STOCKS: STATUS AND MANAGEMENT

3.1 Hooded Seal (Cystophora cristata)

3.1.1 History of exploitation and regulatory measures

Sealing for hooded seals in the West Ice, the Jan Mayen area of the Greenland Sea, gradually developed as a multinational venture from 18th century whaling at Svalbard (Spitzbergen) and Greenland. The first sealing expedition on record dates back to 1720 and the first Norwegian vessel joined the hunt in 1847 (Rasmussen, 1957).

The first Norwegian Sealing Act enforcing an internationally agreed opening date of 1 April was passed in 1876. By the end of last century, only Norway continued to exploit harp and hooded seals in the area.

Complete statistics for early catches of hooded seals in the West Ice were not available to the Working Group, but Norwegian catches alone averaged 29,960 per year in the period 1891-1899 and 14,613 per year through the years 1905-1910 (Iversen, 1928).

Soviet sealers joined the Norwegian ships in the West Ice in 1958 and continued until 1966. Eight years later, Soviet ships returned to the area and with the exception of 1984 have continued sealing since then.

Norwegian and Soviet catches of hooded seals in the West Ice through the years since 1946 are listed in Appendix IV, Table 1. Catches during the years from the introduction of quota regulations in 1971 up to 1982, the last year of permitted pup catches, average 19,863 hooded seals of all age groups and both sexes per year.

A summary of the combined Norwegian sealing effort directed at both hooded and harp seals in the West Ice is given in Table 2 of Appendix IV. The Working Group noted the increase in size (tonnage) and engine power of the fleet and the decreasing number of participating vessels during recent years. Effort data for Soviet sealing were not available at this meeting.

Since 1959, sealing in the West Ice has been regulated on the basis of recommendations from annual meetings of the Norwegian-Soviet Sealing Commission, succeeded in 1984 by consultations under the Joint Norwegian-Soviet Fisheries Commission. With few exceptions Norwegian regulatory measures, therefore, have also been applied to the Soviet operations. A summary of the most important regulations applied to sealing for hooded seals through 1946-85 is given in Table 1 of Appendix V. It was noted that opening dates for the sealing season have been in force throughout the period, closing dates since 1954, protection of females since 1969, licensing since 1970 and quotas since 1971. Norwegian sealers have not been permitted to catch hooded seal pups since 1982.

The distributions of seals in relation to ice edges through the sealing season has been recorded by Norwegian and Soviet scientific personnel in most seasons since the early 1950s (Mikhnevich and Potelov, 1967), but for recent years such information is only available in institute files in Bergen and Arkhangelsk. This also applies to data from samples collected for studies of reproduction, morphometrics and general biology. Age compositions of breeding females in Norwegian samples collected up to 1982, and Soviet samples up to 1977, have been reported in Jacobsen (1984; this meeting:SGS-7). An additional age sample of 341 males and 119 females collected by Norway from the breeding area in 1984 is being processed.

3.1.2 Stock identity

The Working Group reviewed updated data on recaptures of marked seals (Kapel, this meeting: SGS-8; Øien and Øritsland, this meeting: SGS-3) and previous information pertaining to stock identity of hooded seals in the North Atlantic. The Group found no reason to propose any revision of current management stock units.

One recapture on the coast of northern Norway from recent markings in the West Ice, which include 1,195 bluebacks tagged through 1977-85, confirms that young seals may disperse over large areas shortly after weaning (Øien and Øritsland, this meeting: SGS-3).

3.1.3 Biological parameters

Samples of the age composition of breeding females from the West Ice herd between 1961 and 1978 have been collected by scientists from Norway, the Soviet Union and the Netherlands (Jacobsen, 1984). Samples have also been collected for the period 1979 to 1984. However, as yet only samples from 1979 to 1982 have been processed. The age compositions of these samples are on file at the Institute of Marine Research, Bergen. Information on the sex ratio of catches is fragmentary until 1970, when a system of inspection of all Norwegian landings was instituted.

No estimate of total mortality (Z) was available to the Working Group. Jacobsen (1984) estimated natural mortality (M) to be 0.12 based on estimates of pup production for two periods and the known catch history of the West Ice population. A range of between 0.07 and 0.13 has been suggested for the Northwest Atlantic hooded seal population (NAFO, 1983).

New estimates of age at maturity or pregnancy rate were not available at the meeting, although material has been collected since the last published estimate given by Øritsland (1964). The Working Group reviewed data collected in March 1984 from the Davis Strait herd, which gave an estimate of 3.8 years for mean age at maturity and 96% for pregnancy rate. No significant difference in the mean age at maturity and pregnancy rate has been found within or between the West Ice, Davis Strait and Newfoundland breeding areas:

	Newfoundland		Davis Strait	South Greenland	West Ice
	1967-72[1]	1979[2]	1984[3]	1970-74[4]	1963-64, 1975-76[5]
Mean age at maturity (yr)[6]	3.9	3.6	3.8	4.2[7]	4.1
Pregnancy rate (%)	97	97	96	94	95

[1] Øritsland (1975).
[2] Hay, Bowen and Wakeham (1983).
[3] Hay and Wakeham, this meeting (SGS-5).
[4] Born (1982).
[5] Jacobsen, this meeting (SGS-9).
[6] Using method A of Jacobsen, this meeting (SGS-9).
[7] Using direct proportion mature at age.

3.1.4 Population assessment

A number of techniques are available to estimate the pup production of a hooded seal stock. These include direct surveys of the whelping patches, mark recapture experiments, the fitting of age structured population models to catch-at-age data, and the analysis of series of catch-per-unit-effort (CPUE) data. In addition, a minimum estimate of pup production in a particular year can be obtained from the cumulative catch from that year class.

Although Soviet scientists have carried out an aerial survey of the West Ice whelping patches in 1984, the results of this survey were not available to the Working Group. A CPUE series was available (Appendix IV),but this shows large variations from year to year (presumably due to changes in ice and weather conditions). In addition, trends in CPUE may be obscured by changes in the characteristics of the vessels operating in this area. The Working Group had no basis for devising suitable correction factors for these effects and the CPUE series was not used for the assessment.

The only available estimates of pup production came from analyses by Jacobsen (1984; this meeting:SGS-7), who had fitted a population model (1) to the age structure of catch in the periods 1973-77 and 1961-65 assuming that selectivity was constant with age, and (2) to the catch in the period 1973-83, using a method where age-specific selectivities were calculated. Pup production in 1968 was estimated to be 54,000 by method (1) and 58,000 in 1970 by method (2). Pup production in 1956 was estimated to be 95,000; however, there was a relatively poor fit to the age structure of the catch relevant to this period. The author noted that although the estimate using age-specific selectivities had a wider confidence region than that based on a constant selectivity, it was much less sensitive to assumption about age-specific mortality.

The Working Group concurred with Jacobsen (this meeting: SGS-7) that these estimates were of little use for assessing the current size of the stock because the projected value for pup production was very sensitive to the value used for M. Within the feasible range for this parameter (see Section 3.1.3), the population could have increased or decreased substantially during the period 1970-85.

3.1.5 Management advice

Because of the uncertainties about present pup production and stock size of hooded seals in the West Ice, the Working Group was unable to calculate sustainable or replacement yield. With the information available to it, the Working Group was unable to provide scientific advice on catch options for the 1986 sealing season.

The Working Group noted that the Norwegian-Soviet Sealing Commission (in recent years the Joint Soviet-Norwegian Fishery Commission) had recommended quotas for the West Ice population of hooded seals since 1971 (see Section 3.1.1 and Appendix V). However, the reports of the scientific meetings of these Commissions were not available to the Working Group, and, therefore, the scientific basis for the establishment of these quotas could not be evaluated.

3.2 Harp Seal (Phoca groenlandica)

3.2.1 History of exploitation and regulatory measures

Comments on the history of West Ice sealing, given under item 3.1.1 of this Report, apply equally to the hunt for harp seals. Again, complete statistics were not available to the Working Group, but total Norwegian catches of harp seals appear to have been roughly 50,000 per year in the period 1860-1885, with a maximum catch of about 120,000 in 1873, falling to a level of about 25,000 through 1886-1900. Annual Norwegian catches average 15,000 during the first 20 years of this century, increasing to about 35,000 per year in the late 1930s (Rasmussen, 1957).

Norwegian and Soviet catches of harp seals in the West Ice in the period 1946-1985 are listed in Appendix IV, Table 3. Total catches under quota regulations from 1971 to 1983, the last year Norwegian sealers were permitted to take harp seal pups, averaged 12,909 harp seals of all age and sex groups per year.

The combined Norwegian West Ice sealing effort for both harp and hooded seals through 1946-85 is summarized in Table 2 of Appendix IV. Norwegian sealing regulations for harp seals in the West Ice through 1946-85 are summarized in Table 2, Appendix V. As for hooded seals, these measures have also been applied to Soviet sealing in the area.

The Working Group noted that harp seal females were protected in 1967 and that 1-year-old and older seals were protected in 1971. However, since 1974 the sealers have been permitted to fill their allocated pup quota with catches of moulting 1-year-old and older seals after 10 April. A delay in the opening date of the hunt to 10 April has effectively prevented Norwegian sealers from taking whitecoated pups in the last two years.

Data from Norwegian and Soviet investigations of West Ice harp seals since the early 1950s have only been partly analysed and published (e.g. Rasmussen, 1957; Beloborodov and Potelov, 1967). Information which is only available in reports of the Joint Norwegian-Soviet Sealing Commission or the Norwegian-Soviet Fisheries Commission still awaits analysis. It includes data on reproduction, age composition and general biology from samples collected in the late 1960s and through 1977-84. The Working Group was informed that substantial age composition samples of harp seals which have been collected in the West Ice in each of the seasons 1977 and 1979-84 were now being analysed at the Institute of Marine Research in Bergen.

3.2.2 Stock identity

Updated data on recaptures of marked harp seals (Kapel, this meeting: SGS-8; Øien and Øritsland, this meeting: SGS-3) were reviewed. Twenty of 4,312 seals marked in the West Ice through 1970-85 have been recaptured in Greenland, Iceland and Norway up to one year after marking. These recaptures, including two in West Greenland, confirm that young and subadult seals may disperse over wide areas.

However, to date there is no evidence of intermixing between breeding areas and the Working Group did not find reason to propose changes in current management units.

3.2.3 Biological parameters

No information on the vital rates of harp seals at the West Ice was available to the Working Group. However, the Working Group was informed of ongoing research and historical data which require analysis.

3.2.4 Population assessment

The techniques available for estimating pup production are discussed in Section 3.1.4. Results of an aerial survey carried out by Soviet scientists in 1984 were not available to the Working Group. Processing of data on the age structure of the catch is not yet complete (see Section 3.2.1).Although substantial numbers of marks have been applied to harp seals at the West Ice, particularly in recent years, the recoveries from these experiments cannot be thoroughly analysed until more detailed information is available on the age structure of the catch in each year.

There is no published estimate of pup production; however, Ulltang and Øritsland (referred to in Øritsland, 1976) estimated pup production in 1971 to be about 25,000. The Working Group reconstructed their estimation procedure, which was based on the assumption that pup production in 1950 must have been at least 50,000 (catches of pups were 49,800 in 1949 and 1950, and 47,500 pups in 1951). The CPUE series shows a decline of about 50% between 1950 and 1970.

CPUE data were available from 1946-85, but (as noted in Section 3.1.1) there have been considerable changes in the size and power of the vessels undertaking the hunt in recent years, and the Working Group expressed doubts about the consistency of this series. It, therefore, had no basis for calculating current pup production and stock size.

3.2.5 Management advice

There is no estimate of present pup production and stock size of the harp seals in the West Ice. Therefore, the Working Group was unable to calculate sustainable and replacement yield. With the information available to it, the Working Group was unable to provide scientific advice on catch options for the 1986 sealing season.

For the reasons outlined in Section 3.1.5, the Working Group was unable to evaluate the scientific basis for the level of the previous catch quotas for this population.

4 INTERACTION BETWEEN SEALS, OTHER MARINE RESOURCES AND COMMERCIAL FISHING

4.1 Feeding Biology

Limited sampling of both harp and hooded seals at the West Ice confirms the findings from other areas that these species rarely feed during the breeding and moulting seasons. Stomach analyses outside these periods are available from the Northwest Atlantic populations. Because similar prey species are found in the eastern and western North Atlantic, this information should provide some insight into the diets of West Ice seals. This is supported by the results of limited sampling in the Barents Sea.

These studies indicate that schooling pelagic fish species and small crustaceans form the principal diet of harp seals. Young hooded seals appear to have a similar diet to that of young harp seals, whereas the diet of older hooded seals comprises a wider variety of both pelagic and benthic fish, squid and crustaceans. In both species there are geographic, seasonal and yearly variations in diet composition.

It is difficult to obtain an entirely representative picture of the diet and food consumption of harp and hooded seals from the analysis of stomach contents alone. Both species exhibit long migrations, are wide ranging and are pelagic for much of the year. However, for logistic reasons, field collections are usually limited to coastal areas. Also, the rapid digestion of food, which is characteristic of phocid seals, is apt to bias the reconstruction of diets. Given these difficulties, the estimation of energy requirement based on physiological models and measurements offers a promising technique to supplement field sampling programs.

4.2 Energetics

Discussion centered on a physiologically-based computer model of a White Sea harp seal population of one million animals increasing at 6% annually (Markussen and Øritsland, 1985).

Age- and sex-specific energy requirements were calculated. Blubber was considered both in terms of insulation and energy storage. Other physiological factors considered in the model were: thermal conductivity of blubber, heat transfer coefficients of the body, ambient temperature, core temperature, maintenance requirements, activity levels and body growth.

The energy requirement of this population was estimated to be 3.4 x 10^{12} Kcal/yr. If the diet were to consist of 50% shrimps, 32% capelin, 4% herring, 6% polar cod, 3% cod and 5% other fish, the total food requirement would be 2.4 x 10^{6} mt/yr with a mean caloric density of 1.4 Kcal/g.

The results of the model indicate that changes in levels of activity and diet can have a significant impact on food requirements.

4.3 Interaction with Commercial Fishing

Current information on the diet and feeding behaviour of harp and hooded seals is insufficient to determine the extent of their interaction with any commercial fishery. In addition, the Working Group noted that, even if such information should become available, it would only be possible to provide scientific advice on short-term effects of predation by seals. Evaluation of long-term effects would require a detailed understanding of the dynamics of the fish stocks and their predators.

Damage to fishing gear by the West Ice stocks of harp and hooded seals, while occasionally reported, was not considered a significant problem.

Low levels of infestation by the sealworm (Pseudoterranova decipiens) have been reported in harp seals from the Northwest Atlantic. No information on levels of infestation of this parasite in seals at the West Ice was available to the Working Group.

5 FUTURE RESEARCH

The Working Group recommends that:

1) effort data for Soviet catches of harp and hooded seals at the West Ice should be made available;

2) the usefulness of further refinements to the CPUE data should be investigated;

3) information on the sex and age compositions of commercial landings of harp and hooded seals at the West Ice should be made available to the Working Group;

4) the considerable backlog of information relevant to the estimation of reproductive and mortality rates should be analysed;

5) the feasibility of aerial surveys should be investigated because this is the only method which is likely to provide reliable estimates of current pup production for the harp and hooded seals;

6) fitting of age-structured population models to catch-at-age data should be investigated further as a technique of estimating historic population levels;

7) mark-recapture studies of harp and hooded seals at the West Ice should continue;

8) data should be collected on feeding throughout the year, including the relative importance of prey species, their energy value and present exploitation by commercial fishing.

6 FUTURE ACTIVITIES OF THE WORKING GROUP

The Working Group considers that it would not be useful to meet again until the historical data base of harp and hooded seals at the West Ice has been processed and analysed. In addition, at its next meeting, the scientific reports of the Joint Norwegian-Soviet Sealing Commission and the Norwegian-Soviet Fisheries Commission should be made available to the Working Group.

The Working Group also considers that the establishment of a Joint ICES/NAFO Working Group on harp and hooded seals in the northwestern and central North Atlantic could only serve to enhance scientific discussion and exchange of information.

Extension of the terms of reference of such a Joint Working Group to include other seals in the North Atlantic should also be considered.

The Working Group, therefore, recommends that:

1) ICES, through appropriate channels, obtain copies of the scientific reports of the Joint Norwegian-Soviet Sealing Commission and the Norwegian-Soviet Fisheries Commission;

2) the present Working Group on Harp and Hooded Seals in the Greenland Sea be replaced by a Joint ICES/NAFO Working Group, whose terms of reference would include those of the present Working Group;[1]

3) the Report of this Working Group be published by ICES as a Cooperative Research Report.

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[1] This recommendation was endorsed subsequently by the Council at the ICES Statutory Meeting in 1985, and is currently under consideration by NAFO.

APPENDIX I

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on Harp and Hooded Seals

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APPENDIX II

AGENDA

1. Chairman's welcome and opening remarks.

2. Appointment of rapporteur(s).

3. Adoption of Agenda.

4. Arrangements for the meeting:

   4.1 Time schedule,
   4.2 Meeting procedures,
   4.3 Review of computing needs.

5. Review of documentation:

   5.1 Documents submitted to the meeting,
   5.2 Background documentation.

6. Seal stocks, status and management:

   6.1 Hooded seal (Cystophora cristata),

      6.1.1 Review of the history of exploitation, and trends in catches,
      6.1.2 Review of previous regulatory measures,
      6.1.3 Review of recent research and data processing,
      6.1.4 Distribution, migrations, and stock identity,
      6.1.5 Biological parameters,

         6.1.5.1 Sex and age composition,
         6.1.5.2 Mortality rates,
         6.1.5.3 Age at maturity, and pregnancy rates,

      6.1.6 Population assessment,

         6.1.6.1 Assessment methods,
         6.1.6.2 Pup production,
         6.1.6.3 Stock size,
         6.1.6.4 Replacement yield/sustainable yield,
         6.1.6.5 Population projections,

      6.1.7 Management advice.

   6.2 Harp seal (Phoca groenlandica),

      6.2.1 - 6.2.7 as for hooded seal.

7. Interaction between seals and other marine living resources:

   7.1 Feeding biology and energetics of harp and hooded seals,
   7.2 Trophic relations.

8. Future research requirements.

9. Publications.

10. Future activities of the Working Group:

    10.1 Future meetings,
    10.2 Cooperation with NAFO's Scientific Council.

11. Other business.

12. Adoption of report.

APPENDIX III

REFERENCES

I. Working Documents Presented at the Meeting

SGS-1. Øritsland, T. and Øien, N. Catches of harp and hooded seals in the West Ice.

SGS-2. Øritsland, T. Summaries of Norwegian sealing regulations for the West Ice, 1946-1985.

SGS-3. Øien, N. and Øritsland, T. Marking and recaptures of harp and hooded seals in the West Ice.

SGS-4. I-H. Hay, K. and Winters, G.H. Research on harp and hooded seals in Newfoundland, 1985.

SGS-5. Hay, K. and Wakeham, D. Results of a study of reproduction of whelping female hooded seals (Cystophora cristata) sampled in Davis Strait during March 1984.

SGS-6. Hay, K. Inter-observer comparisons, Davis Strait helicopter surveys, March 1984.

SGS-7. Jacobsen, N.O. MS 1983a. An updated estimate of hooded seal production and mortality in the West Ice, including age samples collected in 1979-82. Hooded Seal Workshop, HSW Doc. 4. (Mimeo.)

SGS-8. Kapel, F.O. - Recoveries of harp and hooded seals in Greenland.

SGS-9. Jacobsen, N.O. MS 1983b. Age at first ovulation of hooded seals Cystophora cristata, based on ovary analysis. Hooded Seal Workshop, HSW Doc. 18. (Mimeo.)

II. Other References

Beloborodov, A.G. and Potelov, V.A., 1967. Resultaty izucheniya biologii tyulenei Grenlandskogo Morya v 1965 g. (Results of the study of seals in the Greenland Sea in 1965.) Materialy ryb. Khoz. Issled. sev. Bosseina, 9: 60-66.

Born, E.W. 1982. Reproduction in the female hooded seal, Cystophora cristata Erxleben, at South Greenland. J. Northw. Atl. Fish Sci., 3: 57-62.

Hay, K., Bowen, W.D. and Wakeham, D., MS 1983. Reproductive parameters of female hooded seals, Cystophora cristata Erxleben, sampled at Newfoundland during March 1979. Hooded Seal Workshop, HSW Doc. 7. (Mimeo.)

ICES 1983. Report on the meeting of an ad hoc Working Group on Assessment of Harp and Hooded Seals in the Northwest Atlantic 4-7 October 1982. ICES Coop. Res. Rep. 121.

Iversen, T., 1928. Drivis og selfangst. Årsberetn. Norges Fisk., 127 (11): 1-84.

Jacobsen, N.O. 1984. Estimates of pup production age at first parturition and natural mortality for hooded seals in the West Ice. Fisk. Dir. Skr. (Havunders.), 17: 483-98.

Markussen, N. Hedlund and Øritsland, N.A., 1985. Grønlandsselens matbehov. III. Videreudvikling og anvendelse af simuleringsmodellen SEAERG. Report available from Biologisk, Institutt Avd. for generell fysiologi, Univ. Oslo.

Mikhnevich, O. Ch. and Potelov, V.A., 1967. Dannye o Raspredelinii Tyulenei Grenlandskogo Morya v Zavisamosti ot Poloz heniya Kromki L'da (Data on the distribution of seals in the Greenland Sea depending on the position of ice edges). Materialy ryb. Khoz. issled. sev. Bosseina, 9: 67-72.

NAFO 1983. Provisional Report of Scientific Council, Dartmouth, Canada 8-23 June, 1983. NAFO SCS Doc. 83/VI/21, Serial No. N 730.

NAFO 1985. Provisional Report of Scientific Council January 1985 Meeting. NAFO SCS Doc. 85/I/2, Serial No. N 951.

Øritsland, N.A. and Markussen, N. Hedlund, 1984. Grønlandsselens matbehov. I. Biologisk bakgrunn og generel beskrivelse av simuleringsmodellen SEAERG. II. Programlister for simuleringsmodellen SEAERG (The feeding requirements of the harp seal,I and II). Rapp. Zoofys. Inst. Univ. Oslo, Mars 1984, 48 + 53 pp.

Øritsland, T. 1964. Klappmysshunnens forplantningsbiologi (The breeding biology of female hooded seals). Fisken og Havet 1964, 1: 1-15.

Øritsland T. 1975. Sexual maturity and reproductive performance of female hooded seals at Newfoundland. ICNAF Res. Bull. 11: 135-43.

Øritsland, T. MS 1976. The management of harp and hooded seals in the West Ice. ICES Paper, C.M. 1976/N:17. (Mimeo.)

Rasmussen, B. 1957. Exploitation and protection of the East Greenland seal herds. Norw. Whal. Gazette, 2: 45-59.

Ulltang, Ø. and Øritsland, T. MS 1971. Bestand og beskatning av grønlandssel og klappmyss i Vesterisen (Population and exploitation of harp and hooded seals in the West Ice). Notat Fiskeridir. Havforskn. Inst. Nov. 1971. (Mimeo.)

APPENDIX IV

CATCHES OF HARP AND HOODED SEALS IN THE WEST ICE, INCLUDING CATCHES TAKEN ACCORDING TO SCIENTIFIC PERMITS

Table 1. Catches of hooded seals in the West Ice, 1946-1985, including catches for scientific research.

	Norwegian catches			Soviet catches			Total catches		
Year	pups	1 year and older	total	pups	1 year and older	total	pups	1 year and older	total
1946	8482	3083	11565	-	-	-	8482	3083	11565
1947	26059	12535	38594	-	-	-	26059	12535	38594
1948	23392	9371	32763	-	-	-	23392	9371	32763
1949	48698	7728	56426	-	-	-	48698	7728	56426
1950	49130	18568	67698	-	-	-	49130	18568	67698
1951	47487	35893	83380	-	-	-	47487	35893	83380
1952	18098	21864	39962	-	-	-	18098	21864	39962
1953	21864	4160	26024	-	-	-	21864	4160	26024
1954	53321	12680	66001	-	-	-	53321	12680	66001
1955	45266	11511	56777	-	-	-	45266	11511	56777
1956	31564	9224	40788	-	-	-	31564	9224	40788
1957	13238	8951	22189	-	-	-	13238	8951	22189
1958	38636	19906	58542	-	-	-	38636	19906	58542
1959	22682	4536	27218	623	1246	1869	23305	5782	29087
1960	27572	5389	32961	641	642	1283	28213	6031	34244
1961	43681	29601	73282	3569	2169	5738	47250	31770	79020
1962	27183	18498	45681	2239	4900	7139	29422	23398	52820
1963	17958	4463	22421	2333	2993	5326	20291	7456	27747
1964	21987	6972	28959	1943	2435	4378	23930	9407	33337
1965	28154	10838	38992	633	1474	2107	28787	12312	41099
1966	33214	6762	39976	802	310	1112	34016	7072	41088
1967	21390	20351	41741	-	-	-	21390	20351	41741
1968	11795	2168	13963	-	-	-	11795	2168	13963
1969	15870	7057	22927	-	-	-	15870	7057	22927
1970	25208	12507	37715	-	-	-	25208	12507	37715
1971	19572	10678	30250	-	-	-	19572	10678	30250
1972	16052	4164	20216	-	-	-	16052	4164	20216
1973	22455	3994	26449	-	-	-	22455	3994	26449
1974	16595	9800	26395	-	-	-	16595	9800	26395
1975	18273	7683	25956	632	607	1239	18905	8290	27195
1976	4632	2271	6903	199	194	393	4831	2465	7296
1977	11626	3744	15370	2572	891	3463	14198	4635	18833
1978	13899	2144	16043	2457	536	2993	16356	2680	19036
1979	16147	4115	20262	2064	1219	3283	18211	5334	23545
1980	8375	1393	9768	1066	399	1465	9441	1792	11233
1981	10569	1169	11738	167	169	336	10736	1338	12074
1982	11069	2382	13451	1524	862	2386	12593	3244	15837
1983	0	86	86	419	107	526	419	193	612
1984	99	483	582	-	-	-	99	483	582
1985	254	84	338	?	?	?	254	84	338

Table 2. Norwegian sealing effort in the West Ice, 1946-1985.

Year	Number of trips	Average duration of trips (days)	Average tonnage		Average horsepower	Average crew number
			Gross	Net		
1946	16	47	116	44	151	15
1947	33	39	122	43	206	17
1948	51	46	118	42	199	16
1949	44	45	119	41	206	16
1950	41	39	118	41	215	16
1951	56	40	129	49	250	17
1952	48	42	136	48	273	17
1953	38	45	152	52	309	17
1954	40	36	144	49	282	17
1955	45	37	137	47	271	17
1956	43	49	140	48	287	16
1957	40	48	142	48	301	17
1958	42	47	137	46	295	16
1959	45	55	134	46	264	16
1960	44	51	132	46	263	16
1961	40	37	137	47	302	16
1962	42	45	135	46	302	16
1963	43	53	139	49	320	17
1964	36	52	144	48	356	16
1965	38	49	144	50	407	16
1966	31	44	140	48	417	16
1967	25	38	146	49	484	16
1968	23	42	162	55	553	15
1969	20	49	157	52	519	16
1970	19	38	156	58	528	15
1971	18	23	154	51	548	13
1972	20	42	165	56	551	13
1973	16	37	164	55	526	13
1974	16	42	163	55	561	13
1975	15	39	163	54	573	12
1976	15	51	174	61	650	13
1977	13	43	174	61	642	12
1978	11	42	198	73	773	12
1979	10	46	224	84	910	13
1980	9	52	266	107	1034	13
1981	7	52	281	119	1070	13
1982	6	36	334	134	1348	14
1983	2	39	352	144	1325	10
1984	2	41	237	86	970	10
1985	1	37	178	72	940	9

Table 3. Catches of harp seals in the West Ice, 1946-1985, including catches for scientific purposes.

	Norwegian catches			Soviet catches			Total catches		
Year	pups	1 year and older	total	pups	1 year and older	total	pups	1 year and older	total
1946	14795	1411	16206	-	-	-	14795	1411	16206
1947	28909	7534	36443	-	-	-	28909	7534	36443
1948	36076	23725	59801	-	-	-	36076	23725	59801
1949	29361	5168	34529	-	-	-	29361	5168	34529
1950	23887	9484	33371	-	-	-	23887	9484	33371
1951	39922	12851	52773	-	-	-	39922	12851	52773
1952	37348	7388	44736	-	-	-	37348	7388	44736
1953	27346	6550	33896	-	-	-	27346	6550	33896
1954	23845	5271	29116	-	-	-	23845	5271	29116
1955	23862	13564	37426	-	-	-	23862	13564	37426
1956	8983	6894	15877	-	-	-	8983	6894	15877
1957	4847	11801	16648	-	-	-	4847	11801	16648
1958	24372	7713	32085	1384	445	1829	25756	8158	33914
1959	27812	2901	30713	3527	3264	6791	31339	6165	37504
1960	28421	1544	29965	831	2377	3208	29252	3921	33173
1961	16487	2755	19242	3532	4563	~~8095~~	20019	7318	27337
1962	25738	3126	28864	1636	788	2424	27374	3914	31288
1963	11808	3045	14853	1137	840	1977	12945	3885	16830
1964	2908	3060	5968	2763	1720	4483	5671	4780	10451
1965	20445	3727	24172	4693	1580	6273	25138	5307	30445
1966	23814	2210	26024	6	236	242	23820	2446	26266
1967	19708	1450	21158	-	-	-	19708	1450	21158
1968	20227	1103	21330	-	-	-	20227	1103	21330
1969	3992	1694	5686	-	-	-	3992	1694	5686
1970	16346	1750	18096	-	-	-	16346	1750	18096
1971	11149	0	11149	-	-	-	11149	0	11149
1972	15100	82	15182	-	-	-	15100	82	15182
1973	11858	0	11858	-	-	-	11858	0	11858
1974	14628	74	14702	-	-	-	14628	74	14702
1975	3742	1080	4822	239	0	239	3981	1080	5061
1976	7019	5249	12268	253	34	287	7272	5283	12555
1977	13305	1541	14846	2000	250	2250	15305	1791	17096
1978	14424	57	14481	2000	0	2000	16424	57	16481
1979	11947	889	12836	2424	0	2424	14371	889	15260
1980	2336	7647	9983	3000	539	3539	5336	8186	13522
1981	8932	2850	11782	3693	0	3693	12625	2850	15475
1982	6602	3090	9692	1961	243	2204	8563	3333	11896
1983	742	2576	3318	4263	0	4263	5005	2576	7581
1984	199	1779	1978	-	-	-	199	1779	1978
1985	25	532	557	?	?	?	25	532	557

APPENDIX V. SUMMARIES OF NORWEGIAN SEALING REGULATIONS FOR THE WEST ICE - 1946-1985

Table 1. Sealing regulations for hooded seals in the West Ice, 1946-1985.

Season	Opening[1] date	Closing date	Total quota				Allocation		Scientific permits	Other regulations
			Overall	Pups	Females	Males	Norway	USSR		
1946-53	23 March									
1954-55	" "	15 May								Sailing date[2] and only one trip/season, 1954
1956	22 "	5 May								
1957-67	20 "	" "								
1968	30 "	" "								Killing methods prescribed and inspection introduced
1969-70	20 "	" "								Breeding females protected, 1969[3], Licensing effective, 1970
1971	" "	" "	30000							
1972-74	23 "	" "	30000							
1975	22 "	" "	31800				30000	1800	1800	
1976	" "	" "	34500			5000	30000+4000	4500+1000		
1977	" "	" "		33500	2500	10000	27800+2200+8000	5700+300+2000		
1978	" "	" "		31500	1000	10000	26000+880+8000	5500+120+2000	500 ♀	
1979	" "	" "		23600	1520	10000	19600+1120+8000	4000+400+2000		
1980	" "	12 "		20000	max 2% of pups	free	16700	3300	400 ♀ 200 subad.	Subadults protected
1981	" "	5 "		20000	"[4]	"	16700	3300	400 pups	
1982	" "	" "		20000	"[4]	"	16700	3300	400 ♀	
1983	" "	" "		20000			16700[5]	3300		
1984-85	" "	" "		(20000)[6]			8000[5]	3300	500 ♀	

[1] Introduced upon international agreement in 1876.
[2] First date permitted for departure Norwegian port; 1954-1983: 6-8 days prior to opening date, 1984-1985: 15 March.
[3] Killing for compelling safety reasons permitted; one pup deducted from quota for each female taken.
[4] Two pups deducted from quota for each female taken.
[5] Adult males only.
[6] Basis for allocation of USSR quota.

Table 2. Sealing regulations for harp seals in the West Ice, 1946-1985.

Season	Opening date[1]	Closing date	Total quota (pups)	Allocation		Scientific permits	Other regulations
				Norway	USSR		
1946-53	23 March						
1954-55	" "	15 May					Sailing date[2] and only one trip/season, 1954
1956	22 "	5 "					
1957-67	20 "	" "					Breeding females protected,1967
1968	30 "	" "					Killing methods prescribed and inspection introduced
1969-70	20 "	" "					Licensing effective, 1970
1971	" "	" "	15000				1 yr+ protected
1972-73	23 "	" "	15000				
1974	" "	" "	15000				Pup quota may be filled by 1 yr+ after 10 April
1975	22 "	" "	15900	15000	900	900	
1976	" "	" "	16500	15000	1500		
1977	" "	" "	17000	15000	2000	500 females	
1978	" "	" "	17000	15000	2000	800 1 yr+	
1979	" "	" "	18500	16000	2500	1000 1 yr+	
1980	" "	12 "	25000[3]	21000	4000	500 females + 1500 1 yr+	
1981	" "	5 "	25000	21000	4000	1000 1 yr+	
1982	" "	" "	25000	21000	4000	500 females + 1000 1 yr+	
1983	" "	" "	(25000)[4]	14000	4500	1000 1 yr+	
1984-85	10 April	" "	(25000)[4]	7000	4500	500 females	

1) Introduced upon international agreement in 1876.
2) First date permitted for departure Norwegian port; 1954-83: 6-8 days prior to opening date, 1984-85 15 March.
3) Included 5000 1 yr+ to be taken after 10 April.
4) Basis for allocation of USSR quota.

Indication of spine colours

Reports of the Advisory Committee on Fishery Management	Red
Reports of the Advisory Committee on Marine Pollution	Yellow
Fish Assessment Reports	Grey
Pollution Studies	Green
Others	Black

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