Status of grey seals (*Halichoerus grypus*) in Norway

Kjell Tormod Nilssen and Tore Haug

Institute of Marine Research, PO Box 6404, N-9294 Tromsø, Norway

ABSTRACT

During the period September-December in 2001-2003, ship based surveys of grey seal (*Halichoerus grypus*) pups, including tagging, counting and staging of pups, were conducted along the Norwegian coast. All known and other potential breeding areas were surveyed from Rogaland county in the south to Finnmark county in the north. Most of the breeding sites were surveyed only once, but some sites were surveyed 2-4 times. The investigations resulted in a total minimum estimate of 1,159 grey seal pups born in Norwegian waters. Nordland county was the most important breeding area where about 50% of the pups were born.

Total population estimates were derived from the recorded number of pups born using a range of multipliers (4.0-4.7), based on observed annual growth rates of approximately 7-12% in other grey seal populations. This gave a total estimate of about 5,800-6,600 grey seals including pups in Norwegian waters. However, the total pup production was probably underestimated due to only one pup count in most of the breeding sites. Observed mean pup mortality was 1.1% during the breeding season along the Norwegian coast.

Nilssen, K.T. and Haug, T. 2007. Status of grey seals (*Halichoerus grypus*) in Norway. *NAMMCO Sci. Publ.* 6:23-31.

INTRODUCTION

There are three main groups of grey seals *(Halichoerus grypus)* in the North Atlantic. One of these is distributed from the British Isles northwards along the entire coast of Norway and the Murman Coast of Russia (Bonner 1981, Wiig 1986, Haug *et al.* 1994). The species is resident in Norwegian coastal waters where Wiig (1986) suggested a discontinuous distribution with the largest abundance in mid Norway (between 63°N and 68° N).

Øynes (1964, 1966) concluded that no grey seal pup production occurred in the southern parts of Norway (south of Stad, Fig. 1) in the early 1960s. Only low and scanty abundance of the species was recorded in the northernmost parts of the country (north of Vesterålen, Fig. 1). However approximately 660 pups were born annually in the coastal areas between Stad and Finnmark. To obtain a better basis for management, more extensive studies of grey seals from Stad to Lofoten (Fig. 1) were initiated in 1974, and continued throughout the 1980s and early 1990s, when the geographical range of the surveys was extended to include the entire Norwegian coast (Wiig 1986, 1987a, 1987b, 1988, 1989, Wiig and Øritsland 1987, Haug *et al.* 1994). These studies indicated that the number of grey seals inhabiting Norwegian coastal waters at that time was probably much larger than previously reported for the early1960s by Øynes (1964, 1966).

Prior to 1973, the hunt of grey seals was virtually unregulated (Anon. 1990). In 1973, some regulatory mechanisms were imposed although they did not include restrictions on the numbers of seals allowed to be taken (Anon. 1990). A new management regime was implemented for grey seals in Norway from 1997. The major management objective was to secure viable

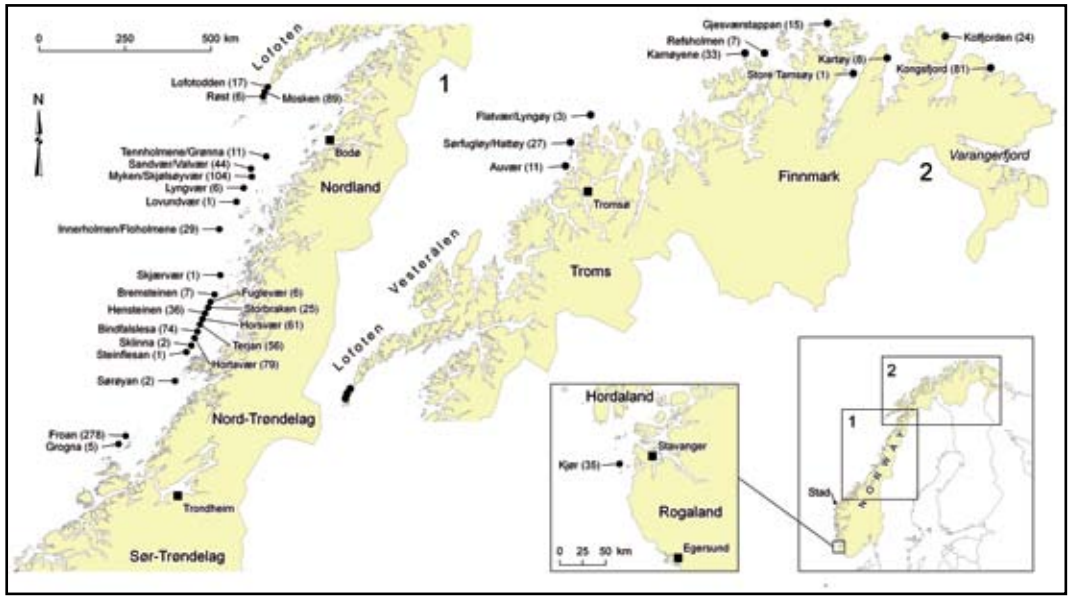

Fig. 1. *Grey seal breeding sites in Norwegian waters. Total recorded number of pups in each site (in parentheses) in 2001-2003.*

stocks within their natural ranges. However, there was also a requirement that consideration should be given to conflicts between seals and fisheries, and that in areas where stocks were proven to sustain a harvest, hunting could be used to control population sizes. This objective was defined in a consensus report from a group of experts including scientists and managers from the Ministry of Fisheries and the Ministry of Environment (Anon. 1990).

An implication of the new management regime was that the hunt should be restricted by quotas, and new hunting periods (between 2 January - 30 April and 1 August - 30 September) were implemented. Although the population structure of grey seals along the Norwegian coast was unresolved, quotas were given separately for three management areas: a southwest Norwegian area including the counties Rogaland, Hordaland and Sogn og Fjordane (termed Rogaland to Stad); a mid Norwegian area including the counties Møre og Romsdal, Sør-Trøndelag, Nord-Trøndelag and Nordland (termed Stad to Lofoten); and a north Norwegian area including the counties Troms and Finnmark (termed Vesterålen to Varanger). Quotas are set annually by the Norwegian Ministry of Fisheries and Coastal Affairs, based on decisions of the national Marine Mammal Council. This council's main objective is to provide management advice to Norwegian authorities in all questions regarding marine mammals.

The introduction of quotas required updated seal abundance information, and it was recommended that a monitoring program be established where the grey seal populations should be surveyed every five years (Anon. 1990). A first survey, covering the areas from Sør-Trøndelag and northwards to the Russian border (Fig. 1), was conducted in 1996-1998 and resulted in a point estimate of approximately 4,400 grey seals (Bjørge and Øien 1999). The quotas recommended by the Institute of Marine Research (IMR) were generally set at 5% of current abundance estimates (Wiig 1986, Haug *et al.* 1994, Bjørge and Øien 1999). In some areas recommended quotas were increased due to assumed immigration of grey seals from large neighbouring colonies, e.g., from the UK in the south (Bjørge and McConnell 1986, Wiig 1986, 1987b) and from the Murman coast in Russia in the north (Haug *et al.* 1994, Henriksen *et al.* 2007). In areas with particular conflicts between grey seals and fisheries, Norwegian management authorities have occasionally attempted to use hunting to control population size by increasing the recommended quotas by 20-30%. In 2003, these quotas were increased substantially, to 25% of current population estimates. Also, a bounty was promised for each grey seal documented killed. This management regime was extended for 2004-2007.

In a culling programme during the period 1980-1990, 15 and 943 grey seals were shot in the Rogaland-Stad and Stad-Lofoten regions, respectively (Anon. 1990). The number of seals taken additionally by local hunters is not known. In Finnmark County, Haug *et al.* (1994) estimated an approximate take of 670 grey seals during the same decade based on interviews with all local hunters known to pursue grey seals. No other quantitive information is available on grey seals taken in regular hunting activities in Norway prior to 1997.

Current Norwegian grey seal hunting is a game hunt. All hunters must obtain permission to hunt from Norwegian management authorities, and they must also report the results from their hunt. Grey seal catch statistics are, therefore, available from 1997. Only 13-49% of the quotas recommended by the IMR, and 11-35% of the quotas issued were taken annually in the period 1997-2002 (total annual removals varying between 34 and 176). The increased quotas and bounty paid in 2003 and 2004 resulted in increased catches of 353 and 302 seals, respectively. This was 117% and 97% of the IMR recommended quotas, although only 30% and 25% of the quotas issued for 2003 and 2004, respectively.

Grey seals along the Norwegian coast are also subject to some bycatch mortality. In a mark-recapture experiment, where 3,571 grey seal pups were tagged, 7% of the tags were returned (Bjørge *et al.* 2002). Incidental mortality, mainly in bottom-set nets, accounted for the majority of deaths (79%), and the seals were most vulnerable during their first three months after birth, although high incidental mortality prevailed during the first 8-10 months. Interactions with fish farms by grey seals are known to occur. Fish farmers are allowed to kill seals when they interact with farm operations and they are supposed to report on the takes. There is likely some lack of reporting which could involve underestimates of the total number of seals taken.

Grey seal pupping occurs in the period mid-September to mid-October in the Stad–Lofoten region and in November-December in Rogaland, Troms and Finnmark counties (Wiig 1986, Haug *et al.* 1994, Bjørge and Øien 1999, Gunnar Henriksen, Origo miljø as, Stavanger, pers.comm.). New ship-based surveys, aimed at assessing current pup production, and designed to cover the complete range of grey seals in Norway, were performed during the pupping season 2001-2003. This paper summarises results from these surveys.

MATERIALS AND METHODS

Pup counts

Grey seal pups were counted on islands along the Norwegian coast where pupping had been previously observed (Wiig 1986; Haug *et al.* 1994; Bjørge and Øien 1999; Gunnar Henriksen, Origo miljø as, Stavanger, pers.comm.) in September-December 2001-2003. All known grey seal pupping sites from the western parts of the Varangerfjord in Finnmark county to Egersund in Rogaland county were investigated during the pupping season in the respective areas (Fig.1). Other areas where grey seals are known to occur were also surveyed.

An inflatable boat was used to search through the potential grey seal pupping areas, after which one to three researchers landed wherever pups were observed, and walked through the pupping area. Pups were caught when possible, tagged with Dalton jumbo Rototags (Fig. 2), and their sex and developmental stage, based on Kovacs and Lavigne (1986), were recorded. In some cases only developmental stage was recorded. For sites that were visited several times during the pupping season all the islands were surveyed on each visit, and all pups were tagged to ensure that they were not double counted. No estimation of the total pup production was carried out because data on pup stage durations to correct for temporal distribution of births are lacking for the Norwegian coast. Early pup mortality was calculated based on the number of dead pups observed at the pupping sites during the survey periods.

In Rogaland county, pups were counted on the Kjør islands during visits on 20 November and 11 December 2001, 18 and 27 November 2002 and on 3 December 2003. Other potential whelping areas in Rogaland were surveyed during the periods 18-19 and 24-27 November 2002. Hordaland county was surveyed on 19-20 November while Sogn og Fjordane county was surveyed on 1 and 21 November 2002.

The outer islands in Møre og Romsdal county were surveyed on 28 and 30 October, and on 1 November 2002. In Sør-Trøndelag county, the most abundant grey seal area in Froan was covered during the entire whelping season. Visits were on 23 and 26 September, and on 5-7, 18-19 and 25-27 October 2002. Adjacent areas close to Froan where pupping is sometimes known to occur, and all outer islands south of Froan in Sør-Trøndelag were visited on 22 and 26-27 October 2002. In Nord-Trøndelag county, the outer islands from Sørøyan in the south to the boarder of Nordland county were surveyed on 18-20 October 2001.

In Nordland county, field work was carried out from Bindalsflesa to Hensteinen during the period 20-23 October and from Grønna to Storbraken on 27-31 October 2001, but the investigations in the northern part of the area were not completed due to poor weather conditions. A more complete survey to the mid and northern areas on the Nordland coast, which also included Lofoten, was carried out during the period 11-24 October 2003.

All known and potential grey seal pupping areas in Troms county were surveyed on 10 and 17-18 November 2003.

Fig. 2. *Grey seal pups were tagged to prevent double-counting on subsequent surveys. (Photo: Sonja Reder)*

In Finnmark county, all known pupping sites were surveyed during the periods 14-23 November 2001 and 12 November - 3 December 2003.

Multipliers and total population estimates

Total population estimates were obtained by using ratios (4.0-4.7) between pup production and one year and older animals taken from other studies. Harwood and Prime (1978) suggested that multipliers ranging from 3.5-4.5 would be appropriate for most populations. They found that 16% of the females in the Farne Islands had their first pup at age 5, 45% at age 6 and 39% at age 7 or over. They used an adult fecundity of 0.9 and adult and juvenile survival rates of 0.94 and 0.49, respectively, for a population growing by approximately 7% annually. The highest multiplier (4.7) was taken from Zwanenburg and Bowen (1990) based on 12.6% annual rate of increase in pup production on Sable Island. They assumed pregnancy rates of 0.16, 0.71 and 0.91 at ages 4, 5, and 6+, respectively, and adult and juvenile survival rates of 0.96 and 0.79, respectively.

RESULTS

The Rogaland – Stad region

In Rogaland, pupping occurred only on the Kjør islands (Fig. 1). In 2001, 2002 and 2003, respectively 30, 28 and 35 pups were recorded on those islands. The area was also surveyed in November 2000 when 30 pups were recorded (G. Henriksen, Origo miljø as, Stavanger, pers.comm.). Based on the maximum observed number of pups an abundance estimate of about 140-170 seals aged 1 year and older was obtained in Rogaland (Table 1). A total of 146 seals aged 1 year and older was observed during the survey along the Rogaland coast in November 2002. Pup mortality was recorded to be 3.3%, 6.7% and 2.8% in 2001, 2002 and 2003, respectively.

In the Hordaland and Sogn og Fjordane, 5 and 22 grey seals (1+) were observed, respectively. No whelping was observed north of the Kjør islands in the region.

The Stad – Lofoten region

No whelping was observed in Møre og Romsdal, and only 10 grey seals were observed along the entire outer coast of the county.

In the Froan area in Sør-Trøndelag, 283 pups were recorded over four visits (including one visit to the Grogna area) within 35 days. Pupping outside the Froan - Grogna area in Sør-Trøndelag was not observed in 2002. Based on the numbers of pups born an abundance estimate of about 1,130 – 1,330 seals aged 1 year and older was obtained in Sør-Trøndelag (Table 1). Pup mortality was recorded to be 0.7%.

In Nord-Trøndelag, all known grey seal areas were surveyed during a 3-day period. A total of 84 pups was recorded (Table 1), which resulted in an abundance estimate of approximately 330 – 400 seals aged 1 year and older. Most of the pups were born in Hortavær, close to the border of Nordland county. Pup mortality was recorded to be 1.2%.

In Nordland, the southern area was surveyed during a 4-day period following the survey in Nord-Trøndelag in 2001. A total of 266 pups were recorded in the southern Nordland area. No dead pups were observed. At the Innerholmene-Floholmene-Lovund area in mid Nordland, 21 and 30 pups were recorded in 2001 and 2003, respectively. Northern Nordland was surveyed in 2003, where 165 pups were recorded in the Lyngvær -Myken-Grønna area, and 112 pups in the Lofoten area. Pup mortality was recorded to be 3.3% in mid and northern Nordland in 2003. By combining the results from the southern (2001), the mid (2003) and the northern part of Nordland (2003), a total of 573 pups were born in Nordland, which results in a population of about 2,300-2,700 seals aged 1 year and older (Table 1).

The Vesterålen – Varanger region

In Troms, a total of 41 grey seal pups were recorded during two visits in November 2003, which results in a total population of about 160-190 seals aged 1 year and older (Table 1). Pup mortality was observed to be 2.4%.

In Finnmark, 142 pups were recorded during one visit to all known pupping sites in 2001. In 2003, 143 pups were recorded over three

Table 1. Maximum counts of grey seal pups from field surveys using inflatable boats in breeding sites along the Norwegian coast. Approximate estimates of seals aged 1 year and older (1+) were obtained by using using the lower (4.0) and upper (4.7) multipliers. (*=Combined results from surveys conducted in 2001 and 2003)

	Pup Production				
	Year				
Region	**2001**	**2002**	**2003**	**Σ**	**Estimated Population (1+)**
Rogaland - Stad					
Rogaland	30	28	35		140-170
Hordaland		0			
Sogn og Fjordane		0			
Stad - Lofoten					
Møre og Romsdal		0			
Sør-Trondelag		283			1,130-1,330
Nord-Trondelag	84				330-400
Nordland				573*	2,300-2,700
south Nordland	266				
mid Nordland	21		29		
north Nordland			277		
Vesterålen - Varanger					
Troms			41		160-190
Finmark	142		143		570-670

visits to the Koiøyene and Kongsfjorden and one visit to the other pupping sites. Pup mortality was recorded to be 1.4% and 4.2% in 2001 and 2003, respectively. A total population of about 570-670 seals aged 1 year and older was derived from the pup production (Table 1).

Total Norwegian coast

The 2001-2003 surveys revealed a total, minimum annual grey seal pup production of 1,159 pups in Norwegian waters, which results in a total abundance estimate of approximately 4,600-5,500 one year and older grey seals. The Nordland coast was the most important breeding area where about 50% of the pups were born.

Based on all observations of dead pups at the pupping sites, mean pup mortality during the breeding season was 1.1% at the Norwegian coast. Of 972 sex-determined pups, 49.5 % were males.

DISCUSSION

The production of nearly 1,200 grey seal pups along the Norwegian coast is most probably an underestimate as pupping sites in some of the most abundant grey seals areas (along the entire coast of Nordland and the western parts of Finnmark) were visited only once. At these sites, some pups may have left the site before the visit occurred and additional births may have occurred after the visit. Currently, we do not have enough information about the distribution of births in these areas to correct our counts. At other important whelping sites in Rogaland, Sør-Trøndelag, Troms and eastern Finnmark, two to four visits were made during the whelping season. At whelping sites where 3-4 visits were paid, the number of pups recorded at one visit (after the peak of pupping) varied between 56% and 81% of the total recorded number of pups born. Nevertheless, the total population estimate of 1 year and older seals obtained from the present surveys (4,600-5,500) is higher than the result of 4,400 seals from the 1996-1998 surveys (Bjørge and Øien 1999). It is important to note that the previous survey design differed considerably from the present in that it was a combination of aerial photographic counts of pups in the Stad-Lofoten region and of moulting seals in the Vesterålen-Varanger region. Also, the previous investigation did not include the Rogaland –Stad region. Preliminary results from recent genetic studies have revealed possible differences between the management regions Rogaland-Stad, Stad-Lofoten and Vesterålen-Varanger (S. Frie, Institute of Marine Research, Tromsø, Norway, pers. comm.). Any questions of possible genetic differences on a more detailed geographic range along the Stad-Lofoten region are, however, still unresolved. The combination of results between the years 2001 and 2003 on the Nordland coast could, therefore, provide both over- and underestimates of pup production due to possible relocation of grey seal breeding between years.

An annual production of about 30 pups in the period 2000-2003 at the Kjør islands may indicate an increase from the mid 1980s when only 5 pups were observed during the period 1983-1985 (Wiig 1986, 1987b). Based on the staging and numbers of pups, the peak in the pupping was during the last week of November, which is much later than the observed peak in early October in mid Norway (Wiig *et al.* 1990) and slightly later than the peak in mid November in Troms and Finnmark (Wiig *et al.* 1990, Haug *et al.* 1994). Flipper- and satellite-tagged grey seals from British waters are known to occur in Norwegian waters, mainly in Rogaland but also further north along the southwest coast (Bjørge and McConnell 1986, Wiig 1986, 1987b, C. Duck, University of St Andrews, Scotland, pers. comm.). The late pupping date in Rogaland suggests that these grey seals could have their origin from British colonies, but genetic studies are required to confirm this.

At the Froan archipelago in Sør-Trøndelag, the recorded numbers of 283 pups born in 2002 were similar to results from another investigation in 1993 where Bakke and Lorentsen (1999) estimated a pup production of 306 based on 226 recorded pups. In 1996, 262 pups were recorded at the Froan islands in aerial photographic surveys (Bjørge and Øien 1999).

The current numbers of 84 and 573 pups observed in Nord-Trøndelag and Nordland, respectively, were higher than the results (67 and 399) from the aerial photographic surveys in 1998 (Bjørge and Øien 1999), but different survey methods make it difficult to draw conclusions about possible increases in abundance.

However, in the Lofoten area comparable ship based surveys were carried out in October 1989 and 1991, when respectively 46 and 31 pups were recorded (Haug *et al.* 1994). In the aerial surveys in 1998 in the same area, 69 pups were recorded (Bjørge and Øien 1999). Those results were lower than the 112 pups recorded in the current study, which may suggest that the number of breeding grey seals in the Lofoten has increased during the last decade.

Ship based surveys, comparable to the current ones, of the pupping sites in Troms were carried out in November 1990 and 1991, when respectively 5 and 17 pups were recorded (Haug *et al.* 1994). Results from the present study could indicate that the number of grey seals in Troms has increased during the last decade. A total of 135 grey seals were recorded in an aerial survey aimed at recording moulting grey seals in April 1998 (Bjørge and Øien 1999), which was less than the total population of about 160-200 (1+) seals derived from the 41 pups recorded in the present study.

In Finnmark, the recorded 142 pups in 2001 was higher than the 117 pups recorded in a similar survey of the same areas in 1998 (Haug *et al.* 1998). Both results were based on only one visit to each pupping site, while in 2003 the pupping sites in both the Kongsfjord and the Koifjord were surveyed three times. However, all studies in Finnmark were likely underestimates of the total pup production, due to only one visit to some pupping sites. A total population of 570-670 seals 1 year and older was derived from the 143 pups recorded in 2003, which was less than the result of approximately 1,000 grey seals from an aerial photographic survey during moult in April 1998 in Finnmark (Bjørge and Øien 1999). Grey seals tagged at the Kola coast in Russia have been taken in gill nets along the Finnmark coast (Henriksen *et al.* 2007), suggesting that Russian grey seals may have contributed to the recorded number during moult.

Pup mortality during the breeding season seems to be low along the Norwegian coast, but the dead pups recorded in the present study might be underestimated if animals were washed away. According to the staging of the pups, almost all pups died as newborns or during the first week after birth. Some dead pups were caught in cracks on the islands. Dead pups were also observed close to the water, which could indicate that they had suffered from heavy seas due to bad weather conditions, but the animals were not necropsied. Tagging and recoveries of pups did not suggest that disturbance of the pupping sites by our fieldwork increased pup mortality.

An important goal of this study was to survey historically known pupping sites and other potential breeding areas and thereby provide a better basis for future surveys aimed at estimating the total abundance of grey seals in Norwegian waters. The investigations were conducted successfully, and identified some new areas where future focus should occur. The most important areas are the Kjør islands, Froan-Grogna, Hortavær-Bremsteinen, Innerholmene-Floholmene, Myken-Grønna, Lofoten, Auvær-Flatvær, Kamøyene-Refsholmen, Gjesværstappan, Kartøy, Koiøyene and the Kongsfjord islands. The long coastline, and the resources available will likely not permit coverage of the entire Norwegian coast during one breeding season. However, surveys should be designed to cover the entire breeding range in each management region (NAMMCO 2004).

Grey seal pupping occurs over quite a prolonged period throughout many parts of its range. Most pup counts under-estimate the true number of pups born because some animals may have left the whelping site prior to our visit to count animals, or some births may have occurred after our visit to a colony. In other regions, attempts have been made to model the distribution of births through multiple counts at major pupping colonies (Duck 2007), or by collecting information on the developmental stages of pups from multiple colony visits (Hammill *et al.* 2007). Currently, the pup stage duration data are not adequate to estimate total pup production. Future efforts are needed to improve the stage duration data for input into models for abundance estimation and should be provided from several sites along the coast (NAMMCO 2004).

The total grey seal population around Norway probably numbers 5,800 to 6,600, which is higher than earlier estimates of 4,400 available from

surveys conducted in 1996-1998. However, it is not clear if this change is real, or reflects changes in methodology, including an increase in area covered by the current survey efforts. In addition to improvements in describing the distribution of births to correct survey counts, as outlined above, information on reproduction rates are needed (Wiig 1991), as well as more formal incorporation of the pup production and reproductive rate data into a modelling framework. Clear management objectives from Norwegian authorities are also necessary to specify the requirements for future grey seal surveys (NAMMCO 2004). Increased survey effort, including a shorter survey interval, will be needed to monitor trends in the population if the quotas of 25% of current population estimates are to be extended, and in particular if these quotas are taken.

ACKNOWLEDGEMENTS

We would like to thank P. Corkeron for field work participation and helpful comments on the work, and to G. Bøthun and T. Thangstad for graphic help. We would like to thank the crew of the coastguard vessels KV"Norvakt", KV"Polarvakt", KV"Peter Jarl" and KV"Nysleppen" for their invaluable assistance. We would also like to thank N-E. Skavberg, G. Henriksen, B.M. Jenssen, S. Reder, L. Lindblom, T. Tuominen, E. Sørmo, D. Vongraven, M. Ekker, A. Gården, O. Vold, R. Vold, Å. Ånesen, R. Kant, U. Lindstrøm and W. Richardsen for field work participation.

REFERENCES

Anon. 1990. Landsplan for forvaltning av kystsel. (National plan for management of coastal seals). Norges Offentlige Utredninger 1990(12): 158 pp. (In Norwegian)

Bakke, Ø. and Lorentsen, S.H. 1999. Estimation of offspring production from a limited number of stage-structured censuses. *Biometrics* 55:321-325.

Bjørge, A. and McConnell, B. 1986. Gjenfangster i Norge av havert merket i Storbritannia. (Recaptures of grey seals marked in Great Britain). *Fisken Hav* 1986(2):1-8. (In Norwegian).

Bjørge, A. and Øien, N. 1999. Statusrapport for Havforskningsinstituttets overvåkning av kystsel. (Status report for the Marine Research Institute's monitoring of coastal seals). Havforskningsinstituttet, Rapport SPS-9904. 35 pp. (In Norwegian).

Bjørge, A., Øien, N., Hartvedt, S., Bøthun, G. and Bekkby, T. 2002. Dispersal and bycatch mortality in grey, *Halichoerus grypus*, and harbor, *Phoca vitulina*, seals tagged at the Norwegian coast. *Mar. Mamm.* Sci. 18:963-976.

Bonner, W.N. 1981. Grey seal *Halichoerus grypus* Fabricius, 1791. In: Ridgway, S.H. and Harrison, R.J. (eds.); *Handbook of Marine Mammals. Volume 2. Seals*. Academic Press, London, 111-144.

Duck, C.D. and Thompson, D. 2007. The status of grey seals in Britain. *NAMMCO Sci. Publ.* 6:69-78.

Hammill, M.O., Gosselin, J.F. and Stenson, G.B. 2007. Abundance of Northwest Atlantic grey seals in Canadian waters. *NAMMCO Sci. Publ.* 6:99-115.

Harwood, J. and Prime, J.H. 1978. Some factors affecting the size of British grey seal populations. *J. Appl. Ecol.* 15:401-411.

Haug, T., Henriksen, G., Kondakov, A., Mishin, V., Nilssen, K.T. and Røv, N. 1994. The status of grey seals *Halichoerus grypus* in North Norway and on the Murman coast, Russia. *Biol. Conserv.* 70:59-67.

Haug, T., Nilssen, K.T. and Skavberg, N.E. 1998. Registreringer og undersøkelser av kasteloka-liteter for havert i Finnmark og Troms i november-desember 1998. (Registration and investigations of pupping locations for grey seal in Finmark and Troms in Nov.- Dec. 1998) Fiskeriforskning, Rapport 23/1998: 12 pp. (In Norwegian).

Henriksen, G., Haug, T., Kondakov, A., Nilssen, K.T. and Øritsland, T. 2007. Recoveries of grey seals (*Halichoerus grypus*) tagged on the Murman coast in Russia. *NAMMCO Sci. Publ.* 6:197-201.

Kovacs, K.M. and Lavigne, D.M. 1986. Growth of grey seal (*Halichoerus grypus*) neonates: differential maternal investment in the sexes. *Can. J. Zool*. 64:1937-1943.

[NAMMCO] North Atlantic Marine Mammal Commission. 2004. Report of the NAMMCO Scientific Committee Working Group on Grey Seals. In: *NAMMCO Annual Report 2003*. Tromsø, Norway. Pp. 231-250.

Øynes, P. 1964. Sel på norskekysten fra Finnmark til Møre. (Seals on the Norwegian coast from Finmark to Møre). *Fiskets Gang* 50:694-707. (In Norwegian)

Øynes, P. 1966. Sel i Sør-Norge. (Seals in Southern Norway). *Fiskets Gang* 52: 834-839. (In Norwegian).

Wiig, Ø. 1986. The status of the grey seal *Halichoerus grypus* in Norway. *Biol. Conserv*. 38: 339-349.

Wiig, Ø. 1987a. The grey seal *Halichoerus grypus* (Fabricius) in Finnmark, Norway. *Fisk. Dir. Skr. Ser. Hav Unders.* 18:241-246.

Wiig, Ø. 1987b. The grey seal *Halichoerus grypus* (Fabricius) in Rogaland, Norway. *Fisk Dir. Skr. Ser. Hav Unders.* 18:303-309.

Wiig, Ø. 1988. The grey seal *Halichoerus grypus* (Fabricius) and the common seal *Phoca vitulina* L. in Troms, northern Norway. *Fauna Norv*. Ser A 9:43-46.

Wiig, Ø. 1989. The grey seal *Halichoerus grypus* (Fabricius) and the common seal Phoca vitulina L. in Lofoten and Vesterålen, northern Norway. *Fauna Norv.* Ser A 10:1-4.

Wiig, Ø. 1991. Demographic parameters for Norwegian grey seals, *Halichoerus grypus*. Fauna *Norv. Ser A.*12:25-28.

Wiig, Ø. and Øritsland, T. 1987. The grey seal *Halichoerus grypus* (Fabricius) and the common seal *Phoca vitulina* L. in Sogn og Fjordane, western Norway. *Fauna Norv. Ser* A 8:21-24.

Wiig, Ø., Ekker, M., Ekker, T. and Røv, N. 1990. Trends in the pup production of grey seals, *Halichoerus grypus*, at Froan, Norway, from 1974 to 1987. *Holarct. Ecol.* 13:173-175.

Zwanenberg, K.C.T. and Bowen, W.D. 1990. Population trends of the grey seal (*Halichoerus grypus*) in Eastern Canada. In: W.D. Bowen (ed.); Population biology of sealworm (*Pseudoterranova decipiens*) in relation to its intermediate and seal hosts. *Can. Bull. Fish. Aquat. Sci.* 222:185-197.