Distribution and population structure of North Atlantic harbour seals *(Phoca vitulina)*

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ABSTRACT

A review of the known geographical distribution and current knowledge on the genetic population structure of harbour seals *(Phoca vitulina)* in the North Atlantic is presented. Based on a synthesis of the results from five different studies of neutral genetic markers (mtDNA and nuclear microsatellites, mainly) twelve genetically distinct populations were identified in the North Atlantic: USA/Canada, Iceland, west coast of Norway, Ireland-Scotland, English east coast, Channel area, Wadden Sea, Limfjord, Skagerrak, Kattegat, West Baltic, and East Baltic. Most of the studies addressed the population structure at the regional level, while only a few addressed the structuring at a local level, *i.e.* within countries. Due to the limited number of studies conducted, the identified population units were considered preliminary and more detailed, local studies would probably reveal structuring on a finer scale. The choice of genetic markers, their properties, resolution in time and applicability in population structure studies is shortly discussed and compared to ecological methods used to delineate populations.

Andersen, L.W. and Olsen, M.T. 2010. Distribution and population structure of North Atlantic harbour seals *(Phoca vitulina)*. *NAMMCO Sci. Publ.* 8: 15-36.

INTRODUCTION

The harbour seal (*Phoca vitulina)* is distributed along the ice-free coasts of the northern hemisphere, and exhibits one of the widest longitudinal and latitudinal spans in distribution among pinnipeds (Burns 2002). Although there is some debate regarding their precise number and taxonomy, it is generally agreed to divide harbour seals into four subspecies, including *P. v. richardii* in the northeast Pacific, *P. v. stejnegeri* in the Northwest Pacific, *P. v. concolor* in the Northwest Atlantic, and *P. v. vitulina* inhabiting the Northeast Atlantic (Árnason *et al.* 1995, Stanley *et al.* 1996, Burg *et al.* 1999, Westlake and O'Corry-Crowe 2002) (Fig. 1). The Atlantic and Pacific subspecies are estimated to have diverged 1.7 to 2.2 mya coinciding with the first record of sea ice and continental glaciations. Colonisation of the North Atlantic suggestively began 0.9 to 1.3 mya proceeding from the West Atlantic to the north and then east to Europe (Stanley *et al.* 1996).

Harbour seal populations in the North Atlantic have experienced significant fluctuations in population sizes and distribution due to local outbreaks of Phocine Distemper Virus (PDV) and anthropogenic effects such as hunting, by-catch and habitat destruction (Dietz *et al.* 1989, Heide-Jørgensen *et al.* 1992, Härkönen *et al.* 2006). Recently, harbour seal populations along the east coast of Canada and in northern Britain have declined markedly (Lucas and Stobo 2000, Thompson *et al.* 2001, Bowen

Status of the harbour seal (*Phoca vitulina*) along the Murman coast of Russia

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ABSTRACT

Harbour seals are observed along the Murmansk coast of Russia, but they are not very abundant there. The estimated abundance for this area was about 500 individuals in 1998. The number of seals observed during winter months is less than during summer. During summer, the main habitats are the Pechenga inlet, the Motovsky and Kola Bays of the Western Murman coast and the Ivanovskaya Bay in the Eastern Murman coast. The Ivanovskaya Bay was thought to be the easternmost breeding colony of the subspecies *Phoca vitulina vitulina*. However, recent sightings may indicate the establishment of a breeding site further to the east, which then becomes the easternmost known habitat for this subspecies. A substantial, recent decrease in abundance has been observed in the Ivanovskaya Bay. The population numbered about 120 seals in the early 1990s, but only about 20 seals were seen in 2007 and 2008. It is presumed that the reasons for this reduction include hunting, fishery by-catch, disturbance and depletion of the food supply in this semi-enclosed inlet. A gender-specific daily activity pattern was observed in the Ivanovskaya Bay. The highest number of single animals (primarily adult males) hauled out during mid day, while hauled out females with pups showed two peaks per day associated with low tides.

Zyryanov, S. V. and Egorov, S. A. 2010. Status of the harbour seal *(Phoca vitulina)* along the Murman coast of Russia. *NAMMCO Sci. Publ.* 8: 37-46.

INTRODUCTION

At present, harbour seals, (*Phoca vitulina vitulina L.*), are considered rare along the Barents Sea coast of the Kola Peninsula (the Murman coast) in Russia. However, earlier presence of the species is documented by historical records (Russian pomors, Finnish and Norwegian colonists) where harbour seals were reported as *"nerpa-kamenka"* (stone seal, spotted seal). In 1900 and 1901, the Murmansk Research and Fishing Expedition only found three live specimens in the East Murman, and one cranium was found on the Novaya Zemlya coast (Smirnov 1903).

In a later report (Surkov 1966), the following was mentioned: "In the Murmansk Region, harbour seals are not present in large quantities, but they can be seen everywhere and come regularly to the shore. They swim up rivers and are found at long distances from the sea, in general the species is coastal. Harbour seals occur as single animals or in small groups forming no large breeding rookeries or moulting lairs and do not make long migrations".

During the 1980s, harbour seals have been observed as single seals or in small groups along the Murman coast including the Ainov Islands, the Zapadnaya Zelenetskaya and Dalneze-

Status and biology of harbour seals (*Phoca vitulina*) in Svalbard

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ABSTRACT

Harbour seals in Svalbard are the northernmost population of this species. This small population is comprised of ca. 1,000 individuals, most of which reside along the west coast of Prins Karls Forland (78°20'N). Satellite tracking studies have shown that adults are resident. Birthing occurs in the latter half of June. Newborns weigh about 11 kg and gain an average of 0.7 kg/d during the nursing period. Haulout patterns in Svalbard harbour seals are influenced by date (season), time of day, tidal cycle and temperature. Moulting takes place in early fall, first among juveniles, then in adult females and finally in adult males. Feeding studies show that polar cod *(Boreogadus saida)* is the dominant prey in terms of numbers, while Atlantic cod *(Gadus morhua)* is the dominant prey based on biomass, at least during the early autumn. Growth curves display significant sexual dimorphism with asymptotic values for standard length and body mass being greater for males. Testosterone levels in males showed an abrupt increase at 6 years of age, while estradiol levels in females increased abruptly from age 4 years. The reproductive rate for adult females was 0.93. Longevity of Svalbard harbour seals is very short compared with populations from other areas.

Lydersen, C. and Kovacs, K. M. 2010. Status and biology of harbour seals *(Phoca vitulina)* in Svalbard. *NAMMCO Sci. Publ. 8*: 47-60.

INTRODUCTION

The harbour seals in Svalbard constitute the northernmost population of this species in the world. The occurrence of this species in Svalbard is mentioned in several accounts from the 1800s (see *e.g.* Brown 1868), but it is evident in some of these records that the authors do not distinguish between harbour and ringed seals (*Pusa hispida*) and that it is the latter species that is described. The first reliable description of this species in Svalbard is from a harbour seal shot in 1898 west of Rossøya (ca 80.83°N, 20.00°E; Fig. 1) described by Römer and Schaudinn (1900). The skull from this specimen has been verified as belonging to a harbour seal by Wiig (1989). The main area of distribution of this species in Svalbard is off the west coast of Prins Karls Forland (Fig. 1 and 2), and the first trapper diary from this area that distinguished between harbour and ringed seals was from 1907-08 written by Peder Pedersen (Prestrud and Gjertz 1990). In the scientific literature the occurrence of harbour seals in Prins Karls Forland is mentioned by Øynes (1964), and their occurrence is confirmed by observations and specimen collections by Benjaminsen *et al.* (1973) and Krog and Bjarghov (1973). Since this time, this population has been the focus of several scientific investigations, and the following is a compilation of results from these studies and a general status of knowledge for this unique harbour seal population.

Status of harbour seals (*Phoca vitulina*) in mainland Norway

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ABSTRACT

Harbour seals were counted along the entire Norwegian coast at known moulting haulout sites in the period mid-August to early September 2003-2006. In 2003-2005, almost all known moulting areas from Finnmark to Vestfold counties were covered by aerial photo surveys flown at altitudes of approximately 800-900 ft (243-274 m), and at low tide (± 2 hours). Surveys in the Østfold County were flown in 2003-2006 at 300 ft (91 m), and the small tidal amplitudes permitted counts to be carried out irrespective of the tidal cycle. In some sub-areas, two or three independent surveys were conducted. Visual counts using binoculars from smaller boats and islands were carried out in some selected areas. The surveys revealed a total minimum population of 6,705 harbour seals in Norwegian waters. Harbour seals were most abundant in the Nordland and Sør-Trøndelag counties with minimum estimates of approximately 2,500 and 1,500 seals, respectively. The presented minimum estimate is approximately 800 seals lower than an estimate obtained in a comparable study carried out during the moult in 1996-1999. Increased anthropogenic removals, and the phocine distemper virus (PDV) epidemic in the Skagerrak region in 2002, may have contributed to the current lower estimate.

Nilssen, K.T., Skavberg, N.-E., Poltermann, M., Haug, T., Härkönen, T. and Henriksen, G. 2010. Status of harbour seals *(Phoca vitulina)* in mainland Norway. *NAMMCO Sci. Publ*. 8: 61-70.

INTRODUCTION

Northeast Atlantic harbour seals (*Phoca vitulina*) are distributed in coastal areas from northern Portugal to the Barents Sea (including also the British Isles, Iceland, and western Spitsbergen) and in the Baltic Sea (Bigg 1981, Wiig 1989, Henriksen *et al.* 1997). In Norway, the species is resident along the entire coast where they occur in three distinct types of habitats: open rocky coasts, deep fjords and estuarine sandbanks (Bjørge 1991). The northernmost harbour seal population in the world occurs at Prins Karls Forland, Svalbard (Lydersen and Kovacs, 2010). Harbour seal hunting has long standing traditions in Norway as an important food and fur resource for the coastal communities. The hunt can be traced back to the Stone Age (Olsen 1976), and the first laws regulating hunting rights dated back as early as 11th – 13th century (Anon. 1990). In the first part of the 20th century harbour seals were regarded more as vermin, with bounty paid in some areas, resulting in local depletion of the species. In order to prevent the species from extermination, local initiatives led to the protection of harbour seals in sub-areas of Nordland (1962) and Møre og Romsdal Counties (1966) (see Fig. 1). Also, during the

Status of harbour seals *(Phoca vitulina)* in the Baltic proper

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ABSTRACT

The small population of harbour seals in the Baltic proper descend from seals that entered into the Baltic some 8,000 years ago. They form a genetically separate population with private alleles not present elsewhere. They were hunted close to extinction in the beginning of the 20th century and experienced a severe bottle-neck with perhaps only ten reproductive females in the 1970s. Protective measures and reduction of xenobiotic substances have improved the situation, and the hauled-out moulting population size was 588 in 2008, and about 100 pups have been born annually during the past few years. The protective measures in the form of banned hunting and establishment of protected areas will suffice to allow the population to grow, but the population will not reach favourable conservation status within foreseeable future.

Härkönen, T and Isakson, E. 2010. Status of harbour seals *(Phoca vitulina)* in the Baltic proper. *NAMMCO Sci. Publ*. 8: 71-76.

INTRODUCTION

The harbour seals in the Baltic proper, currently confined to a handful of sites in the Kalmarsund region in Sweden (Fig. 1), form a discrete population that is genetically distinct from adjacent populations in the southern Baltic and the Kattegat. It shows substantially lower genetic diversity in microsatellite loci (F_{ST} = 0.37) than other populations of harbour seals worldwide (F_{ST} = 0.48-0.60) (Goodman 1998), and is fixed for 3 unique mitochondrial haplotypes that are most closely related to a common haplotype in the central North Sea and Iceland, rather than the most common haplotypes in adjacent waters (Stanley *et al.* 1996).

Since harbour seals entered into the Baltic system in connection with the formation of the Littorina Sea 8,000 years ago (Härkönen *et al.* 2005), the genetic uniqueness of the population can only be explained by its being founded by harbour seals that later went extinct elsewhere. Kattegat and Skagerrak must have been re-colonised by harbour seals at a later stage from a different source population (Härkönen *et al.* 2005). The low genetic diversity is a consequence of stochastic loss caused by low population size and near complete isolation through much of its history (Härkönen *et al.* 2005).

As with other Scandinavian seals, this population was severely depleted by an extermination campaign in the beginning of the 20th century. Modelling based on hunting statistics shows that the minimum population size that could withstand the hunt must have exceeded 5,000 seals in the beginning of the 20th century (Fig. 2). Hunting caused a rapid decline in the 1920s and 1930s, and only some 200 seals remained at the end of the 1960s. Sporadic surveys of the population in the beginning of the 1970s showed that only 10-20 pups were born, indicating a severe bottle-neck caused by

Status of the harbour seal *(Phoca vitulina)* in Southern Scandinavia

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ABSTRACT

The harbour seal population in Southern Scandinavia has experienced repeated declines caused by hunting and epizootics. These events have shaped the current distribution and abundance of the population. This paper assesses the current status of the population. We estimate trends in abundance of harbour seals from long term survey data, compare these with historic trends inferred from previously published material, and discuss past and potential threats to the harbour seal population of Southern Scandinavia. It is evident that harbour seals have disappeared from haulout areas along the Danish shores of Kattegat and in the westernmost part of the Baltic Sea, where they were previously numerous. In the 1920-30s, when abundance was at its lowest, the population is estimated to have been only a fraction of its original size. Following 30 years of protection the population is currently approaching historic abundance and might have reached the carrying capacity in some areas. Further development depends largely on effects of future epizootics, anthropogenic disturbance, and availability of suitable haulout sites.

Olsen, M.T., Andersen, S.M., Teilmann, J., Dietz, R., Edrén, S.M.C., Linnet, A., Härkönen, T. 2010. Status of the harbour seal *(Phoca vitulina)* in Southern Scandinavia. *NAMMCO Sci. Publ.* 8:77-94.

INTRODUCTION

The harbour seals *(Phoca vitulina)* in Southern Scandinavia have experienced a turbulent history. Persisting in low numbers since the end of the last glaciation, harbour seals likely became abundant in the region only a few centuries ago (Härkönen *et al.* 2005). Once established, harbour seals were subject to hunting; first due to the value of skin and blubber and later because of conflicts with the commercial fisheries (Søndergaard *et al.* 1976, Heide-Jørgensen and Härkönen 1988). The decline during the first decades of the 20th century was driven by a coordinated Scandinavian campaign, with the objective to

Population development and status of harbour seals *(Phoca vitulina)* in the Wadden Sea

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ABSTRACT

An index for the condition of a population should include a measure of the recuperative power or resilience of the population in question. This measure needs to cover both the demographic and physiological condition of the population. Applied to the harbour seal population in the Wadden Sea we therefore address respectively the population development and distribution, and its health condition, and relate these to environmental conditions. The harbour seal population has been severely depleted by hunting in the first half of the 20th century. After hunting was stopped in the mid-1970s the population recovered gradually. This recovery was twice interrupted by Phocine Distemper Virus (PDV) outbreaks in 1988 and 2002. These PDV-epizootics reduced the population by 57% and 50% respectively. They also lead to changes in age and sex structure of the population, which gradually returned to a stable age-structure. Despite the reduction in population size by respectively 57% and 50%, the population showed a strong recovery with a growth rate close to the considered maximum possible for this species. The observed changes in the distribution of the population over the 4 sub-regions indicate that distribution is not a static phenomenon. Long term field and pathological investigations point out that the general health status of the population has improved, particularly that of newborn seals (0-6 months old). The increasing prevalence of parasites in lungs and intestine warrants continued monitoring of the health status of seals. This is especially relevant in view of the exponential increase of the population, which may finally approach the carrying capacity of the area. Concluding, we can state that the condition of the population in terms of demographic and health parameters is satisfactory. The best guarantee for maintaining such a favourable conservation status is to abstain from human interferences (*e.g.* rescue, rehabilitation and release) with natural population processes. However, in practice there is increasing exploitation of marine waters. This requires a continuous monitoring of the potential impacts on the population, particularly of the effect on foraging and migratory behaviour.

Reijnders, P.J.H., Brasseur, S.M.J.M., Tougaard, S., Siebert, U., Borchardt, T. and Stede, M. 2010. Population development and status of harbour seals *(Phoca vitulina)* in the Wadden Sea. *NAMMCO Sci. Publ.* 8:95-106.

A note on harbour seal *(Phoca vitulina)* distribution and abundance in France and Belgium

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ABSTRACT

The most southern European colonies of harbour seals *(Phoca vitulina)* are located in France, in three areas: Baie du Mont Saint Michel, Baie des Veys and Baie de Somme. The largest colony is situated at the Baie de Somme, with a maximum of 186 individuals recorded on one occasion in the summer of 2008. All colonies are regularly monitored by different organisations. Different monitoring methods are used, including land-based, air-based and ship-based survey techniques. The basic results of the monitoring indicate a regular increase in the population size since 1990, with the total count of hauled out harbour seals for the three colonies increasing from 24 in 1990 to 295 in 2008. During the last years, an increasing number of pregnant females, pups and post-weaned seals have been observed. The recorded number of pups in 2008 was 53. Along the Belgian coast, no harbour seal colonies exist anymore, although individual animals and small groups are regularly observed at different locations. The high recreational use of Belgian beaches may prevent the establishment of colonies or regularly used haulout sites.

Hassani, S., Dupuis, L., Elder, J.F., Caillot, E., Gautier, G., Hemon, A., Lair, J.-M. and Haelters, J. 2010. A note on harbour seals *(Phoca vitulina)* distribution and abundance in France and Belgium. *NAMMCO Sci. Publ*. 8:107-116.

The status of harbour seals *(Phoca vitulina)* in the United Kingdom

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ABSTRACT

The UK holds approximately 40% of the European harbour seal population, with the majority found around the coasts of Scotland. Harbour seal populations in the UK have been monitored through a series of repeated aerial surveys of animals hauled out during the annual moult in early August. This moult count is used as a consistent index of population size. Survey methods and frequencies vary. The Scottish and English east coast populations mainly haul out in tidal estuaries and are surveyed annually, using fixed wing aircraft and digital photography. Populations in north and west Scotland often haul out on rocky shores and are surveyed less frequently, using helicopters fitted with thermal imagers. Overall, the most recent minimum estimate of the UK harbour seal population is 24,250 seals of which 19,800 are in Scotland, 3,200 in England and 1,250 in Northern Ireland. The results show that the number of harbour seals in eastern England was increasing before the 1988 and 2002 phocine distemper (PDV) epizootic but has not increased since the end of the 2002 epizootic. There is also evidence of a general decline in most of the large harbour seal colonies around Scotland. The populations along the north and northwest mainland coast were an exception, with numbers appearing to be stable. Between 2001 and 2008, the population in Orkney declined by 67% and Shetland declined by 40%, indicating harbour seals in these areas experienced substantially increased mortality or very low recruitment over this period. The widespread declines, ranging from Shetland to The Wash, suggest that the causes may have been present over a large part of the North Sea and waters off western Scotland.

Thompson, D., Duck, C.D. and Lonergan, M.E. 2010. The status of harbour seals *(Phoca vitulina)* in the United Kingdom. *NAMMCO Sci. Publ.* 8:117-128.

INTRODUCTION

Current estimates suggest that the UK holds about 40% of the total European harbour seal *(Phoca vitulina)* population, which is distributed between several major regions (Fig. 1). Until recently, around half of the UK harbour seal population was found in Orkney and Shetland, with large numbers also being recorded on the west coast of Scotland, including the Hebrides, and around the main river estuaries on the east coast of Scotland and England (SCOS 2008). They are rare on the south and west coasts of England and effectively absent from Wales. Different components of the UK population have been affected by hunting (Vaughan 1978; Bonner *et al.* 1973), loss of habitat, effects of human disturbance and pollution (Reijnders 1986, Reijnders 1992a, de Swart *et al.* 1994) as well as other phenomena such as the phocine distemper virus (PDV) epizootics (Hall *et al.* 1992, Hall *et al.* 2006; Härkönen *et al.* 2006).

The level of population monitoring around the UK has been variable. The Wash is the largest

The status of the harbour seal *(Phoca vitulina)* in Ireland

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ABSTRACT

The status of Ireland's harbour seal population and its relationship with that of Britain and Western Europe are poorly understood. Prior to 2003, limited research efforts and poor co-ordination of survey methods fell short at providing an accurate assessment of overall distribution and population size on a regional or national scale. However, in August 2003, the Republic of Ireland's harbour seal population was assessed by means of a geographically extensive survey conducted during the annual moult, providing an up-to-date minimum population estimate and a reliable baseline for future surveys. Trends on a national scale could not be assessed due to absence of a reliable historic population estimate; however there is some evidence of local decreases and increases in harbour seal numbers in Northern Ireland and southwest Ireland respectively. Research effort to date on aspects of the ecology of the harbour seal in the Republic of Ireland is reviewed and current research and management priorities highlighted.

Cronin, M.A. 2010. The status of the harbour seal *(Phoca vitulina)* in Ireland. *NAMMCO Sci. Publ*. 8: 129-142.

HARBOUR SEAL ABUNDANCE AND DISTRIBUTION

Minimum estimate of the Irish harbour seal population

The population of harbour seals *(Phoca vitulina vitulina)* in Ireland was first enumerated by Lockley (1966) who based his minimum estimate of 1,000 on data collected incidentally, during surveys of grey seals *(Halichoerus grypus)*, in the autumns of 1964-65. Further harbour seal specific surveys were carried out in northern Ireland by Venables and Venables (1960), Nairn (1979) and, more recently, by Wilson and Corpe (1996). The first harbour seal census of the island of Ireland was undertaken in July 1978 (Summers *et al.* 1980). Based on a combination of boat and aerial surveys, this gave a minimum estimate of 1,248 but absolute abundance was considered to be 1,500 to 2,000 individuals. Additional information in the Republic of Ireland was collected by Warner (1983, 1984) and haulout counts were conducted by the National Parks and Wildlife Service (NPWS) of the Department of Environment, Heritage and Local Government at some well-known sites in the intervening years (Table 1). However, these counts have varied in location, consistency, timing and methodology and could not provide complete national or island-wide perspectives on population size and distribution.

Population monitoring in Northern Ireland has indicated a consistent decline in the breeding population along the County Down coastline (Wilson and Montgomery-Watson 2002;

A note on the harbour seal (*Phoca vitulina*) in the Faroe Islands

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ABSTRACT

The harbour seal was exterminated as a breeding species in the Faroe Islands in the mid-19th Century. Historical sources document that the harbour seal used to be a common inhabitant of the sheltered fjords where breeding occurred. It was reported to be more common than the grey seal, the other pinniped specie resident around the Faroes. But the number of harbour seals seemingly decreased as human settlements and other anthropogenic activities increased. Seal hunting was apparently already introduced by the Norse that arrived on the islands in the 7th century, a hunt that finally lead to the extermination of the harbour seal. For the last 40 years the harbour seal has only been positively identified twice in the Faroe Islands, in 2001 and 2005.

Mikkelsen, B. 2010. A note on the harbour seal *(Phoca vitulina)* in the Faroe Islands. *NAMMCO Sci. Publ. 8*: 143-146

INTRODUCTION

The harbour seal (*Phoca vitulina*) is a medium-sized coastal seal widely distributed in temperate and arctic waters of the North Atlantic (King 1983, Bonner 1994). In the eastern Atlantic *Phoca vitulina vitulina* is breeding from Svalbard in the north to France in the south and around the UK and Iceland (King 1983, Bonner 1994). The species is typically found in congregations of up to several hundred animals around favourable haulout sites (King 1983). They are philopatric to their natal area and are rarely moving longer distances away from these locations (Stanley *et al.* 1996, Härkönen and Harding 2001). In the Faroe Islands the harbour seal was a common species, breeding in the fjords in early summer (Svabo 1783, Landt 1800), but the species became exterminated by the islanders around 1845 (Degerbøl 1940, Dánjalsson 1960, Reinert 1982). The species has not re-colonised the Faroes, and has more or less been absent from these waters for 150 years (Bloch 1998). The present note gives a brief summary of the very limited information, mainly from anecdotal sources, available on the harbour seal in the Faroes Islands.

HISTORICAL INFORMATION

The Faroe Islands were settled by the Norse in the 7th century (Jóhansen 1985). The existence of the inhabitants on these isolated islands was very much dependent on natural resources. Cultivation of the land could fail and fish could also be absent from shallow waters in unfavourable years, so the use of whale resources in the traditional drive hunt, using wooden boats, became important at an early stage (Bloch 1998). Seal hunting was also an important food supplement which in addition provided oil for indoor lighting. Seals were

Historical trend in harbour seal *(Phoca vitulina)* abundance in Iceland back to the year 1912

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ABSTRACT

The harbour seal *(Phoca vitulina)* is Iceland's most abundant seal and has likely been exploited since the settlement of the country. Detailed information on skin exports is available as far back as 1912, and suggests that the catch, consisting mainly of pups, was far higher in the early 20th century than now. Assuming that skin exports were proportional to catches, these data were used to back-calculate the size of the Icelandic harbour seal population to the year 1912. The results indicate that the harbour seal population was considerably larger in the early 19th century than at present, about 60,000 (90% CI:40-100) animals. Aerial surveys conducted since 1980 indicate that the population has declined from 33,000 (90% CI:26,000-44,000) animals in 1980 to about 12,000 (90% CI:9,000-16,000) animals in 2006. The population time series suggests that the stock began to decline rapidly around 1960 and continued to decrease until 2003. In the period 1980 - 2003, the population declined even though reported catches were relatively low. Harvest rate had probably been about 10% before 1960. Between 1960 and 1980 the reported harvest rate increased to about 13%, but unknown numbers of adult seals were also taken as by-catch and shot in defence of salmon rivers. Since 2003, total removals have decreased and the population decline appears to have ceased. Entanglements in fishing gear and other incidental unreported hunting could increase again in the future. Therefore, the population must be monitored on a regular basis, and better information on by-catch and other unreported harvest is needed.

Hauksson, E. and Einarsson, S.T. 2010. Historical trend in harbour seal *(Phoca vitulina)* abundance in Iceland back to the year 1912. *NAMMCO Sci. Publ.* 8:147-160.

INTRODUCTION

The harbour seal *(Phoca vitulina)* has been, according to anecdotal information the most common coastal seal in Iceland for centuries. Its exploitation probably started immediately upon settlement of the country in the 9th century (Hauksson and Einarsson 2010). The hunt was based on exploiting harbour seal herds breeding on privately own land. Further, this information also suggests that harbour seal skins, salted or dried, were exported in earlier times as they are today. A large dataset of catch statistics is available from trading logbooks as far back as 1897(Appendix 1). Information on exports of seal skins from 1897 to 1972 was compiled by Arnlaugsson (1973).

The pre-exploitation size of the population size is not known, as systematic monitoring of the Icelandic harbour seal population was initiated in 1980 (Hauksson 2010). Based on the catch statistics it is apparent that the Icelandic harbour seal population must have been considerably

Catch history and status of the harbour seal *(Phoca vitulina)* in Greenland

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ABSTRACT

The number of harbour seals *(Phoca vitulina)* in West Greenland declined rapidly after the 1950s and the seals have now abandoned their traditional haulout locations along the Greenland west coast. However, in recent years, a previously undetected group of about 60-100 harbour seals has been observed approximately 80 km upstream in a large river, and some traditional haulout locations are still in use near the south-eastern tip of Greenland. A small number of harbour seals is caught annually far from any of these locations, indicating that other groups might live unnoticed. Catch statistics provide the best evidence of the presence and locations of these remnant harbour seals. Therefore efforts were made to validate the recent catch statistics and to describe the catch history for the past 60 years. The catch statistics were also used to estimate plausible ranges of past and present numbers of harbour seals based on the assumption that hunting has caused the observed decline. The total number of harbour seals in Greenland according to these estimates was about 3,000 in 1950 and fewer than 1,000 in 2007. The number of harbour seals caught in the southernmost part of Greenland has, unlike in the rest of Greenland, increased significantly in some of the recent years. This change seems to be related to changes in the amount of drift ice. Drift ice reduces the frequency of contact between hunters and harbour seals in South Greenland and above normal quantities of drift ice from the mid 1960s to the mid 1980s probably allowed these seals to increase in numbers. Record low inflow of drift ice in some of the recent years, however, has resulted in record high catches, which likely have reduced the seals again. The remaining harbour seals in Greenland are few and without protection these seals are potentially in danger of extinction.

Rosing-Asvid A. 2010. Catch history and status of the harbour seal *(Phoca vitulina)* in Greenland. *NAMMCO Sci. Publ*. 8:161-174.

INTRODUCTION

The harbour seal *(Phoca vitulina)* is distributed along the sections of the Greenlandic coast which have sub-arctic marine environments (south of 67°N on the east coast and south of 75°N on the west coast). Only a few sightings have been reported along the high-arctic part of the coast. The population structure of Greenland harbour seals has not been investigated (see Andersen and Tange Olsen 2010).

A breeding site once existed at 66°N near Ammassalik on the east coast (Teilmann and Dietz 1993) and harbour seals were common in the area by the start of the 20th century (Winge 1902). It is uncertain when this breeding locality was abandoned, but catch statistics indicate that harbour seals had become rare around Ammassalik by the 1950s. Today, the only area along the east coast where harbour seals are commonly seen is on the southernmost coast near Cape Farewell (south of 61°N).

Status of harbour seals (*Phoca vitulina*) in Atlantic Canada

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ABSTRACT

Harbour seals are associated with small islets, reefs and rocks exposed at low tide and estuarine habitats throughout eastern Canada. Evidence of harvesting by indigenous people has been found in pre-European contact archaeological excavations. A bounty harvest as well as subsistence and commercial hunting probably lead to a decline in the population from 1949 to the early 1970s. The bounty was removed in 1976, and harbour seals, in the southern parts of their range have been protected since then. There is little information available on total abundance and current population trend. Mitochondrial and microsatellite DNA research has shown separation between Northeast and Northwest Atlantic harbour seals. Within Canada, the subspecies *Phoca vitulina* concolor shows some population sub-structure with three distinct units that could be separated into Hudson Bay, Gulf of St. Lawrence and Sable Island. Urban development resulting in habitat degradation is probably the most important factor affecting harbour seal populations in Atlantic Canada, although other factors such as incidental catches in commercial fisheries and competition with grey seals may also be important.

Hammill, M.O., Bowen, W.D. and Sjare, B. 2010. Status of harbour seals *(Phoca vitulina)* in Atlantic Canada. *NAMMCO Sci. Publ.* 8:175-190.

INTRODUCTION

The harbour seal (*Phoca vitulina*) has the most extensive breeding distribution of any pinnipeds with breeding colonies distributed over 16,000 km from the Baltic Sea to Japan (Stanley *et al.* 1996). Five subspecies are recognized, with *P. v. richardii* and *P.v. stejnegeri* occurring in the eastern and western Pacific respectively, *P.v. vitulina* occurring in the Northeast Atlantic, *P.v. concolor* in the Northwest Atlantic, eastern Canadian Arctic and Hudson Bay, and *P.v. mellonae* confined to a few freshwater lakes in northern Quebec (Rice 1998).

In eastern Canada, harbour seals are also known as Kasigiak in Inuktitut, or ranger (young), dotard or doter (adult), bay, common and spotted seal in English (Mansfield 1967). In French they are known as phoque commun, loup-marin d'esprit, loup-marin de baie, loup-marin de batture, and loup-marin de grève (Comeau 1945, Mansfield 1967).

P.v. concolor has been reported throughout Hudson Bay, along the Baffin Island coast, Labrador, Newfoundland, the St. Lawrence River Estuary and Gulf of St. Lawrence, along the Nova Scotia coast, Sable Island, and in the

A review of the status of harbour seals *(Phoca vitulina)* in the Northeast United States of America

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ABSTRACT

We conducted a review of the literature and unpublished databases to describe the distribution, abundance, ecology and status of harbour seals *(Phoca vitulina concolor)* in U.S. Atlantic waters. The harbour seal is the most abundant and widespread seal species in this area. Since passage of the U.S. Marine Mammal Protection Act of 1972, the number of harbour seals observed during the pupping season in this region has increased from about 10,500 animals in 1981 to 38,000 animals in 2001 (uncorrected counts), an average annual rate of 6.6%. This increase has been relatively consistent over the 20 years, and there is no indication that the population size has stabilized. Correspondingly, the seasonal distribution has expanded and interactions between seals and anthropogenic activities have increased.

Waring, G.T., Gilbert, J.R., Belden, D., Van Atten, A. and DiGiovanni, R.A. 2010. A review of the status of harbour seals *(Phoca vitulina)* in the Northeast United States of America. *NAMMCO Sci. Publ.* 8:191-212.

INTRODUCTION

Harbour seals *(Phoca vitulina concolor)* have been recorded in the journals and sketches of European settlers in the northeastern U.S. since the beginning of the 17th century (Katona *et al.* 1993, deHart 2002). Historically, harbour seals were killed by fishermen and others as they were considered a nuisance and a competitor for fish (Gilbert *et al.* 2005). New England hunting and bounty programmes resulted in local extinction (Katona *et al.* 1993). However, since 1972 seals have been protected in U.S. waters under the Marine Mammal Protection Act (MMPA).

Following enactment of the MMPA harbour seal studies were initiated along the coast of Maine (Richardson 1976, Wilson 1978). The first studies provided information on distribu-

A modelling framework to optimize timing of haulout counts for estimating harbour seal *(Phoca vitulina)* abundance

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ABSTRACT

The time of year and day, the state of the tide and prevailing environmental conditions significantly influence seal haulout behaviour. Understanding these effects is fundamentally important in deriving accurate estimates of harbour seal abundance from haulout data. We present a modelling approach to assess the influence of these variables on seals' haulout behaviour and, by identifying the combination of covariates during which seal abundance is highest, predict the optimal time and conditions for future surveys. Count data of harbour seals at haulouts in southwest Ireland collected during 2003-2005 were included in mixed additive models together with environmental covariates, including season, time of day and weather conditions. The models show maximum abundance at haulout sites occurred during midday periods during August and in late afternoon/early evening during September. Accurate national and local population estimates are essential for the effective monitoring of the conservation status of the species and for the identification, management and monitoring of Special Areas of Conservation (SAC) in accordance with the EU Habitats Directive. Our model based approach provides a useful tool for optimising the timing of harbour seal surveys in Ireland and the modelling framework is useful for predicting optimal survey periods for other protected, endangered or significant species worldwide.

Cronin, M.A., Ingram, S.N., Zuur, A.F. and Rogan, E. 2010. A modelling framework to optimize timing of haulout counts for estimating harbour seal *(Phoca vitulina)* abundance. *NAMMCO Sci. Publ*. 8:213-226.

INTRODUCTION

Deciding on the optimal time to conduct a survey of an animal population to determine the size of the population is a challenging task. Such surveys are necessary for reasons such as basic ecological audits for conservation management and planning decisions or population estimate and trend analyses for assessing the conservation status of endangered or protected species. They are also essential in policy making for the protection of the environment. It is rare that all individuals in a population can be counted during an assessment of population size, making accurate estimates of population size difficult to obtain. Various approaches have been used to overcome this problem including mark-recapture models, distance sampling techniques and

Monitoring trends in the abundance of harbour seals *(Phoca vitulina)* in Icelandic waters

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ABSTRACT

Harbours seal (*Phoca vitulina)* numbers along the coast of Iceland were monitored by aerial survey in the period 1980-2006. Trends in the abundance of the harbour seal population on the whole coast and in coastal regions of Iceland waters were estimated using ANCOVA on the survey counts, corrected for the influence of several covariates. Harbour seals were found in every coastal area, but were most abundant in Faxaflói, Breiðafjörður and on the northwest coast in the beginning of this study. Harbour seal numbers declined significantly at a rate of r_{est} = -0.04 (SE 0.005) yr^{-1} during this period. Decline was highest in Faxaflói and at the south coast (≅7%), while the east coast experienced a significant but lesser (≅1%) decline. Other coastal areas did not show significant trends. The northwest coast was the richest harbour seal area in Iceland in 2006. In Icelandic waters seals are commercially harvested, and unreported but probably high numbers of harbour seals are killed intentionally by shooting and accidentally in fishing gear each year. These factors likely contributed to the overall observed decline in seal numbers.

Hauksson, E. 2010. Monitoring trends in the abundance of harbour seals (*Phoca vitulina*) in Icelandic waters. *NAMMCO Sci. Publ.* 8:227-244.

INTRODUCTION

An understanding of population status of the Icelandic harbour seal (*Phoca vitulina vitulina*) is a fundamental requisite for its effective management and conservation. The current catches are low (104 harbour seals were caught in year 2007) but were much higher in the past (in the 1970's the annual catch was about 6,000 (MRI 2008)). The exploitation of the stock and the unreported but possibly high numbers of harbour seals killed intentionally by shooting and accidentally in fishing gear each year (Hauksson and Einarsson 2010) makes it highly relevant to monitor harbour seal abundance on a regular basis. In addition, current and accurate information on trends in abundance is needed to understand the role of the population in ecosystem dynamics, its potential interactions with fisheries, the impacts of global climate change, and other anthropogenic changes caused in habitat (Small *et al.* 2003).

In Iceland harbour seals inhabit coastal waters all around the country (Fig. 1). There are 2 types of haulout sites, rocks (Fig. 2) and sandbanks (Fig. 3), which can be at the exposed coast or inside sheltered river estuaries, frequently glacial rivers. Hardly any data on trends of total numbers are available prior to 1980 and no aerial surveys covering the entire coastline were undertaken. Arnþór Garðarsson (unpublished) counted harbour seals from an aircraft on part of the Icelandic coast in the summers of 1973 and 1977. He found 2,500; 632 and 3,568 harbour seals in Faxaflói, Vestfjörðum and the northwest - north-

Age determination methods in harbour seals *(Phoca vitulina)* with a review of methods applicable to carnivores

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ABSTRACT

The development of age determination methods in marine mammals is reviewed with particular reference to the use of teeth Growth Layer Groups (GLGs) formed in the dentine and cement of carnivores. Using this background, practices for sampling, tooth extraction and collection, storage and different methods of preparation of teeth as well as reading and counting GLGs are discussed and evaluated for the harbour seal *(Phoca vitulina)*. The paper includes comments on best practices for counting GLGs with new examples from known-age seals, and also a detailed examination of confounding factors in interpreting GLGs such as mineralization anomalies and the phenomena of accessory lines, "false annuli" and "paired laminae" which have not been discussed previously. The paper concludes with recommendations for undertaking age estimation in harbour seals from sampling through final GLG interpretation with special emphasis on standardization of methods with other researchers.

Lockyer, C., Mackey, B., Read, F., Härkönen, T. and Hasselmeier, I. 2010. Age determination methods in harbour seals *(Phoca vitulina)* with a review of methods applicable to carnivores. *NAMMCO Sci. Publ.* 8:245-264.

Epizootics in harbour seals *(Phoca vitulina)*: clinical aspects

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ABSTRACT

Epizootic diseases causing considerable mortality in harbour seal populations have mainly been reported from the waters of the United States and Europe. Such die-offs were largely attributable to viral infections. Several hundred individuals died from respiratory infections caused by Influenza A viruses at the coast of New England, USA, in 1979, 1980 and 1982. More than 53,000 harbour seals were killed in European waters by Phocine Distemper Virus (PDV), a morbillivirus, in two outbreaks in 1988 and 2002. For several other epizootics of smaller scale in the waters of the Atlantic and Pacific coast of the USA and, most recently, in Danish and Swedish waters in 2007 the causes remain unclear, although characteristic respiratory symptoms and interstitial pneumonia suspicious of viral etiology were detected as well as occasionally bacterial infections caused by *Erysipelothrix rhusiopathiae* and *Pseudomonas aeruginosa*. Mass mortalities caused by biotoxins, direct human interactions or changes in oceanographic conditions have so far not been described for harbour seals. However, high organochlorine loads detected in European harbour seal populations and suspected to impede immune functions, were considered an aggravating factor in the 1988 morbillivirus epizootic. Establishing supranational stranding networks is a key prerequisite for the detection of future unusual die-offs in marine mammals. Detailed post-mortem investigations of all organ systems are essential for targeted etiological studies towards the causes of mass mortalities in seals.

Siebert, U., Gulland, F., Harder, T., Jauniaux, T., Seibel, H., Wohlsein, P. and Baumgärtner, W. 2010. Epizootics in harbour seals *(Phoca vitulina)*: clinical aspects. *NAMMCO Sci. Publ.* 8:265-274.

Predicting recurrent PDV epizootics in European harbour seals *(Phoca vitulina)*

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ABSTRACT

Phocine Distemper Virus (PDV) caused mass mortality in European harbour seals *(Phoca vitulina)* in 1988 and in 2002. Both epizootics likely originated from *refugia* in Arctic seals, where data indicate PDV hops among populations and species. The metapopulation structure of host populations is suggested to be the reason why PDV is preserved among Arctic seals, since the high rate of spread of PDV would require much larger panmictic populations to maintain an infection. The pattern of sudden outbreaks of PDV is also seen in grey seals *(Halichoerus grypus)*, the only to date identified species that could act as a vector between Arctic and North Sea seal populations. Harbour seal populations along mainland Europe were below critical herd immunity levels by 3-5 years after the events, and thus vulnerable for new outbreaks, but historical data and the 14 years between the 2 epizootics suggest that harbour seals in the North Sea area are only rarely exposed to the infective agent. The risk for new outbreaks of the seal plague in North Sea harbour seals is likely linked to the dynamics of the disease in Arctic seal species as well as vector species.

Härkönen, T. and Harding, K.C. 2010. Predicting recurrent PDV epizootics in European harbour seals *(Phoca vitulina)*. *NAMMCO Sci. Publ*. 8:275-284.

INTRODUCTION

A majority of epizootic diseases affecting domestic and wildlife populations originate from reservoir species where they are endemic, thus infections are maintained without the need for external inputs. Illustrative examples are blue tongue disease which is caused by an orbivirus probably originating from African ungulates (Bekker 1934), rabies present in many species of carnivores (Childs 2002), and severe acute respiratory syndrome (SARS) endemic in Chinese bat populations (Lau 2005). The phocine distemper virus (PDV) circulates among Arctic seal species, predominantly harp seals *(Phoca groenlandica),* ringed seals *(Phoca hispida)* and hooded seal *(Cystophora cristata)*, which can act as reservoirs from where new infections can spread to other seal species further south (Härkönen 2006).

Two of the most severe mass mortalities ever recorded in wildlife populations were caused by PDV epizootics in European harbour seals *(Phoca vitulina)* in 1988 and 2002, when more than 50,000 seals died (Härkönen *et al.* 2006). Mortality rate along mainland Europe was close to 50%, whereas British stocks were less affected on both occasions (Harding *et al.* in prep.).

The connectivity between source and peripheral host populations is one important parameter affecting the risk of transferring the infective

Winter habitat use of harbour seals *(Phoca vitulina)* fitted with Fastloc™GPS/GSM tags in two tidal bays in France

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ABSTRACT

Winter movements and habitat use of harbour seals *(Phoca vitulina)* were investigated in two tidal bays in France, at the southern limit of their species range in the Northeast Atlantic. We fitted 15 seals with Fastloc™GPS/GSM tags in the Baie du Mont-Saint-Michel *(BMSM)* and the Baie des Veys (*BDV*). Tags relayed 20.6±7.1 GPS locations per seal-day, 81% of all dives performed by the seals and 87% of haulouts, during an average tracking duration of 108±56 days. One seal travelled 380 km away from the *BMSM* but the other seals remained stationary, with 95% and 55% of at-sea locations ≤ 5 km from the haulout sites in *BMSM* and *BDV* respectively. Home range sizes were 137 and 161 km² in *BMSM* and *BDV*, and core areas' sizes, 35 and 22 km² respectively. The seals remained very coastally in both sites with 93% and 71% of at-sea locations located in the intertidal zone of *BMSM* and *BDV* respectively. Accordingly, dives were shallow with 63% and 61% of dive maximum depths <4 m and 94% and 88% <10 m (in *BMSM* and *BDV* respectively). Preferred foraging areas were located in tidal channels in *BMSM*, sometimes in the vicinity of rocks or mussel farms. In *BDV* one seal made foraging trips 10-15 km offshore but all other seals repeatedly used coastal areas, often foraging around mussel farms, shipwrecks or intertidal rocks in tidal currents. We suggest that the importance of the tides combined with local features of the topography allow seals to predict prey availability, driving their foraging strategies towards a number of specific coastal areas. These results further illustrate the behavioural plasticity of the species according to habitat and environmental conditions. Fastloc™ GPS/GSM telemetry is particularly well adapted for the study of seals' habitat use at a fine geographical and temporal scale, as long as they occasionally come close to shore within GSM coverage.

Vincent, C., McConnell, B.J., Elder, J.-F., Gautier, G. and Ridoux, V. 2010. Winter habitat use of harbour seals *(Phoca vitulina)* fitted with Fastloc™ GPS/GSM tags in two tidal bays in France. *NAMMCO Sci. Publ.* 8:285-302.

Haulout behaviour of harbour seals *(Phoca vitulina)* during breeding and moult in Vesterålen, Norway

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ABSTRACT

Haulout behaviour of harbour seals *(Phoca vitulina)* in Vesterålen, Norway, was investigated from 1 July to 23 August 2003 using a combination of high- and low-tide counts performed from boat and elevated land positions, and hourly counts from the land positions through 12- or 24-h cycles at specific haulout sites. There were obvious contrasts in haulout patterns of the seals throughout the period. The number of seals hauled-out was considerably higher in the area in July (the pupping period) than during August when the moulting period started. Contrasting July, when numbers of seals hauled-out at low tide was clearly higher than at high tide, there were virtually no systematic differences in haulout numbers between high and low tides in August. Circadian patterns were weaker in August than in July as well. Low temperatures had significant adverse effects on haulout numbers both in July and August, whereas increased cloud cover resulted in fewer seals hauled-out in July, but more seals in August.

Mogren, H.-G., Lindstrøm, U., Nilssen, K.T. and Haug, T. 2010. Haulout behaviour of harbour seals *(Phoca vitulina)* during breeding and moult in Vesterålen, Norway. *NAMMCO Sci. Publ.* 8:302-312.

INTRODUCTION

Under a new management regime for harbour seals *(Phoca vitulina)* in Norway (Anon. 1990), it has been recommended that a monitoring programme be established where the population should be surveyed approximately every 5 years (see Nilssen *et al.* 2010). The most feasible approach to estimating harbour seal abundance is to use aerial photographic surveys when the seals are hauled-out of the water. Understanding the timing of haulout behaviour, therefore, is of critical importance to survey design. Harbour seals are usually counted during pupping and/or moult, when a larger fraction of the population hauls-out (Heide-Jørgensen and Härkönen 1988, Thompson and Harwood 1990, Reijndeers *et al.* 1997, Huber *et al.* 2001, Boveng *et al.* 2003, Gilbert *et al.* 2005). In Norwegian coastal waters, 2 abundance estimate surveys have been performed to assess the size of the entire population, and both were conducted during moult in 1996-1999 (Bjørge *et al.* 2007) and in 2003-2006 (Nilssen *et al.* 2010), respectively.

Several factors have been identified as factors that affect the number of harbour seals hauling out. These include seasonal, meteorological, tidal and diurnal factors. However, relationships between these conditions and the numbers of seals hauled-out tend to be quite variable between years and locations indicating that population or site specific analyses of conditions may be required (*e.g.*, Stewart 1984, Thompson and Miller 1990, Roen and Bjørge

The diet of harbour seals *(Phoca vitulina)* at the southern limit of its European distribution (Normandy, France)

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[4] *Réserve Naturelle Nationale du Domaine de Beauguillot, F-50480 Sainte-Marie du Mont, France*

ABSTRACT

Changes in habitat availability or resources are likely to have the biggest impact on survival or abundance of individuals found at the extremity of the population's range. In the case of such marginal populations, the first step in designing appropriate conservation plans is the identification of potential risks to the viability of the population, or subpopulation. For example, the interaction between coastal seals and fisheries is often considered as a major conservation issue, due to the potential co-exploitation of the same resources by both fishermen and seals. The diet of harbour seals was investigated by scat analysis at the southern extremity of their European range, in *Baie des Veys* (Normandy, France). A total of 121 scats, analysed following standard methodologies, revealed a diet largely dominated by mullets, *Mugilidae* (49% by mass), plaice, *Pleuronectes platessa* (29% by mass) and garfish, *Belone belone* (19% by mass). The diet of harbour seals at the edge of their European distribution differs from all previous studies conducted elsewhere, in terms of species composition, but shows a similar balance between fat and lean fish. Overall diet composition suggests a low potential for interaction with fisheries as commercial fishery target species are almost absent.

Spitz, J., Mariotti, L., Ridoux, V., Caillot, E. and Elder, J.F. 2010. The diet of harbour seals *(Phoca vitulina)* at the southern limit of its European distribution (Normandy, France). *NAMMCO Sci. Publ.* 8:313-328.

Interactions between harbour seals *(Phoca vitulina)* and coastal fisheries along the Swedish west coast: an overview

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ABSTRACT

The conflicts between seals and fisheries along the Swedish west coast have intensified during the last decades, concurrently with the increase in the harbour seal population size. This study presents published information about interactions between harbour seals and fisheries in the Kattegat-Skagerrak, in addition to new information on the seal by-catch rate and an overview of fisheries suffering from seal damage. Several fisheries have reported interactions with seals, principally fisheries with fyke nets, gill nets and static gear. Development of mitigation measures has been focused on the eel fishery with fyke nets, in which the use of stronger net material has significantly decreased the damage frequency from seals and has yet maintained the catches at satisfactory levels. Under-water filming at fyke nets together with studies of the prey preferences of seals has shown individual specializations in certain foraging techniques. For example, eel may not be a common prey for harbour seals in general, but, it was chosen in preference to other species by seals attacking fyke nets. There is a lack of current data concerning the diet of harbour seals. Previous studies, based on material from the 1970s and 1980s, have shown that locally and seasonally abundant prey is preferred. Due to the non-existent information about the food choice, current assessments of the ecological role of harbour seals in Sweden cannot be evaluated.

Lundström, K, Lunneryd, S.-G., Königson, S. and Hemmingsson, M. 2010. Interactions between harbour seals *(Phoca vitulina)* and coastal fisheries along the Swedish west coast: an overview. *NAMMCO Sci. Publ.* 8: 329-340.

INTRODUCTION

Interactions between seals and fisheries can be divided into operational and ecological interactions. Operational interactions arise when seals cause damage to fishing gear and catch, and when seals are incidentally by-caught in fishing gear. Ecological interactions can be either direct or indirect. Direct ecological interactions include the consumption of commercial species by seals and the reduction of important seal prey by fisheries. Indirect ecological interactions include the consumption of prey and predators of commercial species by seals, the reduction of prey and predators of important seal prey by fisheries and the dispersal of seal borne fish parasites.

Review on utilization and research on harbour seal *(Phoca vitulina)* in Iceland

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ABSTRACT

Harbour seals *(Phoca vitulina)* have been harvested in Iceland since the first settlers arrived in the 9th century. Pups were generally netted, clubbed and harpooned until 1875 when general use of guns for hunting began. Seal-hunting has been traditional amongst the farms legal rights. Seal hunting was an important supplement to other economic resources. Harbour seal skins, salted or dried, were exported and large dataset of catch statistics is available from trading logbooks since the late 19th century. In the early 20th century catch was about 6,000. In the 'bounty' period 1982 – 1989, maximum catches were of 4,000 animals with about 350 hunters participated; in 2006 catches were only about 100 animals with 18 hunters. After 1989 the population continued to decline even though catches decreased markedly. Unreported by-catch in fishing gear, hunt for local consumption and shooting of seals swimming in salmon rivers estuaries may have kept the total removal from the stock above sustainable levels. A considerable Icelandic knowledge base had been compiled about the biology of the harbour seal since the late 16th century, with the first written reference in 1588-1589. In the last decades, research on various aspects of its biology and monitoring have been intensified, with focus on abundance, distribution, diet and nematode infestation. The main results show that the Icelandic harbour seal population - has declined annually about 5% in the period 1980-2006, - was most abundant on the NW-coast, - feeds mainly on sand-eels and gadoids, - and was less infected with anisakid nematodes than grey seals. Seal-watching, as a low-consumptive indirect utilization, may represent a new economical opportunity if properly regulated.

Hauksson, E. and Einarsson, S.T. 2010. Review on utilization and research on harbour seal *(Phoca vitulina)* in Iceland. *NAMMCO Sci. Publ*. 8:341-354.

INTRODUCTION

In the 9th century, when Iceland was settled there is indication of large abundance of seals and many locations are named after seals and sealing (Kristjánsson 1980, Hallgrímsson 1985). Sealing likely started right in the beginning of the settlement and seals were probably a quite important resource for the early settlers. Indications of this are reflected by clauses in the early laws and rules that relate to seals and sealing. Settlement locations were often chosen with regard to facilities for seal hunting and from early days landowners sold permissions for sealing at places where prospects for spotting seals were considered good (Kristjánsson 1980).

Seal-hunting has been traditional amongst the farms legal rights, no form of license or catch quotas have been introduced. All individuals holding Icelandic license for shooting weapon are allowed to hunt seals outside the jurisdictions of private land. All adult residents in Iceland can apply for this license and visitors may apply for temporary license.

Harbour seal *(Phoca vitulina)* skins were exported salted or dried and large dataset of catch statistics is available from

Harbour seals *(Phoca vitulina)* and rehabilitation

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ABSTRACT

Throughout the past few decades, rehabilitation of seals has become an activity that is anchored in the present day society of many countries. Seals are primarily rehabilitated to help individual animals in distress. At the same time, the release of seals which would have otherwise died can be considered as a contribution to the population. Most rehabilitated seals are animals under one year of age. They are mainly orphans, weaned seals with complications and seals with a parasitic bronchopneumonia. For the optimal handling of seals and their diseases, centralised operations with quality standards are essential. Rehabilitation provides an instrument to monitor the health of the seal population and its ecosystem. Changes in stranding trends or the appearance of new diseases can be monitored. Moreover, rehabilitation is important to show the general public the state of the marine environment. In the Netherlands there is significant social support for the rehabilitation of seals. Experience obtained with seal care is of importance in countries where urgent help of threatened seal species is required. Here individual seals are also ambassadors to raise support for the protection of this species in general. Given that the anthropogenic impact on the seals and their environment is extensive in the Wadden Sea, rehabilitation centres can compensate the consequences of this impact on individual seals as well as the population as a whole.

Osinga, N. and Hart, P. 't. 2010. Harbour seals *(Phoca vitulina)* and rehabilitation, *NAMMCO Sci. Publ.* 8: 355-372.

INTRODUCTION

The harbour seal *(Phoca vitulina)* is a species that is rehabilitated on a significant scale. During the 1970s, rehabilitation proved to be an important factor in stopping the decline of the number of common seals in the Dutch Wadden Sea. It also was important to the recovery of the population in the 1980s (Reijnders *et al.* 1996). Rehabilitation is first of all the expression of the need to help individual animals in distress, which is experienced by many. At the same time it can provide support to a population under pressure. These two approaches, animal welfare and population biology, are central to the discourse surrounding this subject. Furthermore, during the two major outbreaks of phocine distemper virus (PDV) in 1988 and 2002, rehabilitation made an important contribution to the identification of the virus (Osterhaus and Vedder 1988, Jensen *et al.* 2002). While the rehabilitation of common

A note on seal watching in the Northeast United States

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Di Giovanni Jr, R.A. and Sabrosky A.M. 2010. A note on seal watching in the Northeast United States. *NAMMCO Sci. Publ.* 8: 373-377

The harbour seal *(Phoca vitulina)* is a year-round inhabitant of coastal waters of eastern Canada and Maine (Boulva and McLaren, 1979), and occurs seasonally along the New Hampshire to New Jersey coasts from September through late May (Barlas 1999, Hoover *et al.* 1999, Slocum *et al.* 1999) (Fig. 1). The grey seal *(Halichoerus grypus)* has a similar winter distribution in U.S. coastal waters, and is found year-round further south to Massachusetts. Both species haul-out on identical substrate and mixed groups are not uncommon, particularly around Cape Cod (Barlas 1999, Murray 2008). Many of the haulout sites are viewable from shore or accessible by foot, small boat and aircraft. Therefore, seal watching is a popular activity for the general public, and is an important component of the coastal marine eco-tourism industry. Organized seal watching most likely evolved as an addition to existing programmes, such as nature walks, whale watching, birding, charter fishing, and coastal embayment monitoring programmes (*e.g.*, Narragansett Save the Bay; http://www.savebay.org).

Along the northeast US coast, seal watching has a distinct seasonality related to the movement of seals. Seal watching occurs from May through October in Maine, April through November in Massachusetts (excluding Cape Cod, which has a year-round programme), December through mid-April in New York, and February through April in Connecticut.

Seal watching programmes provide important information on the level of public interest and potential support for conserving protected species, and provide a venue for researchers to bring science to the public.

To characterize seal watching off the northeast US coast we conducted a phone survey of state government agencies, environmental organizations, and commercial enterprises in the states of Maine, Massachusetts, Rhode Island, Connecticut, New York, and New Jersey. A list of 43 short-answer survey questions was developed, covering diverse topics such as fees, presence/absence of a naturalist, and reporting/response to stranded animals or human harassment (Table 1). Organized seal watching activities included in our survey were those which have a regular schedule, pricing structure, and are open to the general public. Our survey did not take into account organizations that conduct one-time seal-walks for their membership. Thirty seal watching organizations were identified (Table 2), and all but one agreed to be interviewed. The 29 interviewed organizations (Table 2) represented private charters (62%), state agencies (17%), non-profit organizations (17%), and resorts (3%). Some organizations offer both seal cruises and walks, while other organizations offer only one programme yielding a total of 33 programmes. Seal walk programmes were confined to New York and Connecticut.