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New investigations and status of knowledge

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Contents

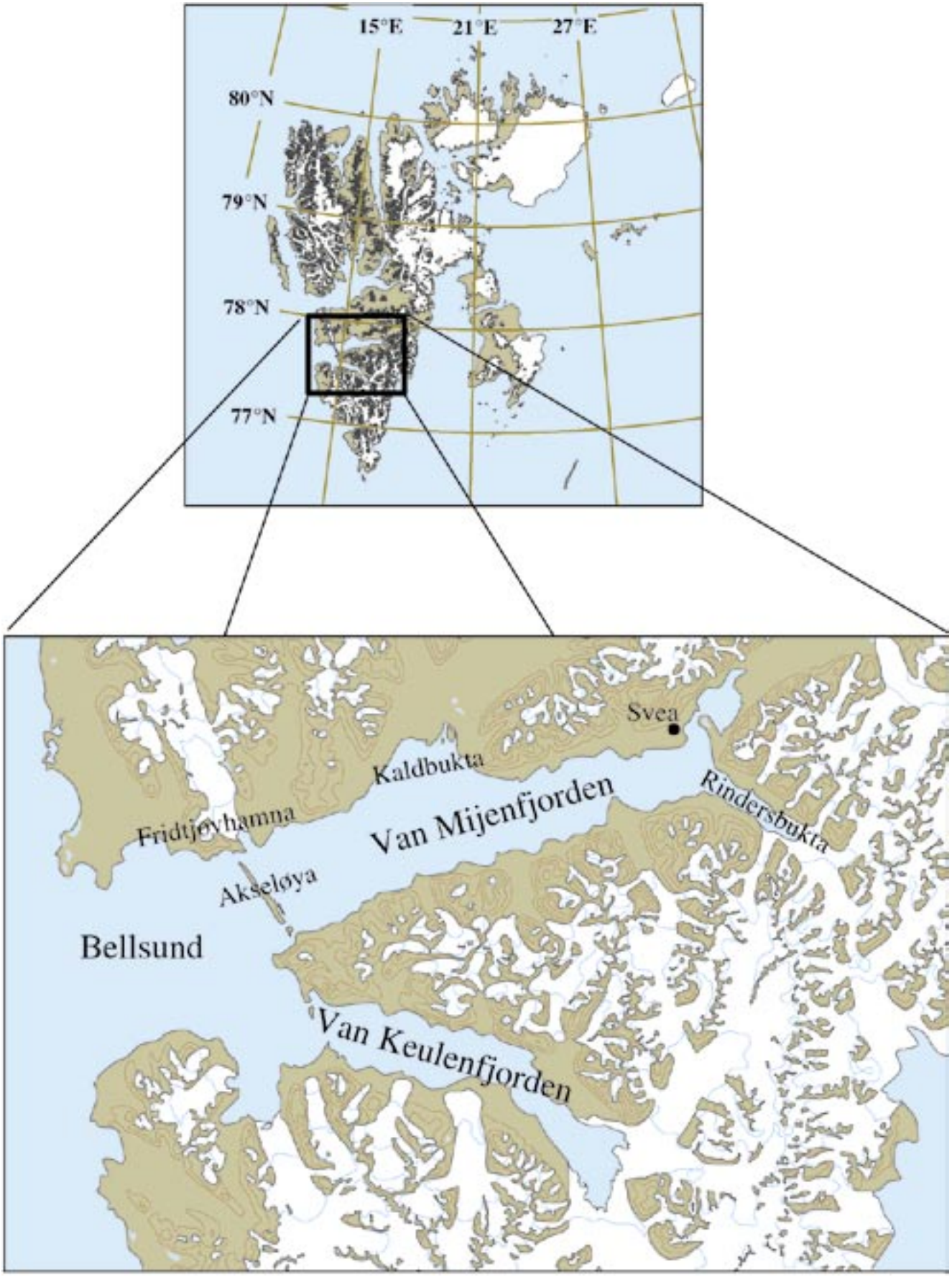
1. Preface

I tilknytning til sin konsekvensutredning for åpning og drift av Svea Nord har Store Norske Grubekompani A/S (SNGK) blitt pålagt av Sysselmannen på Svalbard (SMS) å foreta undersøkelser og overvåkning av naturmiljøet. For å dekke de viktigste kunnskapsbehovene påpekt av SMS har SNGK og Norsk Polarinstitutt (NP) inngått en avtale om biologiske undersøkelser og overvåking i området Bellsund, Van Mijenfjorden, Van Keulenfjorden og nærliggende kystområder, med en mulig tidsramme på fem til ti år. For år 2002 ble det vedtatt å utføre tre prosjekter; et på vegetasjonskartlegging, et på sjøfugl og et på sjøpattedyr, og dette er en rapport for sistnevnte prosjekt. I løpet av dette prosjektet ble det foretatt en flytelling av ringsel og andre sjøpattedyr i det aktuelle området, samt en undersøkelse med båt for å kartlegge forekomsten av steinkobbe. En del av NPs tidligere forskningaktivitet på sjøpattedyr har foregått i området Bellsund, Van Mijenfjorden og Van Keulenfjorden. I tillegg har noen sjøpattedyr som er blitt utstyrt med satellittsendere i andre områder på Svalbard senere beveget seg inn i dette området. Slike data, samt en del mer historisk informasjon fra publiserte arbeider og databaser om tilstedeværelse av sjøpattedyr i dette området, er også inkludert i denne rapporten. Etter avtale med SNGK er rapporten på engelsk med norsk sammendrag.

Norsk Polarinstitutt, Tromsø 30/11 – 2002

Christian Lydersen Bjørn A. Krafft Magnus Andersen Kit M. Kovacs

2. Map of study area



3. Norwegian summary

Formålet med denne rapporten var å gjøre en evaluering av området Bellsund – Van Mijenfjorden – Van Keulenfjorden som habitat for ulike arter av marine pattedyr. Dette ble gjort ved hjelp av en flytaksering av ringsel og storkobber, taksering fra båt av steinkobber, en gjennomgang av tilgjengelig kunnskap fra vitenskapelige publikasjoner og ulike publiserte rapporter, samt ved søk i forskjellige fauna databaser.

Flytakseringen ble foretatt den 12. juni 2002. På dette tidspunktet er ringselene i området midt i hårfellingsperioden. Mer enn 50 % av fjordis-arealet ble fotografert med digitale kameraer, noe som resulterte i 3055 bilder. Ved en manuell gjennomgang av disse bildene ble det funnet 399 ringsel, noe som resulterte i et estimat på den lokale ringsel-bestanden på rundt 1000 individer. Høyest tetthet av ringsel ble funnet i ytre og nordre deler av Van Mijenfjorden samt indre og sørlige deler av Van Keulenfjorden. Basert på resultater fra flytakseringen og annen tilleggsinformasjon, ble den lokale storkobbe-bestanden beregnet til mellom 50 - 100 individer. Det ble observert 44 steinkobber i Van Mijenfjorden i juli og 31 i august, slik at rundt 50 steinkobber synes å ha tilhold i denne fjorden i den isfrie delen av året. De fleste av disse holder til i Kaldbukta på nordsiden av Van Mijenfjorden.

Isbjørn utstyrt med satellittsendere kommer vanligvis inn i studieområdet fra sørvest tidlig på våren, mest sannsynlig transportert med drivisen fra østsiden av Svalbard. Disse bjørnene holder seg i det aktuelle området noen få uker før de vandrer over land tilbake til Storfjorden og østsiden av Svalbard igjen. I tillegg har det de to siste årene oppholdt seg mer enn ti isbjørn i Bellsund – Van Mijenfjorden – Van Keulenfjorden området også om sommeren. Dette har ført til mange menneske - isbjørn konflikter hovedsakelig relatert til skader bjørnene påfører hytter i området.

Bellsund – Van Mijenfjorden – Van Keulenfjorden er også et viktig oppholdsområde for hvithval. Dette er blant annet vist ved å følge hvithval med satellittsendere påsatt i Van Mijen- og Van Keulenfjorden samt andre steder på Svalbard. Vi har ingen data på hvor mange hvithval som finnes ved Svalbard, eller hvor mange dyr som oppholder seg i det aktuelle studieområdet. Satellittsenderne viser at de samme individene gjentatte ganger oppsøker de samme områdene i løpet av sommeren. Dette medfører at antall observasjoner fra et gitt sted ikke er noen god indikator for bestandsstørrelsen.

Hvalross, vågehval og grønlandssel observeres årlig i det aktuelle området. Andre arter som finnhval, spekkhogger, kvitnos og grindhval er også registrert, men disse regnes som mer sjeldne gjester.

4. English summary

The purpose of this investigation was to evaluate the importance of the Bellsund – Van Mijenfjorden – Van Keulenfjorden area as habitat for marine mammals. This was done via an aerial survey of ringed and bearded seals, boat surveys of harbour seals and a review of available knowledge from this area, via material published in the primary scientific literature, published reports, fauna data base searches and local knowledge surveys.

The aerial survey was flown 12 June 2002, during peak moulting time for ringed seals. It covered all fast ice regions in the study area. A total of 3,055 digital images, covering 50 % of the ice cover of the area, were manually inspected for the occurrence of seals. 399 ringed seals were counted on these images resulting in an estimate of the resident ringed seal population of about 1000 animals. The highest densities of ringed seals were found in the outer, northern parts of Van Mijenfjorden and in the southern, inner parts of Van Keulenfjorden. A combination of data from the aerial survey and other information resulted in an estimate of 50-100 bearded seals inhabiting the study area. The boat surveys for harbour seals found 44 animals during the July survey and 31 during the August survey. Thus, about 50 harbour seals occupy Van Mijenfjorden. Most of these animals are found in the area around Kaldbukta on the northern shore of this fjord.

Polar bear satellite tracks show that bears generally enter the area from the southwest during early spring/late winter, probably transported with drifting ice that originates from eastern parts of Svalbard. The bears stay in the area for a few weeks before migrating eastward, overland to Storfjorden. In addition during the past two years, more than ten bears have also stayed in the study area during the summer. This has resulted in many human - bear conflicts mainly due to polar bears damaging cabins in the area in search of food.

Satellite tracking of white whales captured in the study area, as well as elsewhere in Svalbard, shows that the Van Mijenfjorden-Van Keulenfjorden area is used extensively by this whale species. We do not have data on the actual population size for white whales in Svalbard, nor do we have information on the actual number of animals that utilize these fjords specifically. The satellite tracking studies indicate that the same animals make repeated visits over the summer months to the same areas. Thus, sighting frequency is not a good indicator of actual population size.

Walruses, minke whales and harp seals are routine annual visitors to this area, and fin whales, killer whales, white-beaked dolphins and pilot whales have been observed, but are not common.

5. Ringed seals

Ringed seals occupy a key ecological role in the Arctic ecosystem. They are the most widely distributed high Arctic seal species, with a world population that probably numbers 5-7 million animals. Ringed seals are found in virtually all seas and oceans encircling the North Pole. They are the main prey species of polar bears and the most important natural resource for many indigenous peoples in coastal areas throughout the circumpolar Arctic.

Ringed seals are small seals, with an average body length of about 130 cm for adult animals (Lydersen and Gjertz 1987). They have marked seasonal variation in body mass in both sexes with the highest mass records being recorded in early spring before the breeding season occurs, and with minimum values in the summer after breeding and moulting have taken place (Ryg et al. 1990). Thus, body mass is highly variable, but usually falls between 60-100 kg for adults. The variation observed is mainly due to changing blubber-layer thickness of the seals. The blubber layer of ringed seals can be several centimetres thick and acts as an insulator and energy storage mechanism that permits the animals to survive in very cold conditions and to tolerate the marked seasonal changes in food abundance experienced in the Arctic. Male ringed seals tend to be somewhat larger than females. In Svalbard ringed seal males attain sexual maturity at the age of five to seven years, while females reach maturity when they are three to five years of age (Lydersen and Gjertz 1987). Ringed seals are a long-lived species and maximum-recorded age in Svalbard is 45 years.

Ringed seals are perhaps the most highly adapted Arctic seal; they live most of their lives in association with sea ice. They have powerful claws on their fore-flippers that they use to create breathing holes in the newly forming ice (Fig. 5. 1) and to maintain these holes through the winter. When enough snow accumulates on top of a breathing hole, the seal may dig out a lair. Ringed seals of both sexes and different age groups make these small snow caves, and adult females use them as a sheltered place to give birth and care for their young (Fig. 5. 2). The birth lairs protect newborn ringed seals against harsh weather conditions, and to some degree, provide protection against predation. The temperature inside lairs varies between 0°C and -2°C, independent of the ambient, outside temperature (Taugbøl 1984). The protection against predators lays in the fact that it takes time for polar bears or Arctic foxes to break through the roof of the lair, so the seals have a chance to escape into the water. Also, the fact that they are under a snow layer removes them from the reach of visual predators.

Fig. 5. 1.
Ringed seal peeping up through the water in one of its breathing holes in the ice (Photo by Kit & Christian, NP).

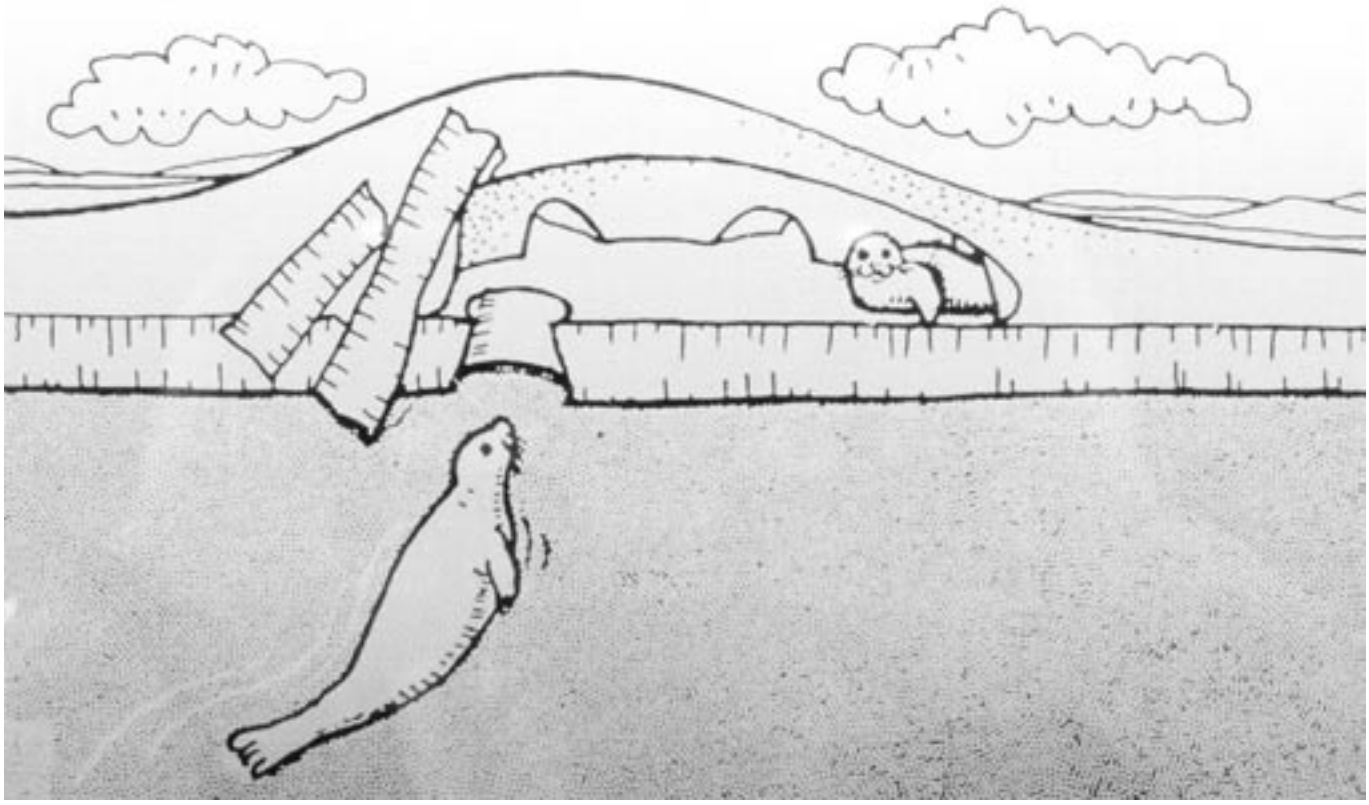


Fig. 5. 2.
Cross section through a birth lair. When enough snow accumulates ringed seals dig lairs in the snow covering some of their breathing holes. Adult ringed seal females normally give birth in such structures.

However, bears and foxes, that use scent to find their prey, kill a lot of seals in lairs, particularly during the spring season (Gjertz and Lydersen 1986a; Lydersen and Gjertz 1986). Sometimes snow conditions are so poor that ringed seal females are forced to give birth on the open ice outside lairs (Gjertz and Lydersen 1983). When this happens, the pups are extremely vulnerable to predation, and even glaucous gulls are able to kill them (Lydersen and Smith 1989). The preferred habitat for birth lairs is inside fjords, close to glacier fronts where glacial ice pieces freeze into the fjord ice and cause snow to collect; snow in which the seals can dig lairs. Birth lair complexes are generally larger and have more snow covering their roofs compared with lairs used by single adults or juvenile animals (Lydersen & Gjertz 1986). Lairs are also found on flat fjord ice in places where enough snow accumulates. Ringed seals also breed in pack ice areas in the Barents Sea quite far from land (Wiig et al. 1999). The ability of ringed seals to build lairs allows them to live year-round in the Arctic, despite their relatively small body size and the generally harsh environmental conditions during Arctic winters, and their ability to maintain breathing holes in more than 2 m thick ice allows them to occupy areas where no other seal species can survive.

Ringed seals are the most abundant mammal species in the Svalbard area. Annual production in Svalbard is estimated to be about 20,000 pups (Smith and Lydersen 1991). Ringed seals in the Svalbard area feed on a variety of prey organisms, the most important of which are polar cod and the crustaceans *Parathemisto libellula* (an amphipod), *Thyssanoessa inermis* (a krill) and *Pandalus borealis* (a shrimp) (Gjertz and Lydersen 1986b; Lydersen et al. 1989; Weslawski et al. 1994). During summer and autumn they spend a lot of their time at the ice edge north of Svalbard or on the banks off-shore from the archipelago (Gjertz et al. 2000a), returning to areas where they will breed in the fjords sometime late in the autumn before ice forms. The peak pupping period for ringed seals in Svalbard is the first week of April (Lydersen 1995). Newborn ringed seals weigh an average of 4.6 kg. They are born bearing a white, fuzzy coat of lanugo. They are nursed for about 39 days (Fig. 5. 3), and weaned at an average body mass of around 22 kg (Hammill et al. 1991). Ringed seal pups start diving during the nursing period while they still have their white-coats, and spend about 50 % of the time in the water prior to weaning (Lydersen and Hammill 1993a). They are capable of diving for up to 12 minutes and in the fjords where they have been studied they dive to the bottom (max. 89 m). Lactating mothers spend more than 80 % of their time in the water. The maximum-recorded dive duration for mothers is 21.2 minutes (Lydersen 1991). During the period of maternal care pups consume a total of about 54 L of milk (Lydersen and Hammill 1993b). The milk has a very high energy content. The composition is approximately 38 % fat and 10 % protein (Lydersen

Fig. 5. 3.
Young ringed seal pup nursing next to a breathing hole. Pups born outside lairs are extremely exposed to predation. An Arctic fox killed this pup some days after this picture was taken (Photo by Kit & Christian, NP).

et al. 1992). In order to replace the energy invested in a weaned pup, each ringed seal mother would have to consume energy corresponding to 185 kg of polar cod or 282 kg of *P. libellula* (Lydersen 1995).

Similar to all other seals, ringed seals mate toward the end of the lactation period. During the spring, from the time females start to give birth until mating is over sometime in late May, adult male ringed seals maintain underwater territories. Each male defends an area that contains several breathing holes and lairs that can overlap with areas used by several females. During this period the adult males secrete a substance with a strong smell from sebaceous glands in the facial region (Fig. 5. 4). The function of this substance is probably related to reproduction and territorial defence (Ryg et al. 1992). Rutting males are believed to mark their breathing holes and haul-out lairs with their individual-specific smell. During the period of territorial defence, juvenile animals are generally excluded from prime breeding areas; they are generally found in the outer parts of the fjords or in the drifting ice that occurs beyond the land-fast ice edge. When the breeding season is over, and the adults stop defending territories, young animals re-enter these areas, and dramatic increases are seen in the numbers of ringed seals hauled out on the ice. Small clusters of ringed seals

Fig. 5. 4.
Rutting ringed seal males secrete an oily substance from glands in their facial region that gives them a strong smell and a dark facemask in the spring (Photo by Kit & Christian, NP).

are commonly seen during warm spring days around breathing holes.

In the period from late May until early July in Svalbard, ringed seals go through their annual molting period. All seal species go through this process of replacing their outer skin and hair each year. During this period seals prefer to stay out of the water much of the time. Being in the air enables them to increase circulation to their skin and thus speed up the molting process with much less heat loss than would occur if this happened in the water. The availability of ringed seals on the surface of the ice during this time provides the best opportunity to determine how many ringed seals occur in an area. We took advantage of this situation in our studies in the Bellsund - Van Mijenfjorden – Van Keulenfjorden area to conduct an aerial survey of the number of ringed seals in the early summer of 2002.

Ringed seal survey in the Bellsund -Van Mijenfjorden – Van Keulenfjorden area

Methods

The aircraft used for this aerial survey was a twin propeller Piper Seneca II (PA 34) (Fig. 5. 5). Two camera houses (Hasselblad 555 ELD) were attached to the aircraft-floor and pictures were taken through a hatchway. The two camera houses were outfitted with 80 mm lenses and a backpack (H-20 Phase One A/S, 2000 Frederiksberg, Denmark) containing a CCD-chip designed to capture digital images. The cameras were connected to two laptop computers with external hard disks (Dell Latitude, One pt 120 GB), which enabled images to be stored onboard the aircraft (Fig. 5. 6). Before each flight, the orientation and positions of the transects to be flown were determined using purpose built software (Snapplan and Snapshot, Track'Air Aerial Survey Systems, B.V. Boortorenweg 20, 7550 Hengelo, Netherlands). Snapplan was used to plan the photo flights because this software deals well with the specifications of the camera, survey altitude and pre-calculated GPS positions. GPS positions were exported to the flight control program Snapshot. The photo survey altitude was set at 2400 feet. Two images were produced every 5 seconds, which covered an area of 672 m x 336 m of the surface, with no image overlap. Snapshot was used to control the Tracker External Camera Interface (TECI-3) box; which contained a built-in 12 channel GPS system. TECI-3, in combination with Snapshot, automatically activated the two digital cameras, when each pre-defined position was reached. The airplane's position, angle of inclination, track and altitude during the time when the footage was shot were stored on a World Geodetic System (WGS-84) format.

Fig. 5. 5.
Survey plane and crew. From the left: Magnus Andersen (NP), Bjørn Krafft (NP), Ingvar Parmann (data-operator) and Ingomar Hennwald (pilot) (Photo by Bjørn Krafft, NP).

Fig. 5. 6.
Set-up for photo gear and computers inside the plane (Photo by Bjørn Krafft, NP).

This aerial survey work in Van Mijenfjorden and Van Keulenfjorden was conducted 12 June 2002. A line transect method was used. Transect lines started in the inner parts of the fjords and were terminated outside the ice edge. The lines were structured parallel to the north sides of the fjords and generally speaking followed the shape of the fjords. The whole of Fridtjovhamna was photographed, while the coverage of the ice in Van Mijenfjorden and Van Keulenfjorden was 50 %.

3055 digital images were collected from the study area. All images were inspected manually using purpose built software, Light Phase Image Capture (Phase One A/S, 2000 Frederiksberg, Denmark). The images were classified into nine categories: 1) ice-images, in which the entire photo covered only fjord-ice; 2) ice-land-images, in which the photo included areas with

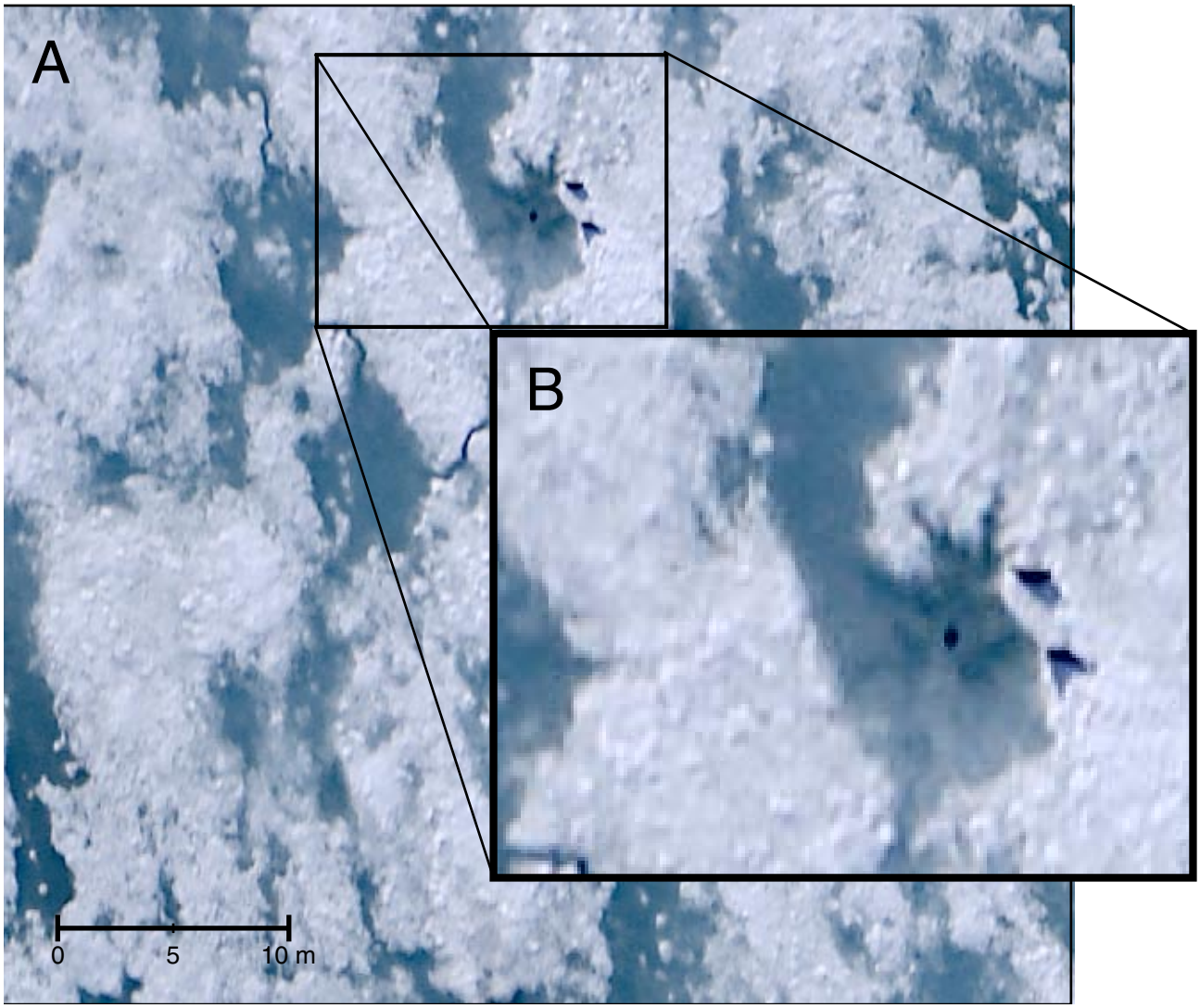


Fig. 5. 7.
Digital images were processed using a Light Phase Image Capture Programme. Each image was magnified 200 % from the original (background picture A) for initial visual scanning for seals and holes. When possible seals and holes were detected additional magnification was applied to confirm the sighting (front picture B).

fjord-ice and land or glacier areas; 3) ice-land-water images included areas with fjord-ice, land or glacier and seawater; 4) ice-water images included areas with fjord-ice and seawater; 5) land-images covered 100 % land or glacier; 6) water-images included 100 % seawater; 7) water-land-images included areas with seawater and land or glacier; 8) floe-water-images included areas with ice floes and seawater; and 9) ice-floe-water-images included areas with fjord-ice, ice floes and seawater. All image types that included fjord-ice (categories 1, 2, 3, 4 and 9) were inspected in detail for the presence of seals and breathing holes. The Light Phase Image Capture Programme enables magnification of the digital images, and each image was inspected using a 200 % magnification of the original. Then structures resembling seals or breathing holes were further scrutinized with additional magnification (Fig. 5. 7).

Results and discussion

A total of 399 ringed seals were identified from the analyses of the images (Table 1). The distribution of the animals is shown in Fig. 5. 8. Most of the ringed seals counted were found in Van Mijenfjorden (204), but the actual density of ringed seals was higher in Van Keulenfjorden (5.2 seals per km^2 vs. 1.0 seal per km^2). The highest densities of ringed seals were located in the outer and northern parts of Van Mijenfjorden and the inner and southernmost areas of Van Keulenfjorden (Fig 5. 9).

Previous studies of ringed seal abundance in Van Mijenfjorden and Van Keulenfjorden included a breeding habitat survey of Van Mijenfjorden and an aerial survey of both areas (Jensen and Knutsen 1987, Lydersen et al. 1990). The breeding area survey was conducted during the spring of 1986. The results suggested that Van Mijenfjorden contains a relatively poor breeding habitat for ringed seals (Lydersen et

Table 1
Surface coverage, number of images and number of ringed seals found during an aerial survey of Fridtjovhamna, Van Mijenfjorden and Van Keulenfjorden, Svalbard, in June 2002.

Survey area	Area size (km2)	Coverage (%)	Number of images	Number of ringed seals
Fridtjovhamna	2.7	100	67	8
Van Mijenfjorden	390	50	2588	204
Van Keulenfjorden	72	50	400	187
Total:	**464.7**		**3055**	**399**

al. 1990), compared with other fjords on Spitsbergen such as Kongsfjorden or Tempelfjorden (Lydersen and Gjertz 1986, Lydersen and Ryg 1991). This is probably because Van Mijenfjorden has very little glacier activity compared to the other fjords. The best areas for birth lairs in Svalbard are places where glacial calvings are frozen into the sea ice. At such structures sufficient snow accumulates for construction of birth lairs. Van Keulenfjorden has much more glacier activity and is probably a better breeding habitat than Van Mijenfjorden. However, this has not yet been investigated. The aerial survey flown in 1986 was conducted in June (Jensen and Knutsen 1987), as was the case for the present study. Jensen and Knutsen (1987) used two methods, one photographic and one visual counting, to study abundance and distribution of ringed seals in the Van Mijenfjorden area, including Fridtjovhamna and Van Keulenfjorden. The ice situation in Van Mijenfjorden was similar to the conditions during 2002 (1986 – 439 km^2 of ice, 2002 - 390 km^2 of ice), while the ice edge in Van Keulenfjorden extended much further to the west in 1986 compared with 2002 (1986 - 189 km^2 of ice; 2002 - 72 km^2 of ice). The glacier in Fridtjovhamna has surged forward some kilometres since 1986, so even if the ice edge occurred in a similar geographic location in each of the two years the area of ice would be different. The ice cover was 5 km^2 in1986, and only 2.7 km^2 in 2002. Based on a pilot study it was found that the density of seals was higher in the outer compared with inner parts of these fjords (which is in accordance with what we found for Van Mijenfjorden, but not for Van Keulenfjorden). As a consequence of their initial findings Jensen and Knutsen (1987) divided the fjords into different strata with different sampling intensities being applied with closer transect lines in outer parts of the fjords where the densities of seals were higher. During their photographic survey the sampling coverage varied between 1.08 - 5.00 %, while the visual survey had a coverage varying between 4.86 - 11.10 %. They repeated surveys on four different dates in June. The highest number of seals was found 6 June. The estimated abundance from the surveys conducted on this day was 582 ± 309 (standard error (S.E.)) ringed seals for Van Mijenfjorden and Fridtjovhamna and 202 ± 81 for Van Keulenfjorden. The results from the visual survey the same day were 354 ± 123 ringed seals for Van Mijenfjorden and Fridtjovhamna and 516 ± 82 for Van Keulenfjorden.

The study from 1986 also counted seals hauled out in Fridtjovhamna in July after the ice had disappeared from Van Mijenfjorden and Van Keulenfjorden. They found up to 600 seals hauled out in this area, which is clearly an important area for ringed seals late in the ice-season. We (KMK and CL) have made similar observations during periods of summer fieldwork in the mid and late 1990s (Lydersen 1998), and the local trapper L. Nielsen (pers. comm.) also reports similar conditions. After the glacier in Fridtjovhamna surged, the area of the bay has become smaller and the sea ice has become less stable and thus probably less important for ringed seals. We have also observed very high densities of ringed seals hauled out in the inner parts of Rindersbukta in July when this was the only remaining ice in the region (Lydersen 1998).

Jensen and Knutsen (1987) performed low sampling intensity, which they recognized to be the source of the large confidence intervals around their abundance estimates. To get more precise density estimates larger sampling intensity is required. However, using the

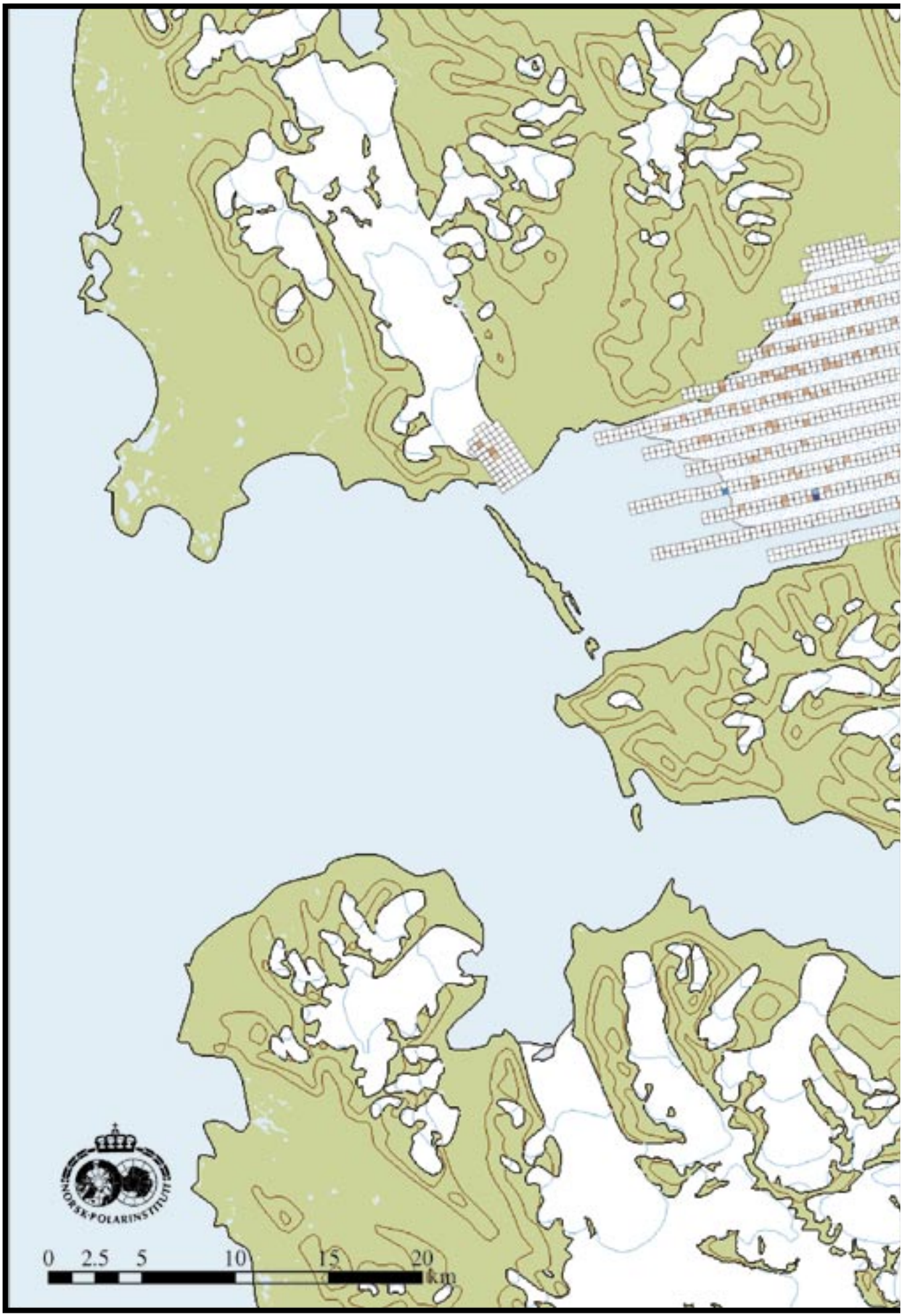
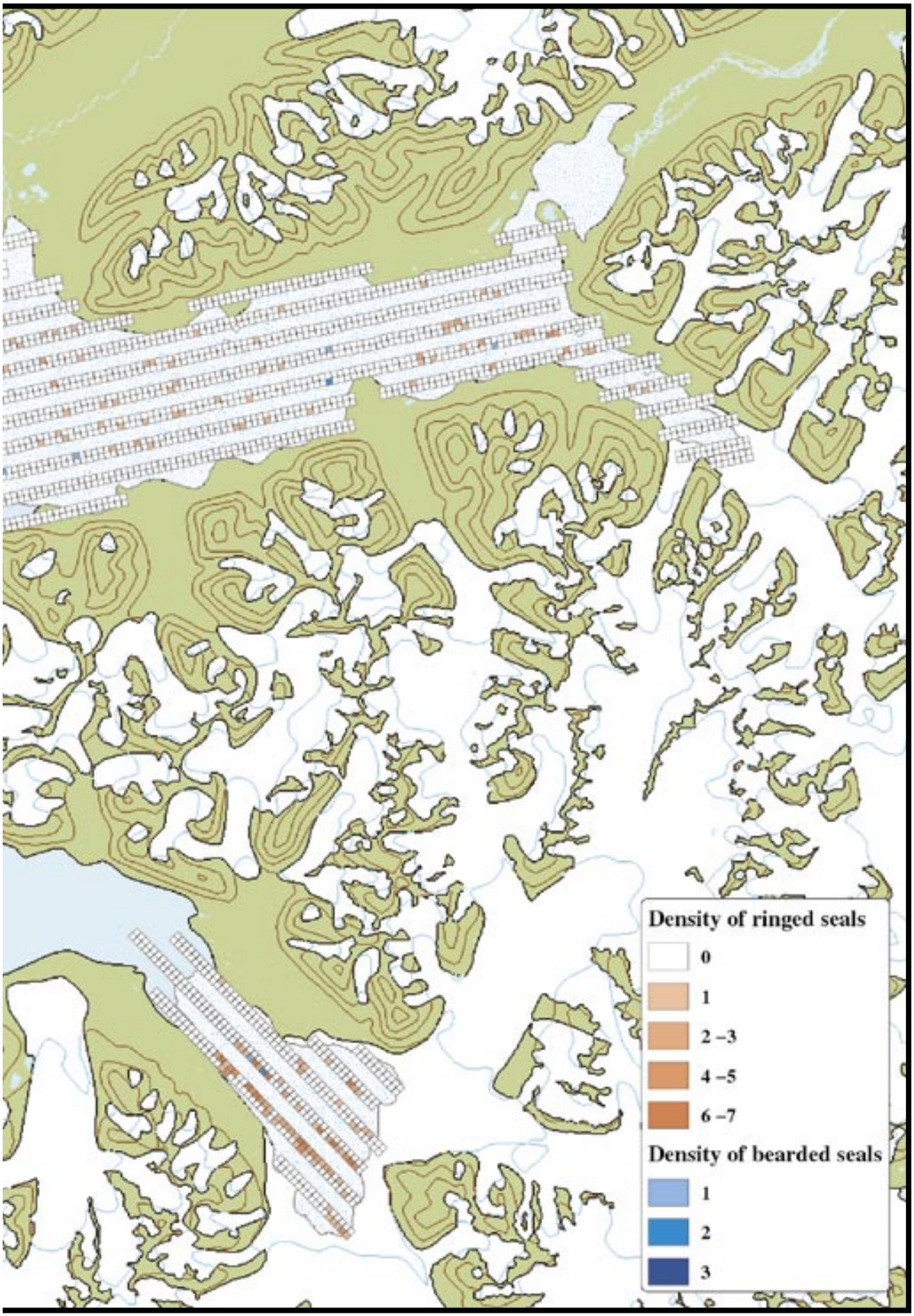


Fig. 5. 8.
Map showing the study area, extent of ice and transects flown during the aerial survey in June 2002. Each small square on the transect lines correspond to a digital image covering 336 x 336 m. Seal locations are indicated in red for ringed seals and blue for bearded seals.


Density of ringed seals
0
1
2 –3
4 –5
6 –7
Density of bearded seals
1
2
3

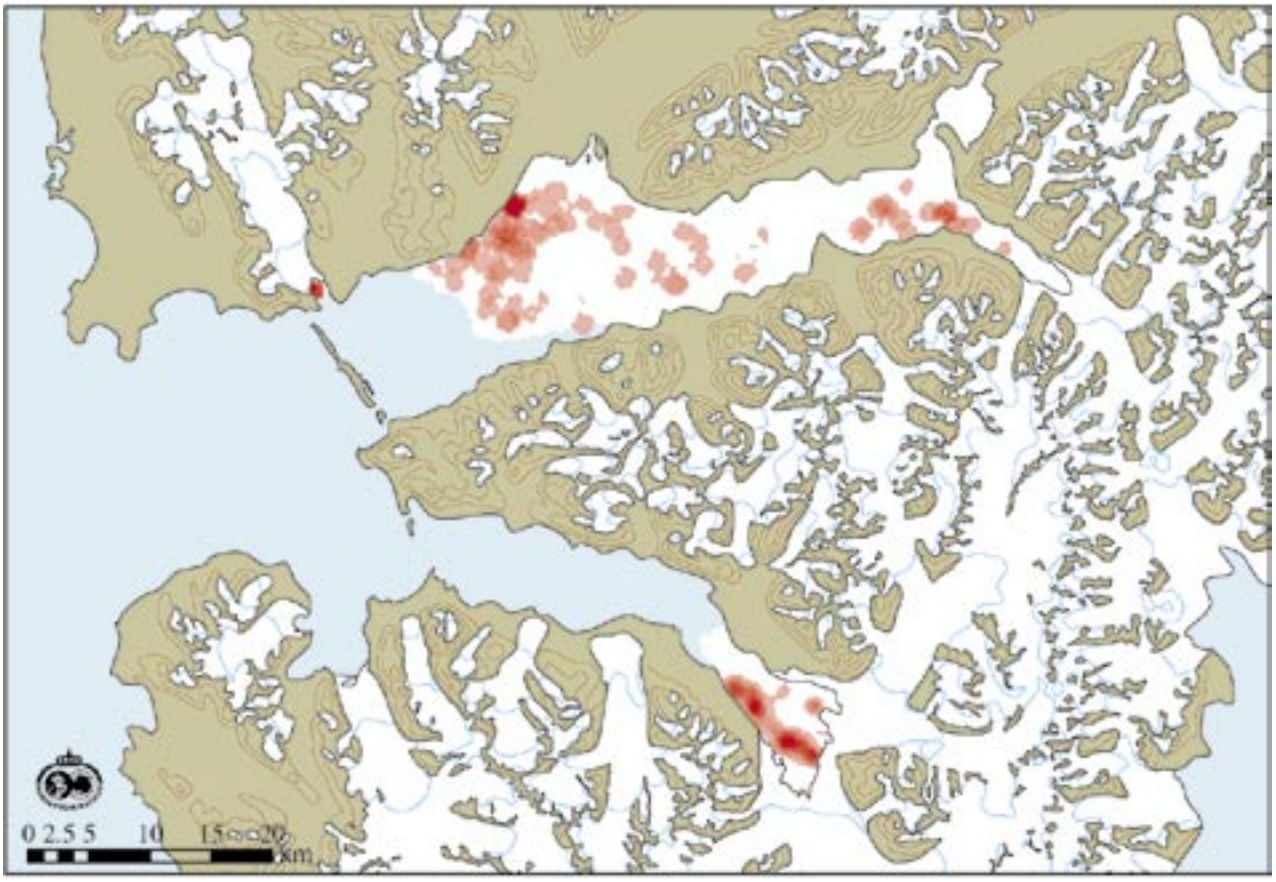


Fig. 5. 9.
Map showing an integration of the densities of ringed seals from the aerial survey applied to the whole of Van Mijenfjorden and Van Keulenfjorden. Higher colour intensity (red) corresponds to a higher density of ringed seals. Most ringed seals in the surveyed area are found in the outer and northern parts of Van Mijenfjorden and along the southern parts of Van Keulenfjorden.

mean values from the two methods they used produced estimates of 784 and 870 ringed seals hauled out in this area in early June, which is similar to the estimate of 790 produced by our work in 2002. We performed a much higher sampling intensity (50%) than the work in the 1980s so our estimates is much more precise. However, one must keep in mind that the estimate produced still must be considered a minimum count, because there will always be a proportion of the seals that are in the water and therefore not accessible for counting on the surface. As stated earlier in this section, the survey was conducted in the molting season to minimize this "missing" fraction. During the summer of 2003 we will perform a study investigating the haul-out behaviour of ringed seals in order to create a correction factor for the fraction of seals in the water at a given time. The proportion of animals in the water is likely to vary with meteorological conditions, including temperature, wind speed etc. as well as the point in the season. When the correction factor is calculated we will produce a confidence interval for our estimate. However, a provisional estimate of approximately 1000 seals is likely to be a realistic assessment.

6. Bearded seals

Bearded seals have a patchy distribution that includes most of the Arctic. The global population cannot be accurately assessed, but it is likely that this species numbers in the hundreds of thousands. Bearded seal populations in some areas are thought to be resident throughout the year, while in other areas they follow the retraction of the pack ice northward during the summer and southward in the late fall and early winter. In Svalbard, bearded seals can be found year-round in areas that contain drifting ice, but they also occur in the fjords during the ice-free seasons. They feed mainly on bottom dwelling organisms in relatively shallow waters and thus tend to stay relatively close to the coastline (Gjertz et al. 2000b; Krafft et al. 2000).

Bearded seals are large animals, and in Svalbard the average lengths and masses for adult animals are 231 cm and 270 kg for males and 233 cm and 275 kg for females (Andersen et al. 1999). As is the case for all seal species, body masses vary dramatically through the year. During our bearded seal studies in Svalbard we have live-captured several females that weighed more than 400 kg (maximum to date 421 kg)

Fig. 6. 1.
Iron compounds in the mud where some of Svalbard´s bearded seals feed precipitate onto the hair shafts and stain the facial and sometimes neck and fore-flipper regions, rust-red when these compounds are oxidized (Photo by Kit & Christian, NP).

after having given birth in the spring. In Svalbard, males become sexually mature at six years of age and females reach sexual maturity at the age of five (Andersen et al. 1999). The oldest animal that has been aged from Svalbard was 27 years old. Studies of the diet of bearded seals in Svalbard, which included 19 animals from the Bellsund-Van Mijenfjorden-Van Keulenfjorden area, showed that polar cod is the most important prey species (Hjelset et al. 1999). However, many species of crabs, shrimps, gastropods and bivalves were also found in significant numbers. Several species on the bearded seal menu reside hidden in soft sediments, and the seals have to stick their face or flippers into these sediments to capture these types of prey organisms. In many of the glacial fjords in Svalbard the soft-bottom sediments are rich in iron compounds that precipitate into the hairs of the seals. These compounds oxidize resulting in a rust-red colouration of the face, neck and sometimes parts of the fore-flippers of the bearded seals (Fig. 6. 1) (Lydersen et al. 2001a). Ringed seals in Svalbard also occasionally have this colouration on their faces.

Bearded seal pups are born on small ice floes during early May in Svalbard (Kovacs et al. 1996). The pups are about 130 cm long and weigh about 35 kg when they are born (Fig. 6. 2). Bearded seal pups swim with their mothers within hours after their birth. This early swimming is probably an adaptation to avoid polar bear predation. The pups' swimming skills develop quickly and they can dive to depths of 90 m and remain submerged for periods in excess of five minutes by the time they are only one week old (Lydersen et al. 1994;

Fig. 6. 2.
New born bearded seal pups weigh about 35-40 kg at birth (Photo by Kit & Christian, NP).

Fig. 6. 3.
Bearded seal pup resting on an ice floe with its mother attending from the water (Photo by Kit & Christian, NP).

Lydersen et al. 2002a). They spend approximately half of their time in the water during the nursing period, which lasts between 18-24 days (Gjertz et al. 2000b). They commence independent foraging, on solid food, while still accompanied by their mother. Female bearded seals spend little time on the surface with their pups, beyond that which is necessary for nursing. Most of the time they attend the pups from the water next to the floe on which the pup is resting at a given time (Holsvik 1998) (Fig. 6. 3). Females leave their pups unattended for periods to forage during the lactation period (Holsvik 1998, Krafft et al. 2000). Mother-pup pairs tend to remain in an area for some days at a time, but they can also move tens of kilometres from one day to the next (Hammill et al. 1994). Pups grow quickly during the nursing period, gaining about 3.3 kg per day while drinking more than 7.5 L of milk per day (Lydersen et al. 1996, Lydersen and Kovacs 1999). The fat content of the milk is quite stable through lactation, at about 50 %.

Satellite tracking of bearded seals show that the adults stay more or less in the same area, while pups after weaning tend to spread out much more (Gjertz et al. 2000b). One pup tagged in Kongsfjorden travelled almost to Greenland and then south to Jan Mayen before the tag ceased to transmit data. The pups were also found to dive much deeper than the adults. Most of the tagged pups (six out of seven) dove deeper than 450 m before they were two months old, while only one record from an adult female displayed this sort of depth (Gjertz et al. 2000b, Krafft et al. 2000). These data show that bearded seals have the capacity to dive to quite deep depths. But, there is little reason to do so because their food is found in relatively shallow water. Inexperienced pups need to learn this, but before achieving this experience they explore deeper, less productive areas of the oceans.

A remarkable characteristics of this species is the elaborate underwater singing performed by adult males during the breeding period. Their songs are a series of complex, downwardly spiralling trills that travel tens of kilometres under water (Van Parijs et al. 2001, 2002). In air, during quiet weather conditions, the calls of male bearded seals can be heard resonating through the ice or through metal hulls of boats.

Bearded seals have quite a diffuse moulting period, and seem to shed hair almost constantly. However, there does appear to be a concentrated period of hair loss and renewal during the early summer. During this period bearded seals tend to remain hauled out. This coincides with the molting period for ringed seals, and consequently the aerial photos taken for ringed seals in Van Mijenfjorden and Van Keulenfjorden were also

scanned for bearded seals. As stated above, bearded seals prefer drifting ice floes for hauling out, however, they can be observed along cracks, leads and holes in the fast ice far from the ice edge. They do not keep breathing holes open in the same manner as ringed seals, but they can take advantage of ringed seal holes, and if a hole is big enough bearded seals may haul out on the ice at such holes. During the early summer when ice conditions are deteriorating and open cracks and leads are common, bearded seals utilize the land fast ice quite extensively. The conditions were conducive to use by this species during our aerial survey period in 2002 in Van Mijenfjorden, Van Keulenfjorden and Fridtjovhamna.

A total of 15 bearded seals were counted on the images from the aerial survey, (See Fig. 5. 8) 12 in Van Mijenfjorden, three in Van Keulenfjorden and none in Fridtjovhamna. Three of the animals were hauled out close to one another on a lead in the ice, and the other seals were spread all the way from the ice edge to deep inside Van Mijenfjorden. Because we had only 50 % photographic coverage, the 15 animals observed in these two fjords correspond with an estimate of 30 bearded seals hauled out on the fast ice. As mentioned above, bearded seals are often found hauled out on ice floes outside the fast ice, and this habitat was not included in our aerial survey. In addition, some bearded seals, at any given time, are likely to be found in the open water areas of Bellsund and outer Van Mijenfjorden and Van Keulenfjorden. A resident trapper normally hunted 10-20 bearded seals annually in this area; during the years he kept dogs (L. Nielsen, pers. comm.). A crude estimate for the number of bearded seals occupying the study area would be in order of 50-100 animals. Bearded seal pupping has been observed in the area, and mother-pup pairs are commonly seen in May on ice floes outside the fast ice in Van Mijenfjorden (L. Nielsen, pers. comm.). However, no surveys for breeding density of bearded seals have been conducted in this area.

7. Harbour seals

Harbour seals have one of the broadest distributions among all seal species, ranging from temperate to Arctic waters of both the North Atlantic and the North Pacific. They are coastal in their distribution throughout the year and non-migratory, although seasonal movements within limited ranges are typical of some populations. Harbour seals haul out in relatively small

Fig. 7. 1.
Harbour seals are a highly social species that often haul out in small groups on beaches or rocky inter-tidal outcrops (Photo by Kit & Christian, NP).

Fig. 7. 2.
Adult male harbour seal (Photo by Kit & Christian, NP).

numbers on rocky outcrops, beaches or inter-tidal areas to rest on a daily basis (Fig. 7. 1). They are a highly social species, but one that occurs at relatively low densities throughout their range.

In Norwegian waters, harbour seals occur from the southernmost regions of the country through to Svalbard in the north. The Svalbard population is by far the northernmost distribution record for this species globally. In Svalbard, they are found mainly along the western coast of Prins Karls Forland, where about 500-600 harbour seals were counted in the 1980s (Prestrud and Gjertz 1990). However, this species has been reported from all along the west coast of Spitsbergen from Sørkapp to Reinsdyrflya. A satellite tracking study conducted on harbour seals captured at Prins Karls Forland indicated that most of the seals remain within quite small home-ranges on a year-round basis, but that movements to places as far away as Bjørnøya do occur (Gjertz et al. 2001).

Harbour seals are on the Red List for Svalbard and are therefore protected against all hunting. However, when harbour seals are in the water they are very hard to distinguish from ringed seals. The two species generally have very different resting habitats, so when they are hauled out it is normally easy to identify them to species. Harbour seals prefer to rest on land, while ringed seals haul out almost exclusively on ice. Harbour seals are slightly larger than ringed seals with average body lengths and masses of 152 cm and 104 kg for males and 140 cm and 83 kg for females (Lydersen and Kovacs 2001). Maximum recorded body masses in Svalbard are 122 kg for males and 111 kg for females (Fig. 7. 2). Harbour seal males reach sexual maturity at four to six years of age while females do so at ages between three to five (Lydersen and Kovacs 2001). For unknown reasons harbour seals in Svalbard do not reach the same maximum ages as conspecifics from more southerly populations. Maximum-recorded ages from Svalbard are 22 years for females and 17 for males (from a sample of 367 animals) (Lydersen and Kovacs 2001), whereas 25-30 years of age is a common longevity in other regions. A study of the diet of Svalbard's harbour seals revealed that they have a varied diet, but one that consists mainly of fish (18 different species); invertebrates consumed include crustaceans, molluscs and cephalopods (Andersen 2001). The most important prey species were polar cod (highest number of prey items) and Atlantic cod (greatest biomass).

Fig. 7. 3.
Harbour seal pups are born in a pelage similar to the adults. This mother-pup pair is nursing in a kelp bed exposed by low tide (Photo by Christian Jørgensen).

Harbour seals in Svalbard give birth during the second half of June (Gjertz and Børset 1992). The pups are born on beaches or rocky outcrops and are able to swim within minutes of being born. Their body mass at birth is on average 11.6 kg and they are nursed for a little longer than three weeks. During the nursing period they gain in excess of five kg per week (Jørgensen et al. 2001) (Fig. 7. 3). Harbour seal pups spend a considerable amount of their time at sea while their mothers attend them and by the time they are weaned they are able to swim and dive reasonably well. Harbour seal pups are thought to disperse at sea for a period following weaning, because they are not seen commonly in their first months of independence.

Harbour seals haul out on land on a regular basis throughout the year in all regions in their range. Despite the 24 hours light of the high Arctic in summer, and the relatively cold summer temperatures, harbour seals in Svalbard follow the same general trends in their haul-out behaviour as their southern counterparts. They haul out most often around low tide, particularly when these periods occur in the afternoon or evening. The greatest numbers occur on land when the weather is warm and dry. Similar to other seals, they remain hauled out for long periods

during their annual moulting period, which in Svalbard peaks in late August, when both adult male and female moulting periods overlap (Reder 2002). Following the moulting period in late summer, harbour seals forage very actively to replenish their body reserves. A study of early autumn diving behaviour of juvenile harbour seals in Svalbard showed that they had a consistent and quite intense day rhythm in which they spent over 80% of their time in the water (Krafft et al. 2002). Each day the seals performed an excursion of just over two hours of swimming, presumably out to the shelf off the west coast, followed by an intense bout of diving that lasted for an average of over 12 hours, followed by a return trip of approximately two to three hours and a haul-out period of about six hours. This intense regime was maintained throughout the period of the study. Most of the diving performed by harbour seals is quite modest in terms of depth and duration. The average dive depth in the study by Krafft et al. (2002) was 40 m and the average duration of diving was 2.6 minutes; the maximum dive statistics recorded in this same study were 172 m and 10 minutes.

During fieldwork conducted to study white whales in Van Mijenfjorden during the years 1995 through 1997, several observations were made of harbour seals hauled out on rocks close to shore on both the northern and southern sides of the fjord. In addition, during August 2001, members of the Norwegian Polar Institute polar bear research team, when assisting Sysselmannen (the Governor of Svalbard) in locating, immobilizing and relocating polar bears that had been breaking into cabins, also registered harbour seals in this area. During this excursion, two polar bears were observed swimming towards different groups of harbour seals hauled out on the south side of Van Mijenfjorden. The bears were obviously trying to hunt them. So, although relatively little is known about harbour seals specifically from Van Mijenfjorden, it appears that they are regular inhabitants of this fjord.

Harbour seal surveys in Van Mijenfjorden 2002

During the summer of 2002, two boat surveys were conducted in Van Mijenfjorden to census harbour seals. The first survey was performed in early July right after ice break-up and the second was performed in August during the peak harbour seal molting period. Both surveys were conducted around the time of low tide. The results are shown in Fig. 7. 4. A total of 44 harbour seals were seen in July and 31 were counted in August. Most of the seals were found in the shallow area around Kaldbukta on the north side of Van Mijenfjorden.

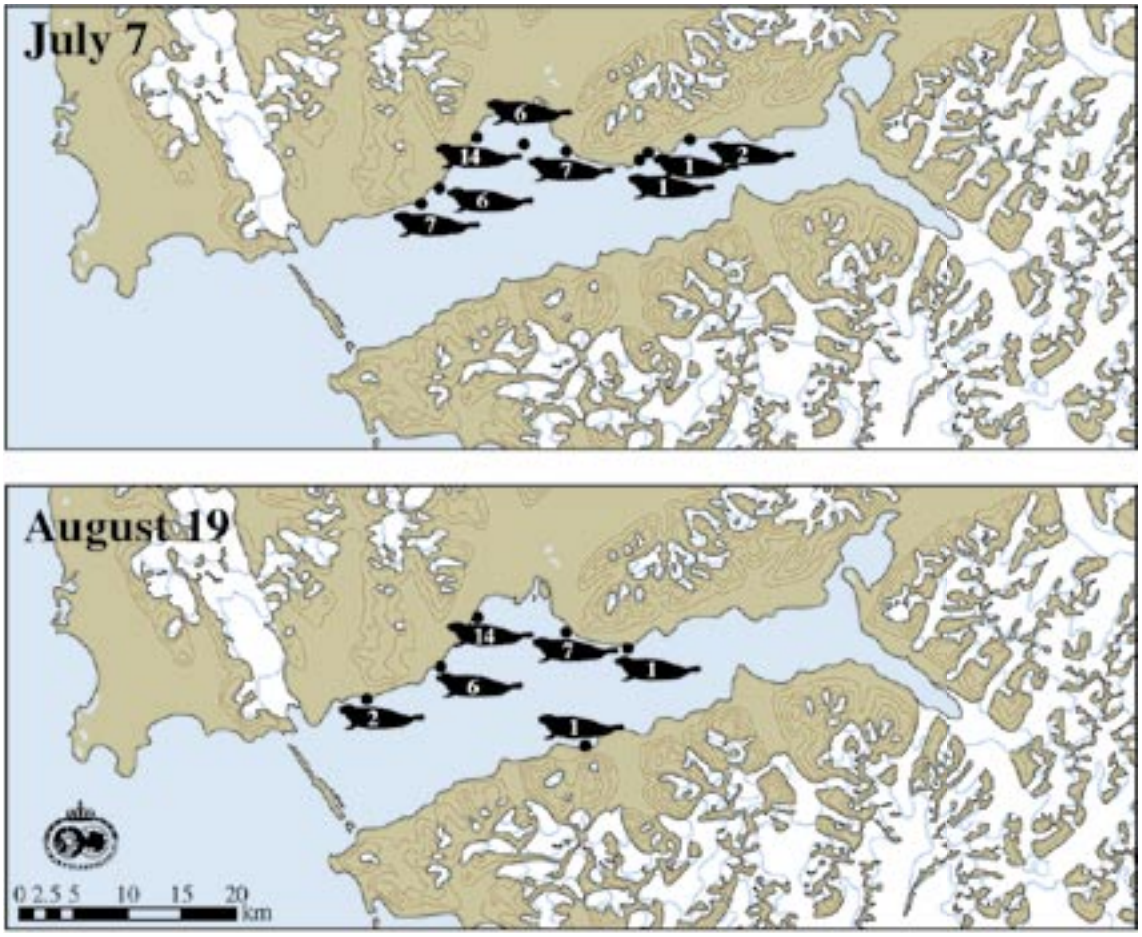


Fig. 7. 4.
Map showing the results from boat surveys of harbour seals in Van Mijenfjorden 7 July (top) and 19 August 2002 (bottom).

No mother-pup pairs were observed nor were any particularly large animals seen. As mentioned above, harbour seals pup on land in the latter half of June. During this time the fast ice normally still covers Van Mijenfjorden, so we did not expect this area to be an important pupping area for this seal species. However, mother-pup pairs do shift locations sometimes, so pups born outside this area might move into the area following the disappearance of the ice. The lack of large individuals indicates that mainly relatively young seals occupy this area. Among seals, it is not uncommon for young non-breeding individuals to stay away from the main breeding areas (which in this case would be Prins Karls Forland) until they reach sexual maturity. In our sample of 367 harbour seals from Prins Karls Forland (Lydersen and Kovacs 2001) sub-adults are markedly underrepresented. It might be the case that they occupy areas like Van Mijenfjorden until they reach an age when they become integrated into the breeding population.

8. Polar bears

Polar bears are at the top of the Arctic marine food chain. They have a circumpolar Arctic distribution. The world population is estimated to be about 25,000 animals. About 5,000 of these are thought to reside in the East Greenland-Svalbard-Franz Josef Land area (Larsen 1986). Polar bears spend most of their time on the sea ice hunting for seals. Ringed seals are their principle prey throughout the Arctic, but Svalbard polar bears also feed significantly on bearded seals and also to some degree on harp seals (Lønø 1970a, Gjertz and Lydersen 1986a, Derocher et al. 2002)(Fig. 8. 1). Polar bears also scavenge on dead mammals and eat some eggs, young birds and even kelp on beaches. In Svalbard they have also been observed successfully hunting reindeer (Derocher et al. 2000).

Average lengths of adult polar bears in Svalbard are 225 cm for males and 194 cm for females, while average adult body masses are 389 kg for males and 185 kg for females (Derocher and Wiig 2002). Similar to seals, polar bear masses vary enormously through the year as well as between years, depending on food availability and the amount of fat stored by the bear at a particular time. The heaviest individual weighed in the study by Derocher and Wiig (2002) was 525 kg. However, an individual shot on Hopen Island a few years ago was believed to weigh close to 800 kg based on body size measurements. Polar bear females reach sexual maturity at the age of four to five years, while males become sexually mature at five to six years of age. During early winter pregnant females make a snow den where they give birth in late December or early January, normally to two cubs (Derocher 1999) (Fig. 8. 2). Polar bear cubs are born very altricial. They weigh approximately 0.5 kg at birth, have little hair and their

Fig. 8. 1.
Polar bears feeding on a seal kill (Photo by Georg Bangjord).

eyes are closed. Female and cubs remain in the security of the den until the cubs are about four months old, and they stay together as a family unit for the next 2.5 years. Mortality for cubs during this period is relatively high, only about 38 % of the cubs survive until weaning (Wiig 1998).

Fig. 8. 2.
Polar bear cubs in the den (Photo by Georg Bangjord).

Polar bears accumulate high levels of organic pollutants because they feed at the very top of the food chain and store large amounts of lipids. In Svalbard the toxic loads in bears are so high that concern for the well-being of the population has been raised. It is thought that the immune and endocrine systems of the bears are being challenged and that the high frequency of pseudohermaphroditism (females with abnormal genitalia) detected in this area may be effects of the high levels of pollutants (Wiig et al. 1998, Bernhoft et al. 2000, Skaare et al. 2001).

Polar bears in Svalbard have been studied for over 20 years using satellite telemetry (Larsen 1986, Wiig 1995, Mauritzen et al. 2001, 2002). Most of these studies were conducted on bears marked in the eastern parts of the Svalbard archipelago where the densities of polar bears are the highest. Only adult females have been studied. The reason for this is that the neck of an adult male is so thick, compared to the dimensions of its skull, that it could easily remove a satellite collar by pulling it over its head (Fig. 8. 3). Studies of the movement patterns of female bears have revealed extreme variation in home range sizes between individuals. Some bears have small home ranges, and remain within some few 100 km^2 for years, while other individuals have large home ranges, which in extreme cases cover areas of several 100,000 km^2, which can include the whole Barents Sea area (Mauritzen et al. 2001).

Even though most polar bear satellite tagging has been conducted on the eastern parts of Svalbard, some bears have been tagged in the Bellsund - Van Mijenfjorden - Van Keulenfjorden area. In addition some bears tagged elsewhere have also moved through this area, remaining for shorter or longer periods. During the period from 1988-2001 a total of 11 tagged bears fell into one of these two categories. Ten of these bears moved through the study area relatively quickly (Fig. 8. 4 upper and middle panels), while one individual spent more than 500 days in the area during three periods between 1992 and 1996 (Fig. 8. 4 lower panel). During the rest of the time this individual was followed, it stayed in Storfjorden. The ten other bears spent an average of 17 days in the study area, with a minimum of six days and a maximum of 39 days. The general pattern is that the polar bears enter the study area from the south during winter or early spring, and then pass through the area leaving towards the east-southeast in the direction of Storfjorden. These bears are probably following the drifting ice from the east side of Spitsbergen brought by ocean currents around Sørkapp and up along the west coast. When the ice reaches or comes close to shore, the bears enter the fjords, stay for a shorter or longer period, and then generally migrate back over land toward the eastern parts of Svalbard. The tracks of the satellite tagged bears suggest that many of the bears enter the study area over land (Fig. 8. 4 upper and middle panels). This is probably a sampling artifact since the transmission of

Fig. 8. 3.
Only adult female polar bears have been used in satellite tracking studies because the neck of males is thicker than the head (as seen in this picture), so satellite collars would slip off (Photo by Georg Bangjord).

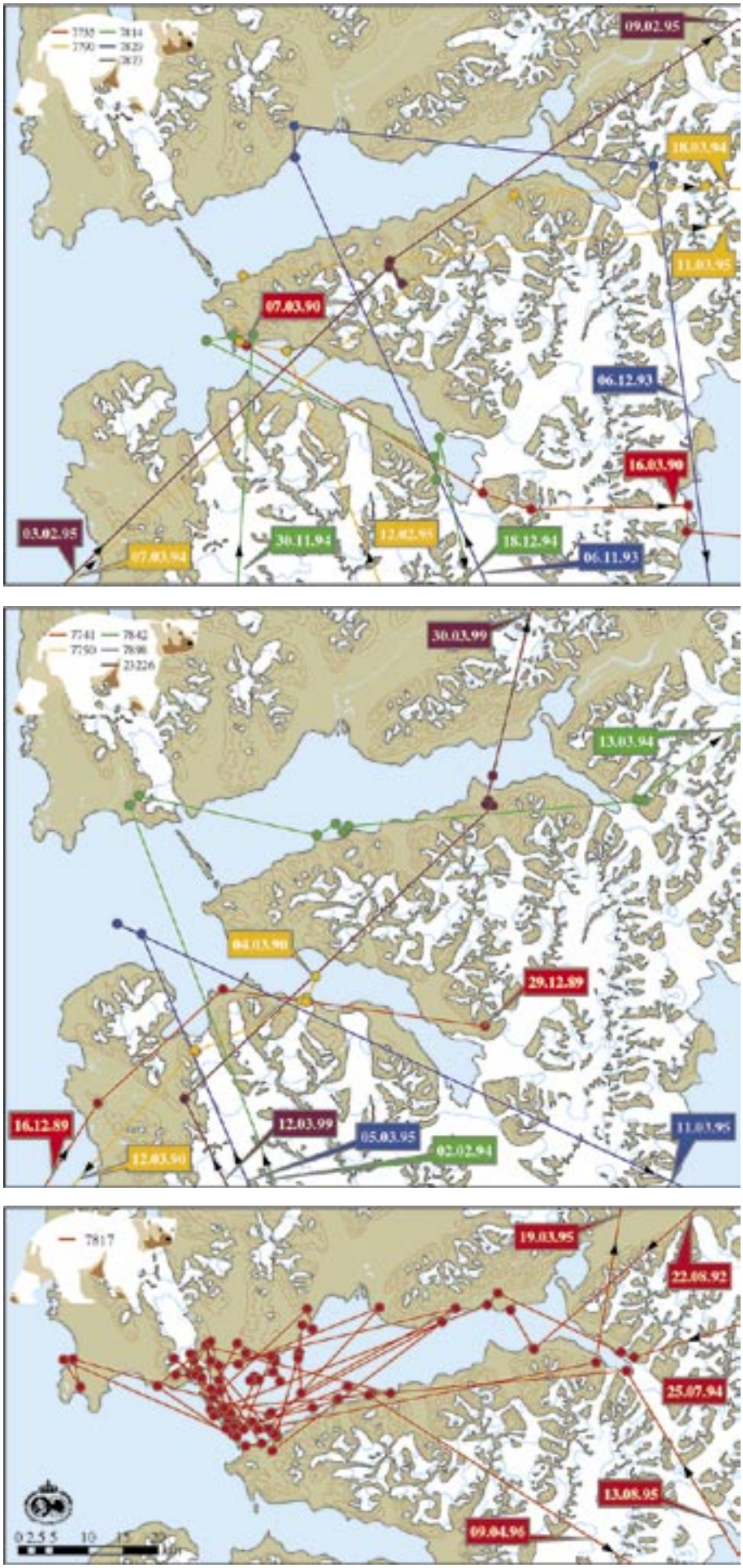


Fig. 8. 4.
Tracks of satellite tagged polar bears in Van Mijenfjorden and Van Keulenfjorden. Upper panel shows 5 polar bears moving through the area. They spent the rest of the year in Storfjorden. Notice bear 7790 (orange track line) that enters the area at about the same time in two consecutive years. Mid panel shows 5 other bears moving through the study area before moving eastwards into the Barents Sea proper. Lower panel show tracks of a bear that during the period 1992-96 spent 507 days in the study area.

Table 2.
Polar bears observed (or shot) during June - August 2001 and 2002 in Van Mijenfjorden and Van Keulenfjorden.

Year	Female with first year cubs	Female with yearlings	Adult females	Adult males	Unknown sex	Total
2001	1+2	1+2, 1+1	1	1	1	11
2002	1+2, 1+1	1+2	0	2	5	15

data from the tags occurs at best frequency only once every five days. The most likely route followed by the bears is that they are carried into the study area on sea ice through the mouth of Bellsund, entering from the south. One of the bears followed the same movement pattern in two consecutive years (Fig. 8. 4. Map - upper panel, orange track lines). The movement patterns of the ten bears that spent relatively short periods on the west coast can be divided roughly into two groups with respect to their activities after leaving the study area. Five mainly stayed in Storfjorden for the rest of the year (Fig. 8. 4. Map - upper panel), while the other five moved out into the Barents Sea (Fig. 8. 4. Map - mid panel), indicating that the first group fall into the small home range bear type, while the latter group comprises bears with large home ranges.

There is not a lot of information from satellite tracking during the summer months from polar bears in the study area. However, incidental summer observations of bears from this area exist. This sort of data from 2001 and 2002 are summarized in Table 2. (These numbers are minimum numbers and repeated observations of the same individual are accounted for).

During the summer bears are generally thought to go without food most of the time, until the ice forms in early winter and seal hunting conditions improve. However, a bear shot in the study area during the summer had seal contents in its stomach. Other polar bears in the area have been observed attempting to hunt harbour seals, and they are also known to feed on bird eggs and chicks, especially eider ducks. Another possible source of food for polar bears, that has become a major problem in the study area, is cabins and huts. Polar bears raid them, causing considerable damage to property while they search for anything resembling food. During 2001 and 2002 five bears have been shot and three have been moved out of the area due to human - polar bear conflicts in this area. One of these bears, captured initially as a cub in Van Keulenfjorden in 1996, was shot in 2002 in Colesbukta together with her two small cubs of the year. This family group was responsible for damaging 25-30 cabins in the area during the last few months of their lives. This series of incidences indicates that mothers teach their foraging habits, including raiding cabins once this is learned, to their offspring.

Polar bears are present in the study area all year around. During the winter and spring individual polar bears stay in this area for variable periods of time hunting seals. Some bears also stay in the area during the ice-free months. We do not know much about the behavioral patterns of these summer-bears, except that some of these individuals end up as “problem bears” with respect to human - bear interactions. Newly developed polar bear satellite tags with an integrated GPS system allow us to track detailed movement patterns of polar bears. This technology could be employed to provide more detailed information about summer movement patterns of polar bears in the Van Mijenfjorden area that might prove useful with respect to the management of problem bears.

9. White whales

White whales, or belugas, are found in cold waters of the Arctic and sub-Arctic. They have a nearly continuous distribution across the Russian Arctic from the White Sea in the west through to the Sea of Okhotsk in the Pacific. In the east Atlantic region they are restricted to Svalbard and the western Barents Sea. In the western Atlantic they occur as far south as the Gulf of St Lawrence and extend from the coast of Labrador up the east coast of Greenland and across North America over to Alaska.

Adult male white whales weigh about 1500 kg and are about 5 m long, while the females are somewhat smaller. The colour of this whale species changes with age. Newborn calves, which weigh about 50 kg, are dark grey, sometimes with a brownish-red tinge (Fig. 9. 1). Then as the animals age they pass through phases when they are grey, light grey, and white with a bluish tinge before they become pure white when they are five to six years old. At this age the white whales become sexually mature. The females have a 14-month long gestation period followed by a lactation period of up to two years. This means that females give birth to a new calf only every third year.

Fig. 9. 1.
White whale calf about 1 week old. White whales are dark grey at birth and pass through various colour phases before they end up white as adults (Photo by Ian Gjertz).

White whales are highly gregarious and are normally found in pods consisting of a mix of different ages and sexes. However, groups composed entirely of adult males are also quite common. Most white whale populations go through an annual pattern of seasonal movements, with herds coming into coastal waters and river estuaries during the summer and then moving offshore to wintering ranges in the pack ice or in areas that contain polynyas.

The white whale is the most commonly observed and most numerous whale species in Svalbard. During spring they come deep into the fjords to feed along ice edges and glacier fronts, and they are presumed to leave again in the autumn, when the fjords begin to freeze. Russian whalers began harvesting this species in the Svalbard area early in the 17th century, mainly operating in the fjords on the west coast of Spitsbergen. Knowledge of these early catches is scarce. During 1866, Norwegians also commenced whaling for white whales in this region, and from this date until whaling ended in the start of the 1960s, about 15,000 whales were caught (Lønø and Øynes 1961, Gjertz and Wiig 1994a). White whales have been totally protected in Norwegian waters since that time (Wiig and Gjertz 1992). Despite the fact that white whales are common in Svalbard and have been exposed to hunting for centuries, very little is known about their biology in Norwegian waters. The Norwegian Polar Institute initiated a research programme in 1995 with the

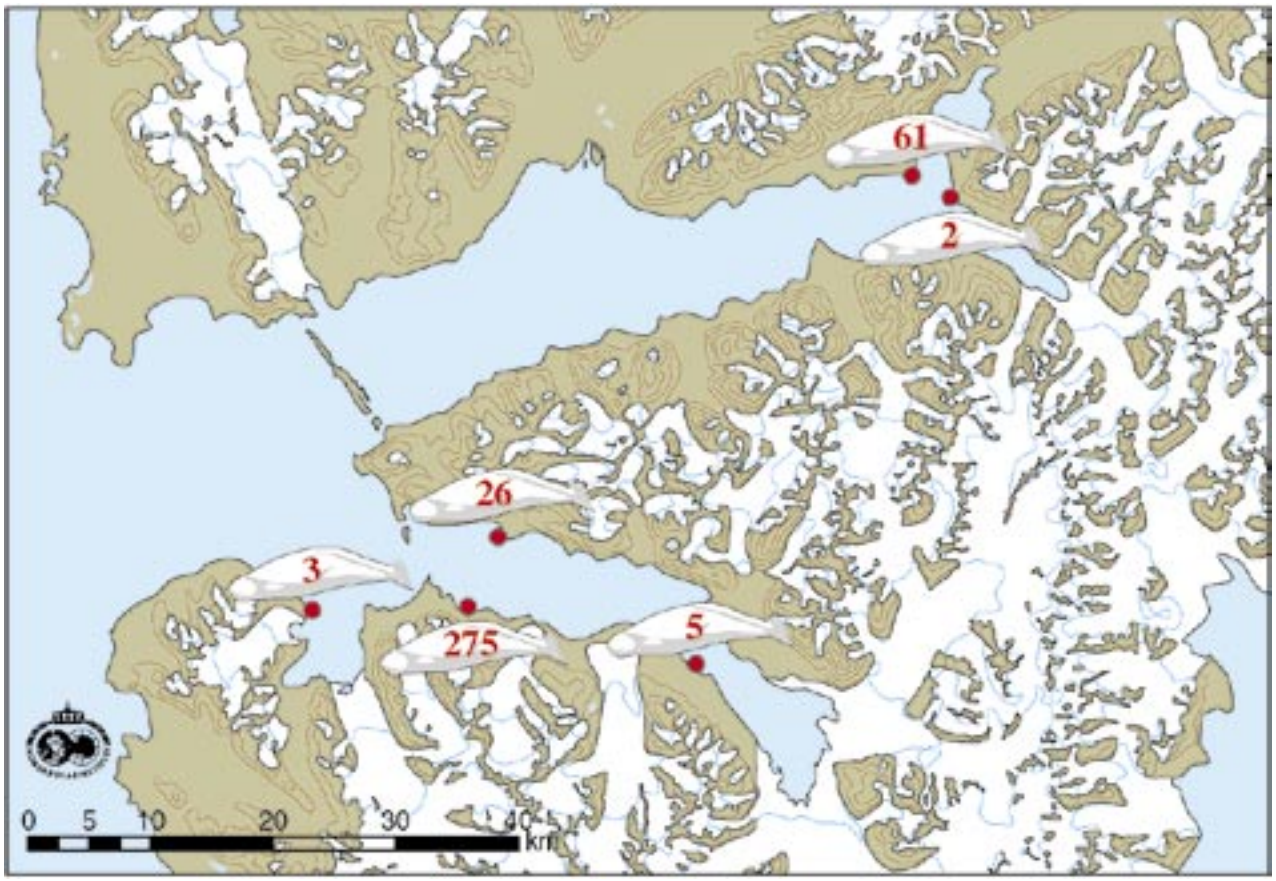


Fig. 9. 2.
Sites where whaling took place in Van Mijenfjord and the number of white whales taken at each site in the period 1945-1960. Data from Lønø and Øynes (1961).

Fig. 9. 3.
White whale skeleton parts from earlier whaling cover some of the beaches on the southern shores of Van Keulenfjorden.

objective of gathering biological information relevant to management of this species in Svalbard. Because white whales are totally protected, research activities were restricted to studies involving material and data collected from live specimens. The Bellsund - Van Mijenfjorden - Van Keulenfjorden area was selected as the area where we started this research programme. Historical information on catches showed that white whales used this area intensively (Figs. 9. 2 and 9. 3), and coal-mining personnel in Svea informed us that white whales were commonly observed in the inner parts of Van Mijenfjorden every summer. From 1995-97, 12 adult males were live-captured in this area for different investigations (Fig. 9. 4). Seven of these animals were instrumented with satellite transmitters (Lydersen et al. 2001b). Based on the results from these animals, we moved the fieldwork to Storfjorden the following years (1998-2001) where another 46 animals were captured; 13 of which were instrumented with different satellite tracking devices (Lydersen et al. 2001b; 2002b).

The movement patterns of the whales captured in Van Mijenfjorden and Van Keulenfjorden showed that the whales move repeatedly in and out of these fjords (Fig. 9. 5). They also leave the area for periods and move up and down the coast and around Sørkapp and into Storfjorden. Only one of the tagged whales moved north of Bellsund. When we started capturing white whales in the northern parts of Storfjorden, some moved north into Hinlopen, some travelled around Egdeøya and Barentsøya, and some swam to the west coast of Spitsbergen and spent considerable amounts of their time in Van Mijenfjorden and Van Keulenfjorden (Fig. 9. 6). These movement patterns suggest that there might be a southern Svalbard sub-population using the areas from Bellsund – Van Mijenfjorden – Van Keulenfjorden

Fig. 9. 4.
White whales captured in the inner parts of Van Mijenfjorden, with the Svea settlement in the background (Photo by Ian Gjertz).

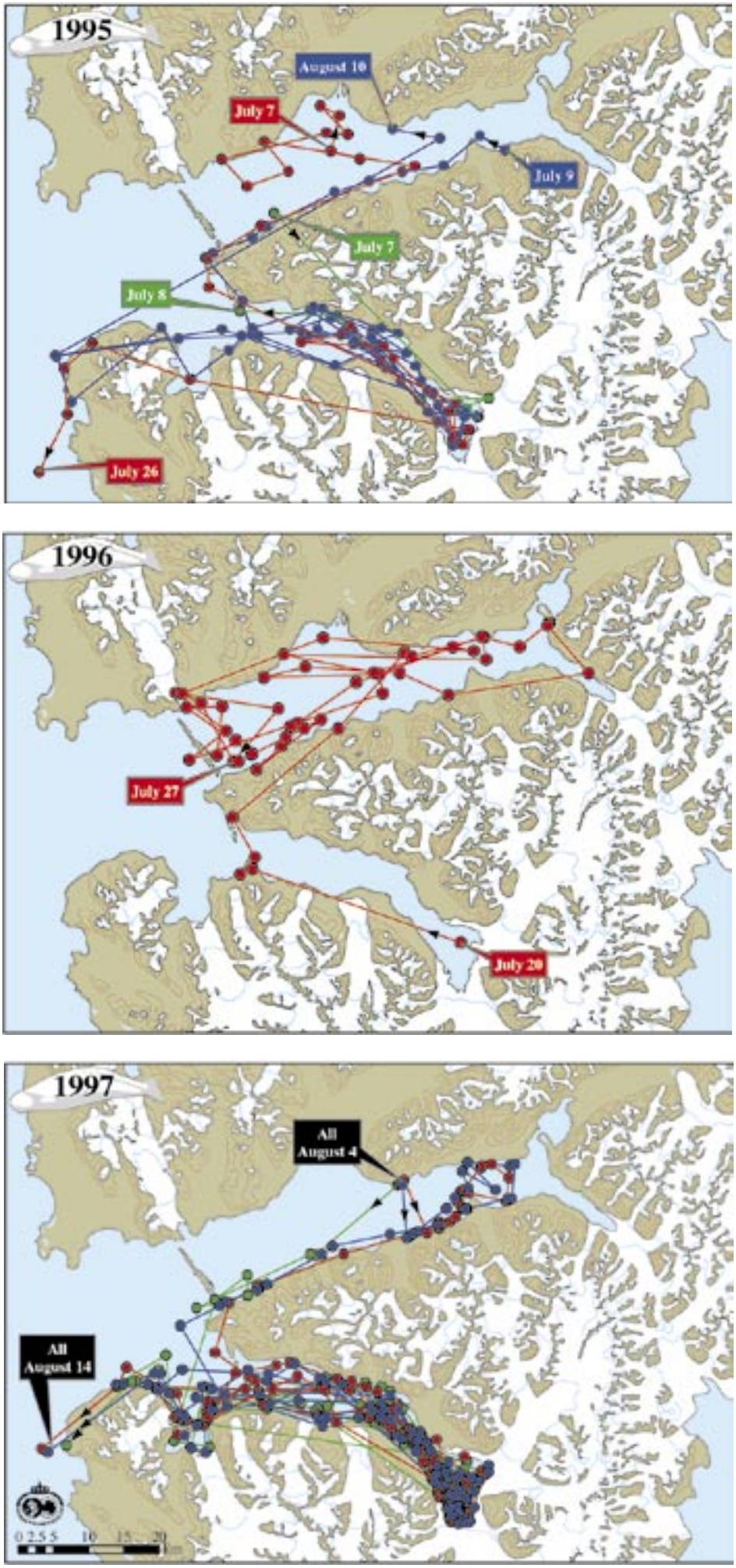


Fig. 9. 5.
Tracks of satellite tagged white whales captured in Van Mijenfjorden or Van Keulenfjorden. The panels show movements within the study area for three whales captured in 1995 (upper panel), one whale captured in 1996 (mid panel) and three whales captured in 1997 (lower panel). The three whales from 1997 were captured simultaneously and they remained together for the complete duration in which the tags functioned, a period of several months.

around Sørkapp and up to southern parts of Hinlopen with Storfjorden as their centre of distribution. Late autumn satellite tracking of these animals indicates that they stay in the outer parts of Storfjorden even during winter in areas with more than 90 % ice cover (Lydersen et al. 2002b). All of the tagged animals spent a lot of time in front of glaciers. Over 50 % of the recorded time (15730 h) was spent in such areas. The reason for this is likely the availability of food. Glacier fronts are known to be up-welling areas and where there is up-welling there is nutrient release, phytoplankton growth, zooplankton accumulation and hence concentrations of larger invertebrates and fish. The main prey for the Svalbard belugas is polar cod (Dahl et al. 2000).

In addition to the satellite tracking studies and studies of diet, the white whales captured in Van Mijenfjorden and Van Keulenfjorden were also involved in pollution studies. This investigation showed that contaminant levels found in white whales from Svalbard were quite similar to those from white whales in other geographical areas in the Arctic (Andersen et al. 2001). Noteworthy was the fact that white whales in Svalbard have higher levels of many pollutants than polar bears, even though they feed at a lower trophic level. This is not because they are exposed to higher levels of these compounds in their diet, but rather because white whales are less capable than polar bears at dealing with these compounds metabolically. They do not break down these substances as easily as bears do, and hence they accumulate in higher concentrations in the blubber layer of the whales.

Vocalisations of white whales in Van Keulenfjorden have also been studied (Karlsen et al. 2002). In this study, the sounds that Svalbard whales produce were classified and compared with white whale vocalisations

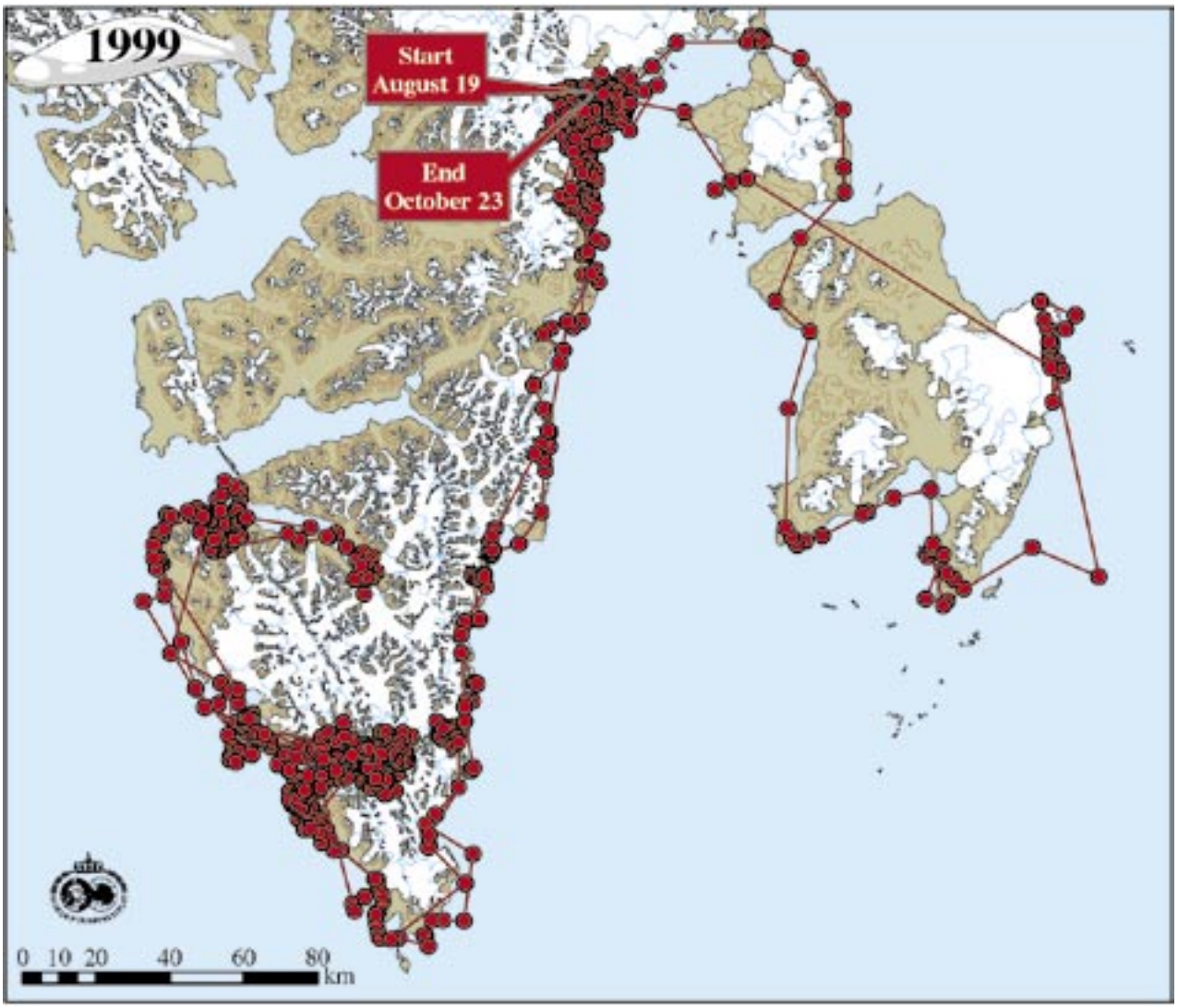


Fig. 9. 6.
Track from one (of many) white whale(s) captured in northern Storfjorden in August that travelled around Sørkapp, north to Bellsund and into Van Keulenfjorden before returning to its tagging location some time later. This whale entered Bellsund from the south on September 17 and stayed there for only one day before moving south again. It returned to the north, again entering Van Keulenfjorden on September 22. It stayed in this area for three days during this visit before leaving the area for the remainder of the tracking period.

from other areas of the Arctic. Svalbard's white whales showed a lot of commonality with populations from elsewhere, but also a few unique call variants were found. A surprising result was that Svalbard white whales were remarkably quiet compared to white whales from other regions. White whales normally are so vocal that they are nicknamed "the canaries of the sea", but in Svalbard they spend a lot of their time silent for unknown reasons.

White whales clearly reside in the Van Mijenfjorden - Van Keulenfjorden area quite regularly. However, the size of the population using the area is currently unknown. Whales are routinely sighted passing by Svea, but our tracking studies indicate that the same animals make many visits to the area, passing repeatedly through the same areas over the summer months. Hence, sighting frequency is not a good indicator of the actual population size.

10. Other marine mammals

Walruses

Walruses are the largest of the pinniped species in Svalbard. Adult males can weight up to 2000 kg (Wiig and Gjertz 1996), while the females are rarely heavier than 1000 kg (Fig. 10.1). The historical population size of walruses in Svalbard is not known, but based on general descriptions of herds encountered by early explorers and whalers as well as catch statistics, it is clear that walruses were once extremely abundant in Svalbard. However, three and a half century of heavy harvesting (starting in 1604) brought the population to the brink of extinction. Walruses became a protected species in Svalbard in 1952. The summering stock of walruses in Svalbard in the beginning of the 1980s was estimated to be about 100 animals (Born 1984). Since that time the population has increased steadily (Gjertz and Wiig 1995). Genetic studies and satellite tracking have revealed that the Svalbard and Franz Josef Land walruses comprise a single population (Wiig et al. 1996, Born et al. 2001). The estimated size of this population is about 2000 animals (Born et al. 1995, Gjertz and Wiig 1995).

Most of the walruses in Svalbard today reside in the eastern and northern parts of the archipelago. However, most of the historical catches of walruses were taken from the west coast of Spitsbergen, including the Bellsund area. Lønø (1970b) reviewed the historical data on walrus catches in Svalbard. He quotes from the Norsk Handels-Tidende from 1827 about the situation regarding walrus harvesting in the Bellsund area : "Walrus hunting in this fjord is very regular. As one piece of proof of the numbers of walrus which are to be found in one single fjord, one small schooner caught a

Fig. 10. 1.
Adult male walruses may weigh up to 2000 kg (Photo by Kit & Christian).

complete catch in one hour there on 12 August, 1826. A group of 20 Russians spent the winter here in 1822-23 and caught 1100 walrus".

In recent times walruses are not so common in the Bellsund - Van Mijenfjorden - Van Keulenfjorden area. However, they are quite regularly observed on the southern shores of Bellsund, and also on beaches in Van Mijenfjorden and Van Keulenfjorden (e.g. Øritsland 1973, Gjertz and Wiig 1994b, Bangjord 1999). The local trapper at Akseløya observes small groups of five to six animals hauled out on ice floes each spring (L. Nielsen, pers. comm.). Thus, walruses are common visitors to the area at least in spring, although none of the former haul-out places seem to have come into regular use again.

Minke whales

Minke whales are found in most oceans of the world, and they are the most numerous of the baleen whales in Svalbard waters during the summer. This species is the basis for the current whaling industry in Norway (Fig. 10. 2), and even if it is the smallest of all baleen whale species they still reach a length of about 10 m and attain a body mass of more than 10 tonnes. The north-eastern Atlantic minke whale population is estimated to consist of about 85,000 animals (Schweder et al. 1997). Approximately 25,000 of these animals are assumed to spend the period from about mid-April to mid-October in the area from east Greenland to 30° E and north of 74° N west of the 0-merdian and north of 73° N east of the 0-meridian (See Folkow et al. 2000). This area includes all of Svalbard. Minke whales are currently hunted in this area, all the way from Bjørnøya in the south up to the ice edge north of the Svalbard Archipelago. Catch statistics show that Bellsund - Van Mijenfjorden - Van Keulenfjorden is not a common area in which to whale today. The last recorded catch from this area was in 1973. In the period 1956 to 1973 a total of 43 whales were caught in Bellsund (Fig. 10. 3); 39 of these animals were caught in the years 1956 and 1957. Even though no minke whales have been caught recently in the area they are regular visitors in and around Bellsund, and they at least pass through the area each year on their way toward the ice edge in early summer and again during the southward migration in the autumn. We (KMK and CL) have observed this species several times while conducting fieldwork in this area.

Harp seals

Harp seals are only found in the North Atlantic and they are the most numerous seal species in this ocean sector. Harp seals are generally divided into three distinct populations, one breeding at two locations at the east coast of Canada (more than five million

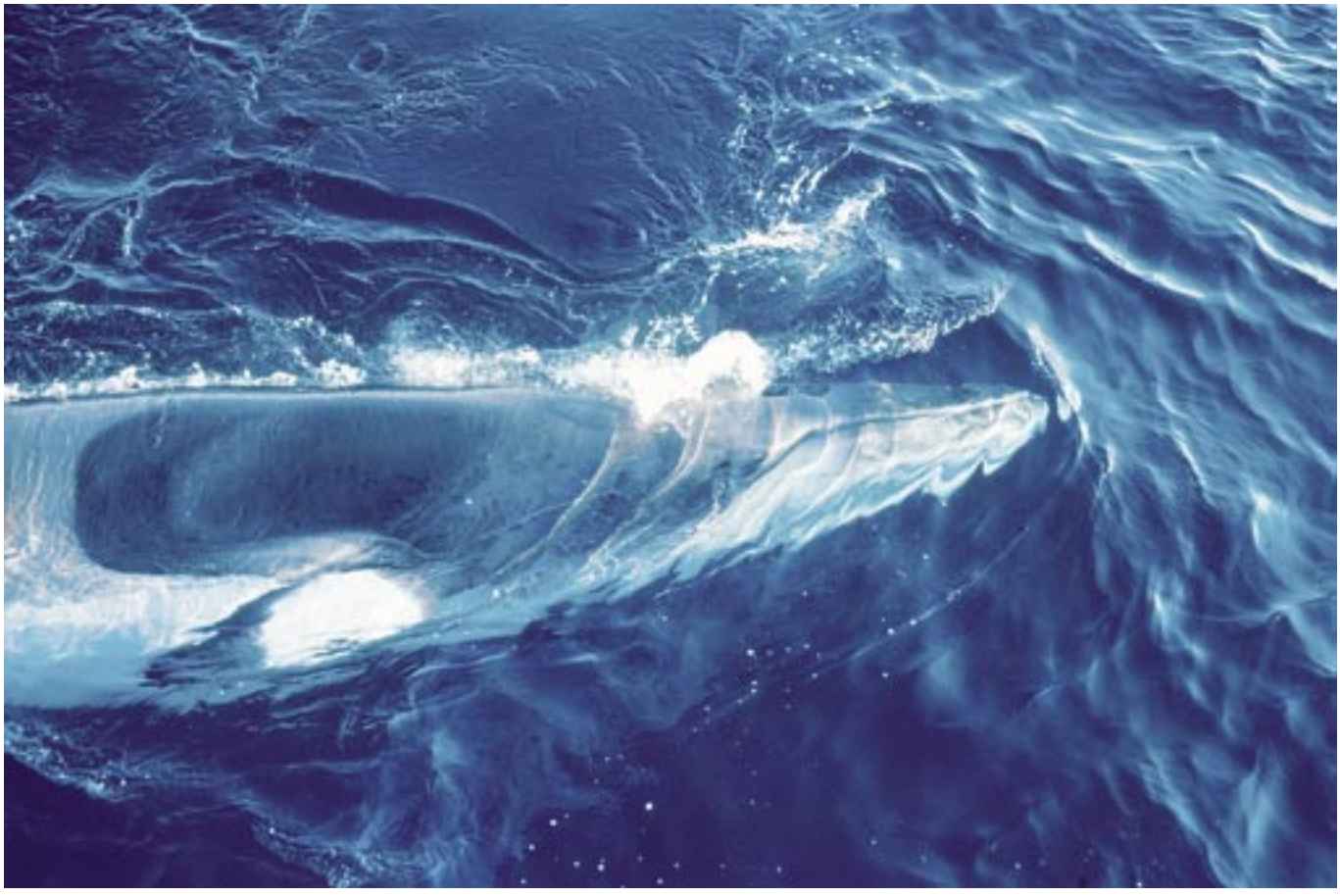


Fig. 10. 2.
A harpooned minke whale pulled up to the side of a Norwegian whaling boat (Photo by Kit & Christian, NP).

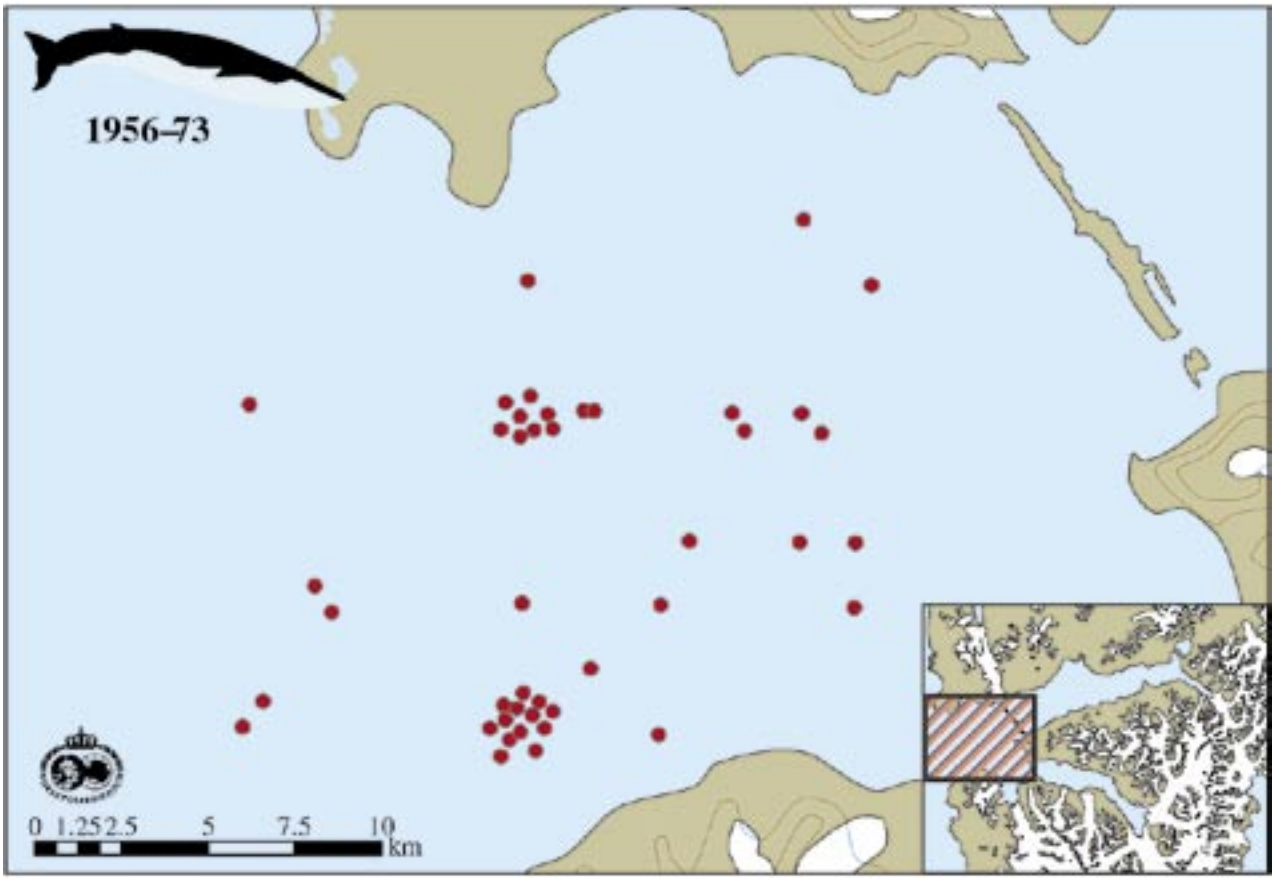


Fig. 10. 3.
Positions of minke whales captured in the Bellsund area in the period 1956-1973. Data from Nils Øien, Institute of Marine Research, Bergen.

individuals), another breeding in the "West Ice" between Jan Mayen and Greenland (about 300.000 animals) and the last breeding in the White Sea (more than two million individuals). Harp seals breed in large colonies and are the basis of ongoing annual harvests at all three breeding grounds. Adult harp seals are about 170 cm long and before breeding they weigh about 130 kg (Fig. 10. 4). Harp seals from the West Ice and the White Sea population can be found in Svalbard waters outside the breeding season. Many harp seals feed along the ice edge in the Barents Sea (Lydersen et al. 1991, Nilssen et al. 1995), often overlapping in their distribution with ringed seals (Wathne et al. 2000). But, many are also observed along the west coast of Spitsbergen (Øien 1997). We (KMK and CL) have observed groups of harp seals both in Bellsund and Van Keulenfjorden, and there are also records from Van Mijenfjorden (Bangjord 1999). The local trapper at Akseløya observes small groups of adult harp seals in the area every September, as well as young harp seals on ice floes in the spring (L. Nielsen, pers. comm.)

Fig. 10. 4.
Adult harp seal (Photo by Kit & Christian, NP).

Other species

Blue whales and humpback whales have been recorded off the west coast of Spitsbergen, both north and south of Bellsund, although the blue whales occur relatively far offshore (Christensen et al. 1992a). We have no specific reports of sightings of either species from Bellsund, but it is likely that humpbacks travel along the coast in this area. Fin whales are regular visitors along the west coast of Spitsbergen in summer (Christensen et al. 1992 a, b), and we (KMK and CL) have observed fin whales in the southern parts of Bellsund. Killer whales have been hunted off the west coast of Spitsbergen both north and south of Van Mijenfjorden and are still routinely observed offshore (Øien 1988). We have seen killer whales in both Hornsund and Isfjorden, and the local trapper at Akseløya has on one occasion observed a killer whale inside Van Mijenfjorden (L. Nielsen, pers. comm.). The

Fig. 10. 5.
A bottlenose whale carcass on the beach in Van Mijenfjorden, summer 1997 (Photo by Ian Gjertz).

Barents Sea population of white beaked dolphins is thought to be about 100.000 individuals (Øien 1993). Most of these animals are found south of Bjørnøya, but some groups do visit areas further north. We have observed small groups of this whale visiting our research vessel in the outer parts of Bellsund several times. A group of five pilot whales was observed in Bellsund in 1995 (Bangjord 1997), but the rarity of sightings suggests that neither of these species are routinely found in the area.

In summer 1997 we found a dead bottlenose whale on the southern shore of Van Mijenfjorden (Fig. 10. 5). This is a deep-water whale that probably resided quite far off shore, west of Spitsbergen. It is likely that currents brought the body into the fjord after it was dead.

11. Recommendations for future investigations

We suggest the following investigations as a follow-up of this initial investigation of marine mammals in the Bellsund - Van Mijenfjorden - Van Keulenfjorden area.

1. **A repeated aerial survey for ringed seals to study inter-annual variability.**
   Aerial surveys for ringed seals conducted in other Arctic areas show a varying degree of inter-annual variability. This should be investigated in order to get a thorough understanding of the importance of the study area as ringed seal habitat.

2. **GPS-satellite tracking of polar bears tagged in the Van Mijenfjorden-Van Keulenfjorden area during the summer months.**
   Some five to ten polar bears seem to stay in the study area during the ice-free season. Some of these individuals cause problems for local cabin-owners. A GPS- satellite tracking study of these bears will give us new insight into the behaviour of these animals that should be useful information for Sysselmannen in relation to handling some of these "problem" bears.

3. **Satellite tracking of harbour seals summering in the study area.**
   Harbour seals (likely) only use Van Mijenfjorden during the ice-free seasons, and a satellite tracking study would reveal where these animals spend the rest of the year, and also whether it is the same individuals that return to the study area each year.

4. **Satellite tracking of ringed seals that inhabit the study area during winter and spring**.
   After the ice disappears from the fjords in Svalbard, most ringed seals leave the coastal areas to feed elsewhere. Satellite tracking of ringed seals inhabiting the study area in the winter and spring would provide information on where these animals spend the rest of the year, and also show whether it is the same individuals that return to the study area each year - similar to the knowledge that would be gained for harbour seals in a comparable study.

12. Acknowledgements

We thank Nils Øien and Louis Nielsen (locally known as Hiawatha in Svalbard) for sharing their expertise regarding the distribution of various marine mammal species in the Van Mijenfjorden - Van Keulenfjorden - Bellsund area, Phil Lovell for formatting the white whale tracks for us, and Harvey Goodwin, Audun Igesund and Jan Roald for help with figures and layout. Special thanks are extended to Odd Harald Hansen for his patience and skill in making the maps in the report.

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