2008

POLAR RESEARCH IN TROMSØ

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IN BRIEF
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POLARMILJØSENTERET

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All eyes to the poles

Polar regions have been in the news a lot this year. When the Svalbard Global Seed Vault was officially opened in February, the event was followed closely in the international media. The vault will serve as safety deposit box for crop seeds from around the world. Placed deep in Svalbard's permafrost, the seeds will be protected from catastrophes: global warming, earthquakes, even nuclear war. With its promise of hope for a new beginning even if our worst nightmares come true, the vault has captivated the public imagination. At the opening ceremony, José Manuel Barosso, president of the European Commission, compared the Global Seed Vault to the Garden of Eden. Norwegian Prime Minister Jens Stoltenberg likened it to a modern-day Noah's Ark.

Later in the year, reports of heavy ice conditions around Svalbard and relatively low temperatures in the Arctic raised hopes that global warming might be slowing down. But such hopes are ill-founded. While more of the Arctic Ocean was covered by ice in December 2008 than a year earlier, the ice was thinner and is therefore more likely to melt away during the next summer season. Some scientists expect to see open water at the North Pole next year. Although some people are hoping that the Northeast Passage will become ice-free, it would clearly be a mixed blessing. A new trade route between Europe and Asia would provide economic opportunities in the Barents region, but shipping would also pose new environmental threats to a sensitive ecosystem. In an area where national sovereign rights are already disputed (see article on page 3), the potential for diplomatic repercussions must also be borne in mind.

Even more Polar Research in Tromsø

None of our readers can have overlooked the International Polar Year – the huge collaborative research venture that has engaged the efforts of so many institutions in Tromsø. Now that IPY is drawing to a close, some might wonder what the researchers will do next. Is the party over now? Never fear! Though 2008 saw an incredible amount of activity, the future may prove to be even busier. Obviously, the data collected during IPY must be compiled and interpreted, a task that will take years. But there are new opportunities on the horizon too. In December, the European Strategy Forum for Research Infrastructure announced its support for the Svalbard Integrated Arctic Earth Observing System (SIAEOS). With a yearly budget of about 70 million NOK and hundreds of millions to be invested in infrastructure, SIAEOS will facilitate research in and around Svalbard, where many of Tromsø's natural scientists do their work. But there are also exciting developments in Tromsø itself. In its most recent budget, the Norwegian Government set aside 22 million NOK per year for a new centre for research on snow and climate, to be established within the Norwegian Polar Institute (see page 18). So instead of a lull in activity after the International Polar Year, we can expect even *more* Polar Research in Tromsø.

Tromsø, January 2009
The Editors

Polar Research in Tromsø

Polar Research in Tromsø is published once a year by the Roald Amundsen Centre for Arctic Research at the University of Tromsø, the Norwegian Polar Institute, the Tromsø branch of the Institute of Marine Research and the Polar Environmental Centre, Tromsø, Norway. Its aim is to describe all manner of education and research in polar (chiefly Arctic) studies carried out during the past year at these institutions and at other research institutes and companies in the Tromsø area with which they have close ties.

It is sent on request and free of charge to all persons who are interested in polar studies.

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Conflict and order in Svalbard waters

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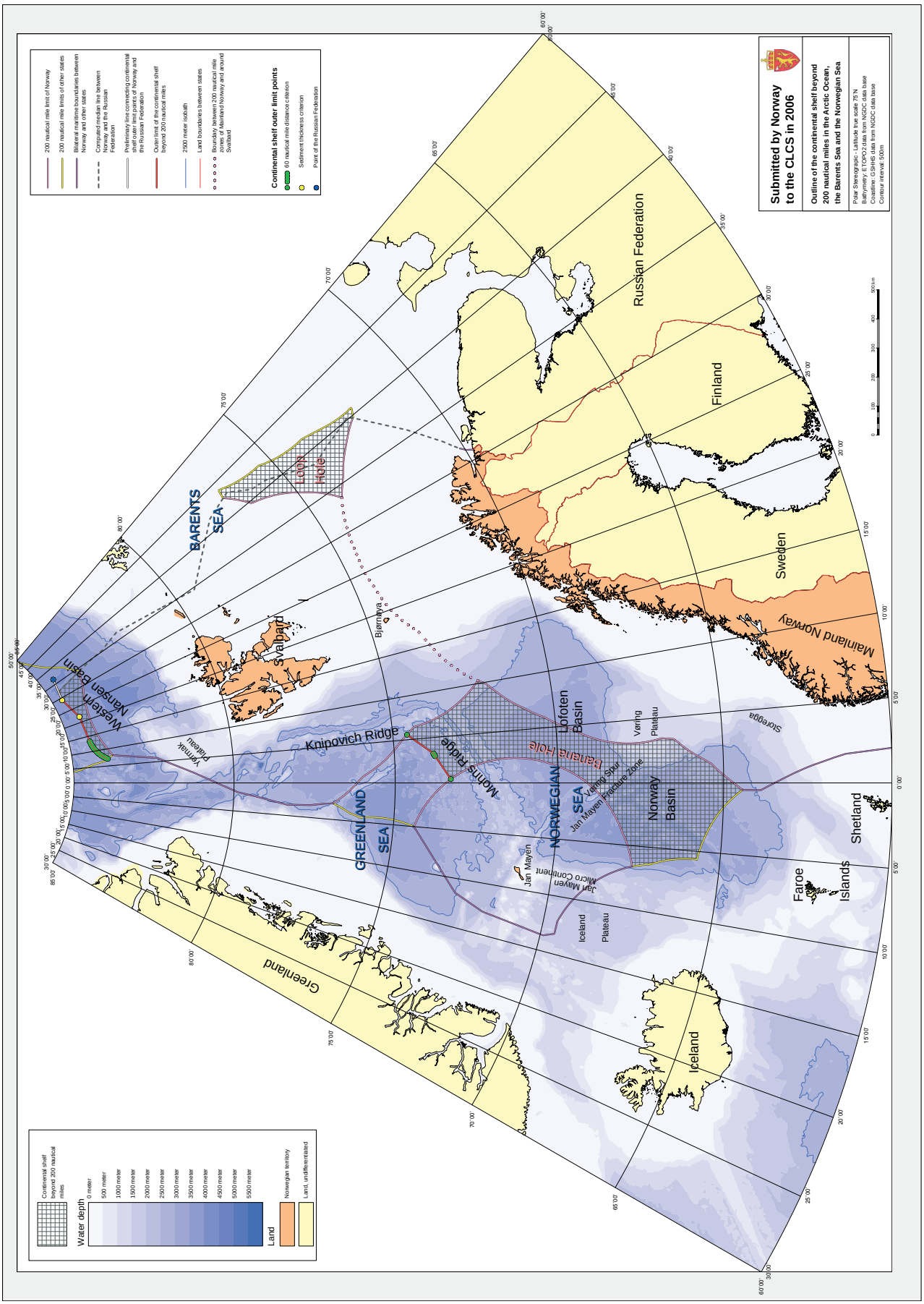
Norway's claim to exclusive rights outside Svalbard is debated. Paradoxically, Norwegian diplomacy has made the claim even more debated. Here, the Norwegian coast guard vessel *Svalbard* approaches Longyearbyen. (Photo by the author)

Amid rich fishing grounds and the bountiful continental shelf of the Barents Sea lies Svalbard. The international community sought to clarify the archipelago's status by agreement in 1919-1920. Paradoxically, the Svalbard Treaty has become a source of international debate over maritime rights. Norway obtained sovereignty over the former *terra nullius* but yielded certain sovereign rights, including the exclusive right to natural resources. The geographical extent of these restrictions has emerged as a matter of international discord. Norway holds that the stipulations do not apply to areas beyond the territorial sea of Svalbard. Some countries, including fishing nations Russia, Spain and Iceland, but also Czechoslovakia, Poland and Hungary in the 1970s, have disputed Norway's right to establish maritime zones adjacent to the archipelago. Others, most notably the United Kingdom and the Netherlands, have maintained that their rights as parties to the Svalbard Treaty – including the right of their nationals to be treated on an equal footing with Norwegians – are applicable to all Norwegian zones generated by Svalbard. Yet others, including the United States, (West) Germany and France, have reserved whatever rights they may have under the treaty around the islands without being specific.

The debates over rights to natural resources outside Svalbard originate in the arguably vague references in the treaty to its applicable maritime areas ("territorial waters"), made prior to the developments in the law of the sea that introduced legal concepts such as the continental shelf and the 200 nm Exclusive Economic Zone (EEZ). The disputes over jurisdiction and sovereign rights on the continental shelf around the archipelago remain unresolved, leaving it an enduring source of international tension. Hence, Svalbard waters have repeatedly become the scene of high-level drama. There was a last-minute standdown in 1986 between Spanish trawlers and a number of Norwegian Coast Guard vessels. In 1994, grenades were fired at an Icelandic-owned trawler trying to escape from Norwegian law enforcement, puncturing its hull. In 2002, a 163-meter long Russian warship was unexpectedly deployed to the Svalbard zone following a Norwegian arrest in a Russian trawler outside Svalbard.

Conflict – but also order – may be seen as products of international processes. One such process is the ambiguous causal interplay of international *politics* and international *law*: after decades of debate, the parties involved remain reluctant to bring in disinterested international third parties to settle their legal differences. Despite the legal character of the dispute, and notwithstanding signals that the case would be referred to the International Court of Justice by Spain (1986) and Iceland (1994), the Svalbard issue endures as a political wrangle, where the parties pursue their national interests, as envisaged in a world of *Realpolitik*. Thus, law may seem irrelevant as an explanatory variable in international relations. However international law is not merely epiphenomenal to politics. International legal rules are cementing Norway's right to establish and exercise jurisdiction in the zones, hence affecting international politics. The cementing effect of law on international relations goes beyond what was intended at the time the law was adopted. For instance, whereas the legal procedures for determining continental shelves reaching beyond 200 nm were established to prevent excessive shelf claims, Norway may by the same procedures establish its right to a continental shelf as well as an EEZ around Svalbard. If the outer limits of a Norwegian shelf surrounding Svalbard become final and binding through an ongoing delineation process that involves the United Nations Commission on the Limits of the Continental Shelf (CLCS), in the absence of foreign protests, the parties to the Svalbard Treaty implicitly acquiesce to Norway's claim to maritime zones around Svalbard. Acquiescence, in turn, would prevent them from challenging the Norwegian claim to maritime zones in the future, in accordance with the legal doctrine of estoppel.

Another process that determines the level of conflict outside Svalbard is the exchanges between the *international system* and a state's *foreign policy*. In the Svalbard case, this proc-



Norway seeks to establish continental shelf limits beyond 200 nm north of Svalbard. If the limits become final and binding through an ongoing process involving the UN Commission on the Limits of the Continental Shelf, Norway's right to maritime zones around Svalbard is indisputable. (Map courtesy of the Norwegian Petroleum Directorate)

ess is quite paradoxical. Norway's policies, including its policy objectives for the area, legislation for the maritime zones off of Svalbard, enforcement practice by the Coast Guard, and even public prosecution in Svalbard matters, are significantly curbed by international conditions. At the same time, international conditions are affected by the policies of Norway. The international system and foreign policy become co-determined variables. But the systemic effects of Norwegian policies are not necessarily intuitive. In the 1970s, when Norway sought support from its western allies in the Svalbard matter, the diplomatic efforts inspired a series of reservations. In the 1980s, Norwegian diplomats turned to the United Kingdom for support, but the efforts led to a more confrontational British position that challenged Norway's claim to exclusive rights outside Svalbard. From 2005, Norway has invited a number of allies to bilateral consultations, partly to gain acknowledgement or support for its Svalbard position. However, the failure of these diplomatic efforts became evident when they prompted ten parties to the Svalbard Treaty to meet in London to discuss the Svalbard issue in June 2006 – a meeting to which Norway was not invited.

In fact, Norwegian High North diplomacy has repeatedly been counterproductive. By attracting attention to an issue, Norwegian diplomats have created what scholars have labeled a "choice opportunity" or "policy occasion" for other nations. Responding to Norwegian initiatives, they have assessed their possible rights as parties to the Svalbard Treaty and consequently expressed policies that best attend to their national interests. Attracting attention to the Svalbard issue has not improved Norway's systemic conditions as aspired for, but rather spurred a more coordinated opposition against the claimed exclusive rights of Norway in the waters off of Svalbard.

The causes of conflict and order in Svalbard waters are certainly complex. As the race for natural resources in the region picks up, understanding what sets off conflict and brings about order has never been more important. Exploring the interplay of politics and law as well as the exchanges between the international system and foreign policy may improve this understanding.

Of clams and climate: what bivalves can tell us about Arctic environmental histories

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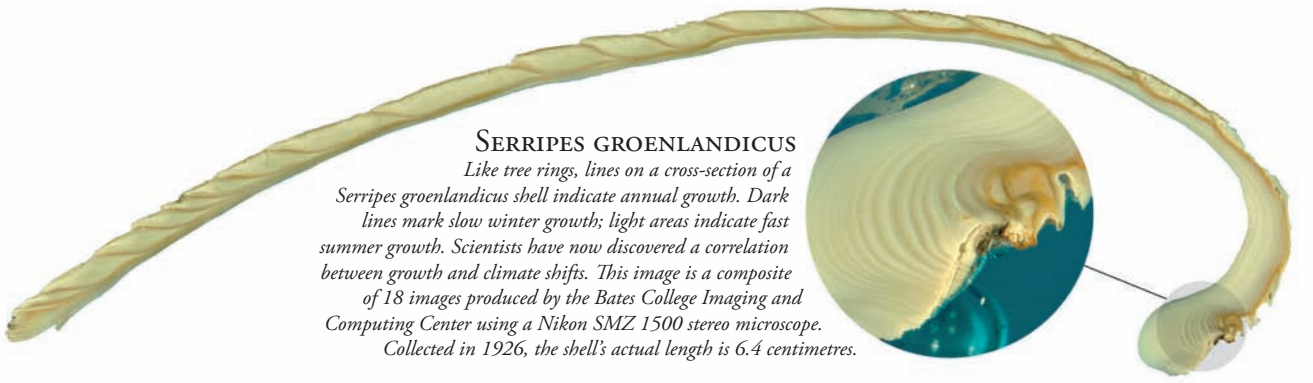
In the present era of perceived climatic upheaval, there is an urgent need to identify exactly how environmental changes will affect Arctic communities and ecosystems, and indeed to identify whether the climatic variations we are currently witnessing are a result of normal cycles or are attributable to the influence of human activity. It is often impossible to decipher baseline conditions in the Arctic due to a lack of records. Clams living on the sea bottom are becoming an important tool in filling in these gaps by providing long-term records of past environmental variations and, at the same time, helping us understand the linkages between environmental variability and ecosystem responses.

Clams have great potential as climatic recorders due to the sequential deposition of shell material through time as the animal grows. The patterns of shell material and its chemical composition provide uninterrupted records of growth histories, metabolism and environmental conditions experienced during the deposition of that shell material over the life of the organism. And with lifespans of several decades – even more than a century for some species – these "trees of the sea" are providing a window into the past environment of the Arctic that will help predict potential ecosystem consequences of Arctic climate change.

Collection of Greenland Cockles (*Serripes groenlandicus*) from Storfjord (Svalbard) at the same site visited by Russian explorers in the late 19th century. (Photo by the author)

For the past five years, my colleagues and I have been collecting and analyzing several bivalve species from Svalbard and the Barents Sea in order to document interannual vari-



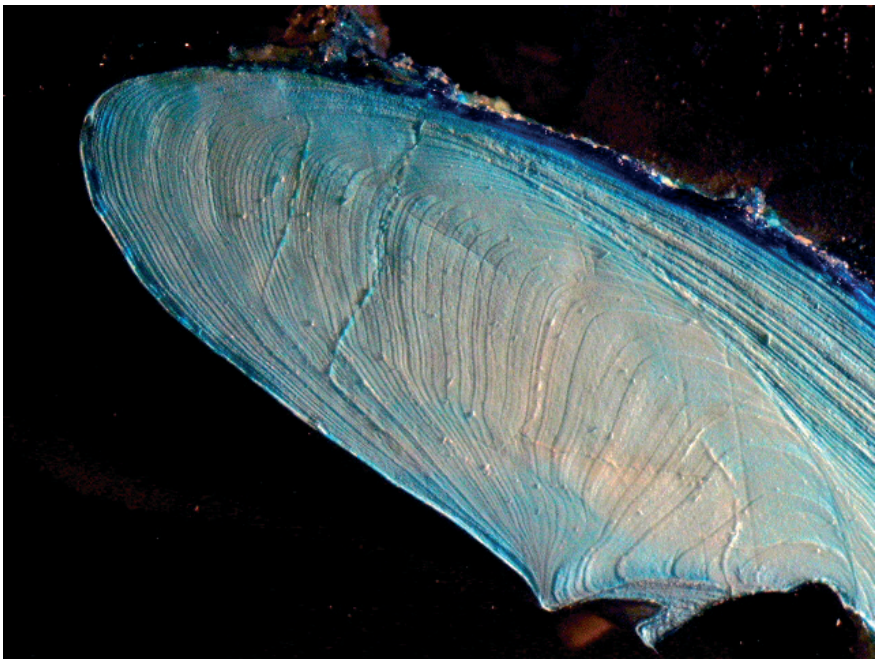
Serripes groenlandicus
Like tree rings, lines on a cross-section of a Serripes groenlandicus shell indicate annual growth. Dark lines mark slow winter growth; light areas indicate fast summer growth. Scientists have now discovered a correlation between growth and climate shifts. This image is a composite of 18 images produced by the Bates College Imaging and Computing Center using a Nikon SMZ 1500 stereo microscope. Collected in 1926, the shell's actual length is 6.4 centimetres.

(Photos: G. Henkes and the Bates College Imaging Center, Maine USA)

ations in growth rates and compare them to large-scale environmental forcing, and their local manifestations (such as weather or meteorological variables). By identifying and measuring each growth ring we can estimate yearly growth over the lifespan of the individual. If the animal was collected alive at a known time, we can assign a calendar year to each growth year by counting backward from the collection date, and compare to environmental conditions occurring at that time. In this way, we can determine the suite of environmental conditions leading to better or poorer growth within a given year.

For example, samples of the Greenland Cockle (*Serripes groenlandicus*) collected from Rijpfjord (Nordaustlandet, Svalbard) in 2003 and 2007 revealed a growth history linked to oscillatory shifts in the overriding climatic regime over the previous 28 years. Clams grew more rapidly during regimes favouring warmer and wetter conditions and grew less rapidly during colder and drier periods. This result is the first documentation in the Arctic where a large-scale climate oscillation was reflected in animals living on the sea bottom, and the sensitivity of these clams to different environmental conditions suggests that they can be considered sentinels of climate change.

We also pushed further back in time by examining archived samples of Greenland Cockles collected in the Barents Sea by Russian explorers in the 19th and early 20th Centuries. From this, we have produced a composite chronology of clam growth over 117 years, from 1878-1995. We also traced variations in river discharge in the coastal



Cross-section image of the hinge area of a 60-year-old Ocean Quahog (*Arctica islandica*), collected from Lødingen, northern Norway in 1906, by Prince Albert I of Monaco. The growth record of this individual extends to 1846. Individuals of this species have been documented to be over 400 years old, making it among the longest-living animals on the planet. (Photo by G. Henkes)

area of the southern Barents Sea through the geochemical signature of shell material, and linked these variations to the North Atlantic Oscillation Index. Further, we collected samples of Greenland Cockles in 2007 from the exact location in Storfjord (Svalbard) where Russian explorers collected in 1899, and are comparing growth patterns and geochemical signatures between these two time periods.

Even when animals aren't collected alive, their growth history can provide clues of the region's past climate. For example, the Wrinkled Rock Borer clam (*Hiatella arctica*), which can reach ages of more than 100 years, is a longtime resident of the seas around Svalbard. Fossilized *H. arctica* in isostatically raised terraces formed 11 000–30 000 years ago show growth rates substantially lower than today, indicating different environmental conditions than at present.

While scientists have analyzed growth lines in shells for decades in order to reconstruct past environments and understand biological histories, there have been relatively few studies of this type in polar regions. The threat of climate change has renewed interest in the field of sclerochronology, and my colleagues and I are using these techniques as part of our toolbox to understand how Arctic marine environments are changing, and the potential consequences to ecosystems.

The NOMAD Expedition: Studying social change in the Russian Far North (Kola Peninsula, NW Russia)

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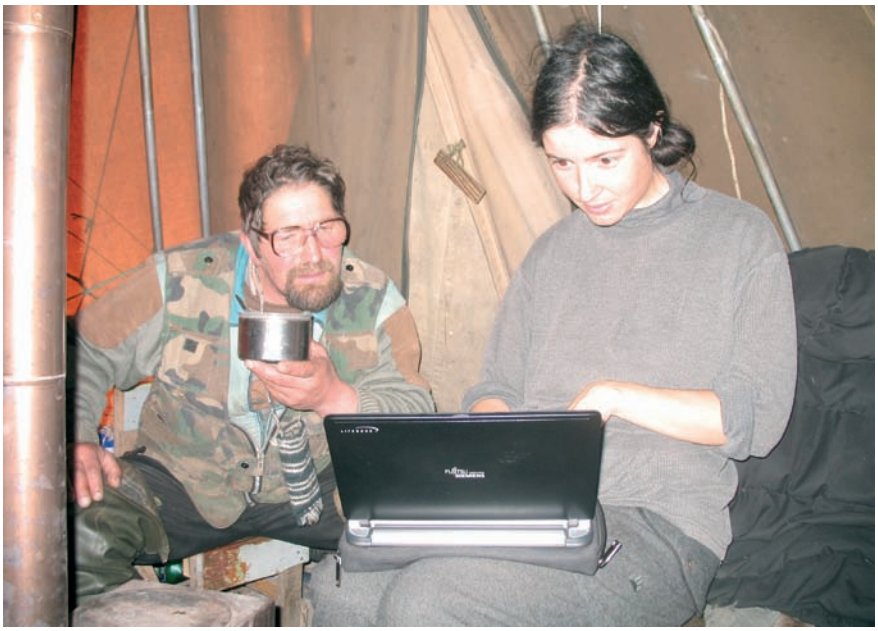

Herder Vassilii Kanev and researcher Vladislava Vladimirova discussing material to be published on the NOMAD website

The NOMAD Expedition (March 2007-February 2008) followed the annual migration of a reindeer herd in the central part of the Kola Peninsula. Endorsed by the German International Polar Year Committee, it was funded by the Max Planck Institute for Social Anthropology (MPI) in Halle, Germany. A constituent part of the expedition was eNOMAD – a cooperative project of the Department of Social Anthropology at the University of Tromsø and the Norwegian Telemedical Centre, funded by the Roald Amundsen Institute for Arctic Research. More details about NOMAD, as well as a month-by-month field-diary of the expedition, can be found at http://polarjahr.de/ under "Forschungsprojekte" (in German) or "Research Projects" (in English).

NOMAD's main task was to study how synergy of socio-economic plus climate change affects the interaction between humans and reindeer, represented by the local maximum extensive form of postsoviet reindeer husbandry. A point of observation was sought which departed from usual field methods of research of the Russian North. In view of the constraints maximum extensive husbandry imposes on fieldwork, the NOMAD project sought close contact with a migrating herd, rather than establishing itself in settlements or tundra herding camps. Creating a mobile (lavvu) camp and following a migrating herd provided rich field data. The mobile camp also created a setting in the tundra, where herders and other tundra-related actors would willingly stop by for a cup of tea and a short respite, while discussing with the research team problems and trends in present-day reindeer herding.

The current increase of private herds kept as an integral part of the overall cooperative stock was a major focus of NOMAD. The process, discussed elsewhere by the authors as a "private-in-the-collective" phenomenon, was observed to be working in synchrony with climate change. This influences in critical ways winter/spring herding operations, principally counting/harvesting corralling and calving.

The eNOMAD component probed into possibilities for establishing telemedical services for the benefit of tundra herding camps and remote villages. Difficult access to medical care is of great significance for the local community and is a factor that contributes to the very pronounced gender split.

Round-up 23 January 2008 at Porosozero corral. (All photos by the authors)

Herders' wives, especially those with young children, would not join their husbands at tundra camps for lack of medical service. Consequences include pronounced enforced celibacy among herders (up to 70%), high levels of alcohol dependence, high incidence of work accidents, and very low life expectancy for men in herding (43 years). Introducing telemedical services was seen by the community to offer a way of improving the situation and helping bring families together. However, the high equipment and running costs present a serious obstacle.

Results have shown how a state of maximum extensivity of husbandry methods leads to an increasing reliance on fence-building and on transportation with heavy tracked vehicles and high speed snow-scooters, the latter increasingly imported second-hand from the Nordic countries. It can be said that maximum extensivity has set in as a stable tendency. Organizationally, every effort is being made, both from the top down and from the bottom up, to retain a state-supported "private-in-the-collective" form, rather than shift to independent private herding. Climate change discourse is turning into a political instrument in this context, being used to sustain the current herding cooperatives as meta-state farms. In studying this process the NOMAD method has proven to be a sophisticated and adequate instrument for understanding social and economic processes in the herding part of the Russian Far North.

Spotting the autumn migration. From left: herders Grigorii Khatanzei, Aleksandr Sorvanov, NOMAD leader Yulian Konstantinov

Oceanic Redfish in the Norwegian Sea – building up research on a rapidly evolving fishery

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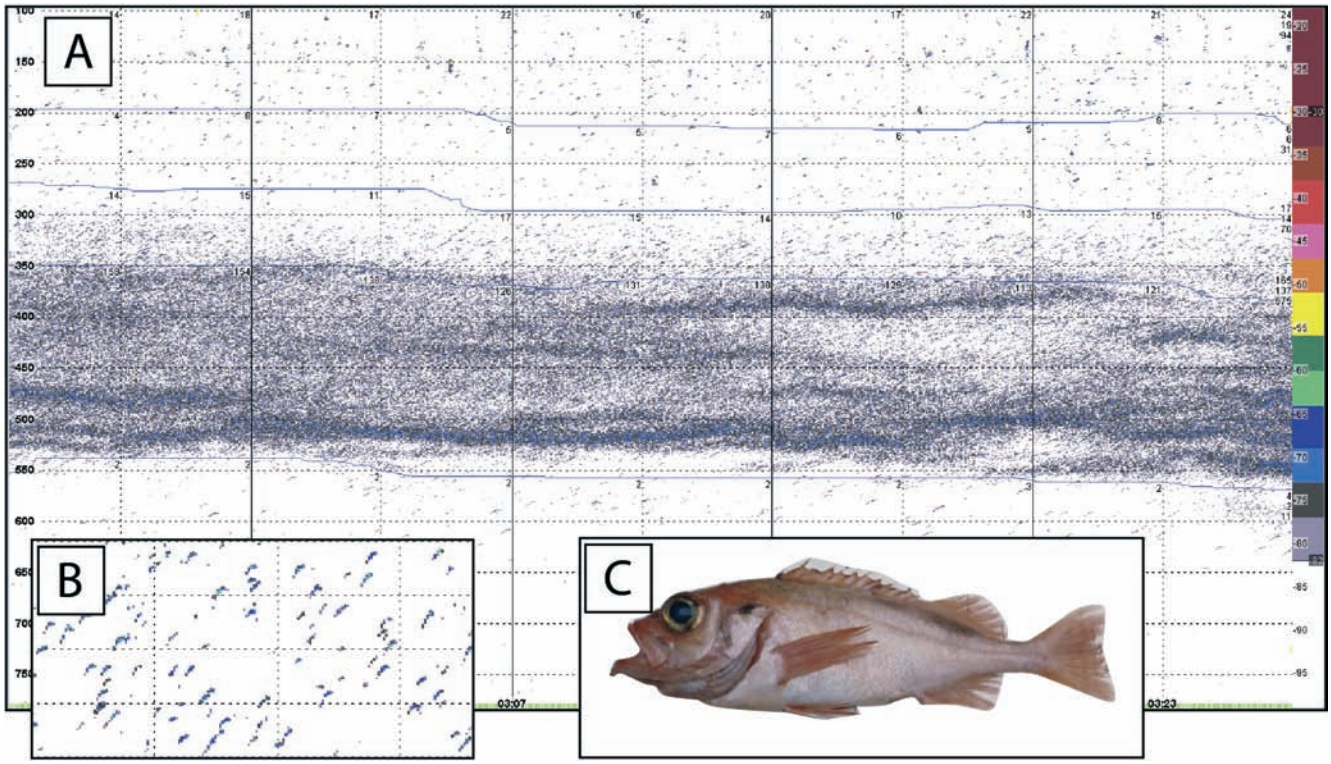
There are more than 100 species of *Sebastes* (redfish) in the world oceans but only four live in the North Atlantic. Among them, the oceanic or beaked redfish (*S. mentella*) is the one with the largest geographical distribution. It is found from the coasts of eastern Canada to the Barents Sea and on the shelf breaks as well as in the open ocean. Like its congener species, the oceanic redfish is a long-lived and slow growing species. Its maximum age has been estimated to be at least 75 years. Unlike most marine fish, oceanic redfish are ovoviviparous and the eggs develop into larvae before being extruded by the females several months after the copulation took place. In the northeast Atlantic, larvae are released on the continental shelf break whilst juveniles are found on the Barents Sea shelf and adults are observed both in the open ocean, the shelf and the shelf break. Two unresolved questions about these fish remain: How do redfish migrate during their successive developmental stages? and How connected are the populations found in different regions of the North Atlantic?

There is a long history of fishing redfish throughout the North Atlantic. In the late 1930s, annual catches rose to 100 thousand tons and in the mid-1970s they exceeded 300 thousand tons (at the time, catches of beaked redfish and golden redfish (*S. marinus*) were not individualized so this figure is for both species combined). Current landings are around 80 thousand tons and are dominated by catches in the Irminger Sea, between southern Greenland and Iceland. In the northeast Atlantic, the current landings are about 20 thousand tons but the fishery in the Norwegian Sea is rapidly evolving. Until very recently, the redfish pelagic population of the open Norwegian Sea was almost unexploited but a new pelagic fishery has developed since 2002, targeting this population, mainly in international waters. Pelagic trawlers equipped with gigantic trawls, such as the Gloria trawls, which can have a mouth opening of 200 × 200 m, filter large volumes of water to exploit this resource. The fast development of this fishery demands that fundamental knowledge on this redfish population be acquired rapidly.

The Institute of Marine Research (IMR) in Tromsø undertook a pilot survey of the redfish population in the Norwegian Sea in summer 2007. In summer 2008, IMR coordinated the first international survey on redfish in the Norwegian Sea. The survey, which lasted 2 weeks and was carried out simultaneously by three vessels, was designed to measure the horizontal



Hydroacoustic recording during the summer 2008 survey in the Norwegain Sea. A: Five nautical miles of hydroacoustic registrations from 100 to 750 m depth. The dense gray layer is the deep scattering layer (DSL) in which redfish are mixed with other small species. B: Zoom on the hydroacoustic registration below the DSL where echo-traces of individual fish can be seen. C: A beaked redfish (*Sebastes mentella*)

and vertical stock distribution and provide an abundance estimate. It also provided essential information on the redfish population demography, habitat and trophic environment. The survey revealed that the redfish is widely distributed in this area; in fact the area surveyed by the three vessels could not cover the full geographical range of the population. Redfish are found mostly at depths between 350 and 550 m within the Deep Scattering Layer (DSL) where small prey occur in high concentrations. Most individual redfish were mature and nine out of ten we aged 15 years or more, supporting the existing view that recruitment has been very low for the last 15 years.

We now know more about the Norwegian Sea redfish population but much remains to be explored. How large is the geographical range of this population? How is it connected with the Norwegian shelf and Barents Sea populations? What controls redfish recruitment, and why has it been so low in the last decades? How much fishing can the population uphold? The forthcoming national and international surveys in 2009 will bring some answers to these questions. So will the ongoing developments in underwater tagging, underwater acoustics, otolith microchemistry, and population genetics of redfish.

Managing spring-migrating Arctic geese in Vesterålen: a success story?

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In recent decades, agricultural practices in Europe have provided goose populations that winter in temperate regions with more food of higher quality. In parallel with the conversion of natural feeding sites to cultivated farmland, most goose populations wintering in Europe have grown dramatically during the past 50 years. This is not unproblematic: agricultural interests are subject to severe damage due to a combination of increasing numbers of geese, concurrence of geese on farmlands and the use of crops that are sensitive to damage. Conflicts with agricultural interests have intensified both on the goose wintering grounds and on stopover sites along their migration route.

Pink-footed geese (*Anser brachyrhynchus*) migrate in spring, via stopover sites in Norway, to Svalbard where they breed. In Vesterålen, the northernmost stopover site in Norway, conflicts with agricultural interests have escalated over the past decades. Local farmers started a scaring campaign in the mid-1990s, where geese were chased off the agricultural fields. The scaring campaign continued at varying intensities for several years. For the farmers, the campaign reduced their problems as significantly fewer "goose days" were recorded, with geese staging for a shorter period and

Pink-footed geese (*Anser brachyrhynchus*) on agricultural fields in May in Vesterålen, northern Norway.
Inset: Neck-banded ("white F23") pink-footed goose. (Main photo by the author, inset photo by Karl-Otto Jacobsen)

avoiding the fields where scaring was most intense. For the geese, on the other hand, intensive scaring in most of their preferred habitats reduced food availability and the rate at which individuals put on weight. For a period of years, the production of young, as assessed in the autumn in Denmark (their first stopover site in the winter period), was low and adult summer survival was decreasing. Results from a model, using dynamic programming based on empirical data from the population, further demonstrated that scaring resulted in a redistribution of geese along the flyway with an increasing use of other staging sites than Vesterålen. Moreover, if geese are assumed to be naïve, as opposed to omniscient, survival will severely decrease if the scaring campaigns continue.

In 2006, the Norwegian Agricultural Authority initiated a subsidy agreement whereby farmers could receive compensation if they allowed spring staging geese to feed on their agricultural fields. The arrangement became a part of the regional management in Vesterålen in order to alleviate the conflicts. Although some adjustments have later been made in terms of compensation level and number of farmers invited to participate in the arrangement, the subsidy agreement appears to be the best solution for managing geese in the area. As most of the farmers in the core goose areas accept the compensation, the availability of goose habitats is secured even if some farmers decide to chase them off their property (i.e. those not a part of the subsidy arrangement). The net increase in body reserves for individual geese staging in Vesterålen is today positive. As the population continues to increase in number, however, adaptive management at all their staging sites will be important also in the coming years.

Invasion of benthic fjord habitats by non-indigenous king crab

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At this very moment, the red king crab is invading the fjords of northern Norway. Adult king crabs are opportunistic omnivores that use the most abundant benthic organisms as food. A single species or group of species tends to dominate the crabs' diet, the composition of which is usually area-specific. Food appears to be the sole factor that could limit the increase in abundance of king crabs within the southern Barents Sea.

King crabs appear to have two distinct methods of feeding: 1) grasping and tearing apart larger evertebrate organisms, and 2) scooping up seabed substrate and filtering out small organisms. Their food consumption patterns depend on their life stage. King crab larvae feed on plankton, consuming both phytoplankton and zooplankton. Juvenile crabs settled on the bottom in the coastal regions of the west Kamchatka shelf feed on hydroids, the dominant epifaunal component of the substrate within the region. Analysis of the stomach content of juvenile crabs settled in other areas showed diatoms, foraminifera, sponge spicules, bryozoans, worms, and small prawns together with sediment.

Adult crabs feed on other food categories. By weight, their diet consists to about 86% of animals with calcareous shells – brittle stars, sea urchins, bivalves and snails. The crab's consumption of calcareous benthic animals increases in connection with shifting to a new shell, suggesting that it needs to replace calcium carbonate lost during molting. Young clams and barnacles in shallow waters represent an abundant resource to fill this need.

Left: King crab cracking and eating a scallop in the laboratory experiment for calculation of the crab's consumption rate.
Right: Prey species (scallops, starfish and blue mussels) used in the experiments. (Photos by the author)

Foraminifera, minute molluscs, and amphipods in the stomachs suggest that adult crabs also feed on small evertebrates living on or within the sea floor sediments. Adult crabs were often observed scooping sand during periods when no food material was immediately evident. Although the significance of this behaviour is obscure, it suggests an alternate method of feeding when larger prey is unavailable.

Low density of benthic food organisms may not necessarily limit feeding activity of the king crab. The crab has developed long, slender periopods ("walking legs") which allow it to move rapidly and efficiently in the vast open regions of the deep sea. The speed and mobility of king crabs would allow them to exploit considerable areas of sea bottom.

Non-native king crabs in the Barents Sea seem to behave much as king crabs in their native habitats – the Bering Sea and the North Pacific. These behaviours include their choice of food, with main prey categories such as bivalves, echinoderms (spring and summer) and worms (autumn and winter). Analyses of stomach content show that the king crab feeds on a variety of resident organisms, including a diverse range of molluscs and other echinoderms, crabs, worms and fish. But positive identification of food items is extremely difficult. Decapods rarely swallow whole animals: they have only a small oral opening, which means that any animals ingested whole will necessarily be small. To consume larger prey, crabs tear pieces from the main portion. Some fragments may be scattered and lost entirely before being transferred to the mouth. Ingested pieces pass to the gastric mill which thoroughly masticates food items, effectively reducing the prey to an amorphous mass. Identification of bivalve prey species through analysis of flesh in crab stomach content would be a challenge – if not impossible.

Laboratory experiments provide one way of studying feeding patterns. Experiments initiated in 2000 to investigate how much the king crab eats and how vulnerable benthic species are to predation demonstrated that crabs are highly mobile when feeding. If specialized hairs on the inner edges of the crab's leg encounter prey, the crab pulls the prey in under its body. When feeding on bivalves the crab uses its larger right claw to crush small prey outright. Then it tears out pieces of flesh with its smaller left chela, and conveys them to its mouth. Large flat bivalves such as scallops are first edge-chipped; then the crab grasps the shell halves with its chela and pulls them apart to expose the flesh.

The commercial scallop *Chlamys islandica* (O.F. Müller) has been observed to be preferred as a prey item when offered to the red king crab in the laboratory. The data set suggests that mature crabs prefer prey larger than 3 cm. For prey with rounded shells the maximum diameter was about 6 cm. Round prey that could not be crushed in a few attempts were abandoned in favour of another food item. But for prey species with flattened bodies, such as scallops and starfish, no upper size limit was observed. For them, size is probably no refuge from predation. The laboratory results also demonstrate the susceptibility of native scallop bed communities to king crab predation. In one day, immature king crabs are capable of killing about 150 g of prey (scallops, sea urchins, starfish, horse mussels, various bivalves, sea whelks), and mature crabs can kill about twice as much. If abundant, king crabs could have a significant effect on Norwegian scallop beds. Conspicuous native species such as *C. islandica* are particularly exposed to risk of local extinction.

The actively moving king crab is thus able not only to crush bivalves, but also to pick off soft animals and filter small organisms from sediment. It remains to be investigated whether this will have irreversible effects on the biodiversity of native benthic communities. Following and quantifying the impact of the king crab along the coast of northern Norway is of high priority, both because of the crab's potential economic value and its potential impact on native benthic communities.

In 2001, fields of non-invaded scallop beds in Porsanger fjord were chosen for long-term monitoring. In 2008 the EPIGRAPH project initiated additional long-term monitoring series on vulnerable benthic animal communities. We hope to publish the results of this work in 2011.

http://www.imr.no/english/news/2008/research_programme_fjord_coastal_ecology

Six hundred years of temperature variations in the North Atlantic as inferred from the Svalbard ice core record

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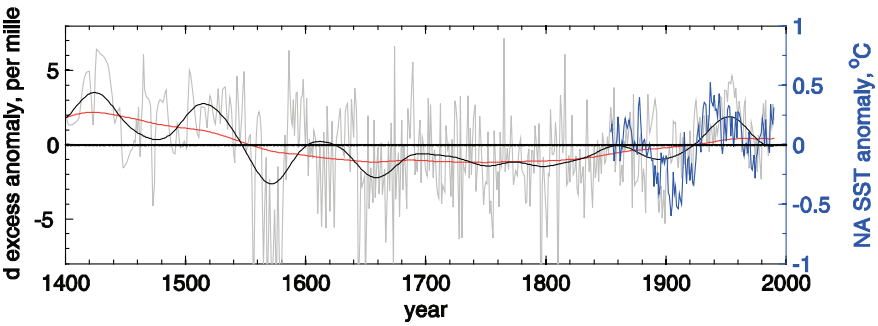
Ice core proxy records from Svalbard suggest that the North Atlantic in the first half of the last millennium was as warm as in the end of the 1980s.

Even though the climate of the last millennium has now been the focus of numerous studies for at least two decades, our knowledge of climate variations during this period are still incomplete. The relatively short time coverage and the sparseness of historical and contemporary instrumental records necessitate the use of various proxy-based sources of climate information. Since the 1960s, studies of ice cores from glaciers and ice caps have provided a powerful and successful scientific tool. The most common method to extract climate information is to use variations in concentrations of stable water isotopes ^{18}O and ^{2}H throughout the ice column as a proxy for past surface air temperature changes at the core site. Their linear combination called "deuterium excess" ($d = \delta D - 8 * \delta^{18}O$) is considered to be a sensitive indicator of temperature at the sea surface in the area where the moisture that formed precipitation had evaporated. Ice core records from high altitude locations in the interior of the large ice sheets of Antarctica and Greenland have been extensively used to infer information about global glacial–interglacial climate alterations at the time scales of hundreds of thousands years. Still, there is a growing interest to conduct research outside major ice sheets on smaller, low elevation ice caps, which provide information about a regional climate history.

Over the last 10 years Norwegian scientists together with colleagues from several other nations have retrieved three ice cores, spanning several hundred years, from different locations in Svalbard. The one from the summit of Lomonosovfonna at 1250 m above sea level is now the most comprehensively studied. Dating of the core has shown that its bottom ice is approximately 800 years old. The deuterium excess record from the core spans some 600 years; this timespan is nonetheless long enough to capture two major climate shifts of this period. As our analysis suggests, it largely reflects the variations of the surface water temperature in the mid-latitude North Atlantic. The time-series gives evidence of highly variable North Atlantic temperatures during this period. A pronounced gradual cooling during the 1400s and 1500s is associated with the onset of the so-called Little Ice Age. The subsequent warming trend, which continues to the present, commenced already at the end of the 1700s. This finding is in line with the current concepts of climate variability in the North Atlantic and Europe during the past millennium. Notable are the values of deuterium excess before the 1550s which are as high as the maximal ones observed during the 20th Century. This suggests that temperatures at mid-latitude in the North Atlantic were at least comparable with those registered before

Ice core drilling (Photo by Elisabeth Isaksson)



Left axis: annual mean deuterium excess anomalies for the Lomonosovfonna ice core (grey line); non-linear trend (red) and the non-linear trend with the superimposed centennial component (black), both retrieved using Singular Spectrum Analysis. Right axis: annual mean sea surface temperature anomalies in the mid-latitude North Atlantic between 20° and 45° N (blue line).

the end of the 1980s.

The other remarkable fact evident from the analysis of this record is its relatively high variability on the centennial time scale. The presence of such quasi-periodic variations in the North Atlantic sea surface temperatures complicates the interpretation of available instrumental records, which now cover about 150 years at best. Our data thereby contribute to a general understanding of natural climate variability, which also has important implications for assessing the relative role of human activity in the ongoing climate change.

This study is funded by the Research Council of Norway via NORCLIMA project "Svalbard ice cores and climate variability" and by the EU via the project "European climate of the last millennium". This work will also contribute to the PAGES (PAst Global changES) Working Group on Arctic climate during the last two millennia (Arctic2k) within PAGES Focus 2 "Regional Climate Dynamics".

The International Polar Year 2007–2008

The ongoing Fourth International Polar Year (IPY) has been called the world's largest international research venture. Tens of thousands of researchers from hundreds of research institutions based in over sixty countries are involved. Although IPY encompasses several hundred projects, each with its own specific aims, they are all working toward the common goal of increasing our understanding of the Arctic and the Antarctic. This multinational research effort transcends boundaries of all kinds. Scientists pursue their research questions from pole to pole. Many of the individual projects bring together specialists from fields as disparate as anthropology and marine geology, and draw on expertise from research institutes in several countries. IPY even transcends time: this Polar "Year" lasts from 1 March 2007 to 1 March 2009.

Four themes

Norway's IPY efforts have been organized under four themes: Sea and Ice, Climate and Environment, Animals and Humans, and Light and Air. Institutes based in Tromsø are involved in most of the projects with Norwegian financing. A few projects with links to Tromsø are presented below.

Sea and Ice: Norwegian Component of the Ecosystem Studies of Subarctic and Arctic Regions (NESSAR) Participating institutions: Akvaplan-niva, UiT

NESSAR is part of a larger project (ESSAR) involving fourteen nations. The Norwegian component aims to quantify how variations in climate affect marine ecosystems in the Norwegian and Barents Seas. These seas have characteristic "fronts" – areas where cold and warm water meet. Fronts are highly productive and are therefore crucial not only for species in the two water masses, but also for commercial fisheries. If the climate were to change, the fronts might move. NESSAR seeks to clarify how physical processes (water mixing, sea ice dynamics, light filtering) interact with biological processes (primary production, food chains, biomass accumulation) at the Arctic front. Quantitative information may help us predict the consequences of future changes of climate in these regions.

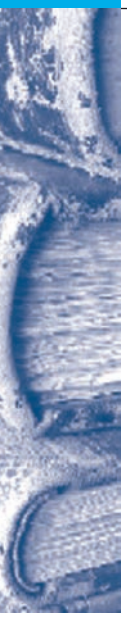
Climate and Environment: Contaminants in Polar Regions–Dynamic range of contaminants in polar marine ecosystems (COPOL) Participating institutions: NP, Akvaplan-niva, NILU, NINA

Organic pollutants and mercury in the environment are easily taken up by lower organisms. Because of their chemical properties, they are not equally easy to get rid of. Organisms that eat contaminated prey also consume whatever pollutants they carry and animals at the top of the food chain can end up with dangerously high concentrations in their fat tissue. Though these basic principles are fairly clear, little is known about how environmental pollutants influence the ecosystem as a whole, especially over time. There is also reason to believe that global warming would increase the release, transport and uptake of these often volatile chemicals. COPOL aims to improve our knowledge of the dynamics of contaminants in polar marine ecosystems.

Animals and Humans: Arctic Natural Climate and Environmental Changes and Human Adaptation: From Science to Public awareness (SciencePub) Participating institutions: NP, UiT

Climate change is nothing new; humans have adapted to change before. But how normal is the climate change we see today? And how did our ancestors adapt at the end of the last ice age? This project links geologi-

COPOL project divers returning to "RV Lance" with samples of marine organisms. (Photo by Geir Wing Gabrielsen, NPI)



cal and archeological evidence of climate change to figure out what has happened in Svalbard, Northern Norway, Northwestern Russia and the Barents Sea, and how human communities might have reacted. SciencePub places strong emphasis on sharing its research results with the general public. In addition to geologists, paleoclimatologists, and archeologists, the project team includes journalists and other communication specialists.

Light and Air: Atmospheric Research and Monitoring at Troll: a Long-term Observational Program (AtmoTroll) Participating institutions: NILU, NP

We know that airborne pollutants from the Northern Hemisphere are transported to the Arctic, even over great distances. Influx of pollution and contaminants has serious consequences at high northern latitudes and much work has been done to clarify the geophysical processes involved. To date, we know very little about how much pollution is transported to Antarctica or the mechanisms that influence its breakdown and deposition. In this project, based at Norway's year-round Antarctic research station "Troll", scientists are studying these questions. They are also setting up a long-term atmospheric monitoring programme.

All things must pass

On 1 March 2009, the Fourth International Polar Year will inexorably come to an end. But in some ways, the end is only the beginning. Compilation and interpretation of the data collected during these two boreal and two austral field seasons will keep scientists busy for years. Some of the data will constitute the beginning of long-term monitoring series that may help us detect future changes in our environment. Several projects will leave an infrastructure legacy to the benefit of coming generations of researchers. Finally, IPY outreach efforts will increase public awareness and knowledge about Polar Regions. Perhaps they will also inspire schoolchildren to join the next generation of polar researchers.

Further information:
www.ipy.no/ (in Norwegian)
www.ipy.no/seksjoner/english

From IGY to IPY: Photo documentation of Norwegian scientific polar research during the last 50 years

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The photo library at the Norwegian Polar Institute consists of approximately 90 000 photographs from Polar areas, the oldest dating back to 1872. These are images from both Norwegian and international activity in the Arctic and Antarctica.

Mapping was an important aspect of expeditions to unknown regions. A systematic series of photographs exists, documenting mapping efforts in Svalbard, Greenland and Antarctica. Various research activities were conducted over many expeditions, documented through a wide range of photos from such expeditions. Trade and industry in the Polar Regions, such as coal mining in Svalbard, sealing in the White Sea, whaling in the Atlantic and land-based hunting and trapping in Greenland and Svalbard are represented in the collection. The photo library is unique in that so many aspects of Norwegian polar history are represented. Yet there has been one substantial lacuna: few of the photographs taken during expeditions from the 1950s through the 1990s have been available.

Expedition leader Sigurd Helle has his teeth fixed by the expedition doctor, Anders Vinten-Johansen, at Norway Station. Photo: John Snuggerud © NPI

Missing documentation

The photo project "From IGY to IPY": Photo documentation of Norwegian scientific polar research during the last 50 years", which is financed by the Norwegian Research Council, addresses the problem of missing research pictures from the past fifty years. These are pictures from our recent past, and it has therefore been feasible to find people who possess comprehensive picture collections of Norwegian expeditions in the Polar Regions. It has thus been possible to obtain a more or less complete photo-historical collection of Norwegian research in the Polar Regions.

Scientific research in Antarctica

The first expedition to Antarctica in this period – The Norwegian Antarctic Expedition 1956-60 – was significant. This was a Norwegian expedition that led to several interesting scientific results but had an even greater impact on Norwegian polar politics, since it contributed to a considerable strengthening of Norway's position as a Polar nation in Antarctica. As a result of this expedition, Norway was awarded a prominent international role in the management of the Antarctic continent through the Scientific Committee on Antarctic Research (SCAR), which led to the Antarctic Treaty of 1961.

John Snuggerud tending the camera that registers Aurora Australis.
Photo: John Snuggerud © NPI

Research on the ice in Antarctica

Norway participated in the American expedition "South Pole–Queen Maud Land Traverse". The expedition was divided into three stages and lasted from 1964 to 1967. Three vehicles (snow cats) drove from the South Pole to the coast of Queen Maud Land. Olav Orheim, from the Norwegian Polar Institute, participated in the second stage, which set out from the Pole of Inaccessibility and concluded at the newly-built American Plateau Station. The main programme for the expedition was to measure altitude and ice thickness. Orheim's role was to investigate surface snow properties and metamorphosis, and to make meteorological observations.

Here there is a parallel with one of the large-scale projects in the current Polar Year, the "Norwegian – US Scientific Traverse of East Antarctica (TASTE-IDEA), which began in November 2007 is investigating changes in the ice sheet in Queen Maud Land, in order to understand the role played by Antarctica in global climate investigation. This expedition passes through some of the same areas in which the "South Pole – Queen Maud Land Traverse" operated and is conducting scientific investigations in some of the same locations. The pictures from the expedition in 1965 were used in the planning of the current expedition.

In 1968-69, with logistical support from the United States, Norway mounted its own expedition to Antarctica: Norway Camp. Since 1976, Norway has undertaken regular summer expeditions to Antarctica. These have been carried out in co-operation with other countries, such as the US and South Africa, and later with Sweden and Finland through the Nordic Antarctic Research Expeditions.

The photo project has collected pictures from all the Norwegian Antarctic expeditions, from the Norway Station expedition up to the present time. In all, this consists of approximately 2 200 pictures.

Research on sea ice in Fram Strait. Photo: Torgny Vinje © NPI

Polar bear research

Thor Larsen was the Norwegian Polar Institute's first polar bear researcher. He began his research work during the early 1960s, and in 1967 he led an expedition on the "M/S Polarulv", aiming to carry out ecological and zoophysiological studies of polar bears in Svalbard's eastern waters. This was the first Norwegian attempt to capture polar bears alive – an activity that was not without risk. Methods, weapons and means of sedation had to be tested. The cold was a risk factor, since there was a danger that the weapon might seize up or the sedative freeze. The weapon did not have a long range and the researchers had to get close up before they could shoot. It could take several minutes for the bear to lose consciousness, and in the meantime the researchers had to crouch down in their white camouflage gear and

hope they were not detected. Nerve-wracking minutes. While the bear was sedated it was transported onto the ship and placed in a cage. In this way, the researchers were able to carry out tests on the bear. On this expedition a total of 51 polar bears were captured, tagged and examined. These investigations were carried out in a research project undertaken over several years by the Norwegian Polar Institute and the University of Oslo, and during the years that followed Thor Larsen led several similar expeditions investigating polar bears out on the drift ice. The toll on polar bears caused by various forms of hunting was considerable at this time and Thor Larsen's engagement in international research work contributed to the polar bear being declared a protected species in 1973.

Thor Larsen is often described as one of the foremost polar bear researchers in the world. He carried out research on this large Arctic mammal for over 20 years and participated in 23 Arctic expeditions. The assembled photographs, almost 1 400 of them, document almost all of his expeditions and represent a valuable historical documentation of Norwegian polar bear research.

Climate research

Torgny Vinje is a qualified meteorologist who became one of the Norwegian Polar Institute's first climate researchers. He was a member of the Norway Station expedition to Antarctica of 1956-60 and was active in climate and sea ice research in both Antarctica and the Arctic up until the end of the 1990s. He took part in the annual research cruise to the northern regions from 1964 to 1990, and spent a great deal of time in the Fram Strait in the Greenland Sea and in the area around Franz Josef Land, where he carried out studies on the movements of water and ice. Through his research he established contact with Russian researchers at an early stage and developed several collaborative projects with the Russians. In the midst of the Cold War, in 1968, he went on a study

Top: Taking aim to shoot a polar bear with a sedative gun.
Bottom: Sedated polar bear being lifted on board the vessel "M/S Polarulv".
Photos: Thor S. Larsen © NPI

trip to the Soviet Union, where he visited scientific institutions in Leningrad and Moscow. On this journey he also visited the drifting station North Pole 18 in the sea area north of the Soviet Union. This was a research station that had its base on a large ice floe drifting in the Polar Basin, and such a visit at that time was quite unique.

Torgny Vinje is among the researchers with the longest periods of travel in the sea areas in the north. He was involved in the inauguration of ice-mapping in northern sea areas, and the first to study iceberg drift with the help of buoys that were set out using a helicopter. More than 1 500 pictures document his research cruises and expeditions.

12 000 photos

Collecting missing photographs from the period 1956-1998 has improved the continuity of photographic archive material and will complete the photographic documentation of Norwegian scientific polar history. By also including some photographs from the 2007-2008 IPY, the project will cover the period from IGY to IPY.

A total of roughly 12 000 photos will be scanned and registered during the project. These photos will be available to the public via the Norwegian Polar Institute's photo archive on the Internet: http://sivert.npolar.no/fotoweb/

Norwegian–US Antarctic Traverse

Nearly a century after Roald Amundsen was the first human to reach the South Pole, and half a century after the flurry of activity in conjunction with the International Geophysical Year, Antarctica remains one of the least-known parts of the globe. As part of the ongoing International Polar Year, Norway and the USA joined forces to try to fill in some of the gaps. In mid-November 2007, a train of tracked vehicles carrying sixteen scientists, technicians and media representatives set out from the Norwegian research station Troll bound for the US South Pole Station over 2500 km distant. On the way, they drilled ice and snow cores, measured snow properties with radar and GPS techniques, set up automatic weather stations, and collected ground data for comparison with satellite data. Their route took them to sites that have been visited in the past, so they could collect material that might reveal changes over time, but also to many places no human has ever seen before. Although equipment problems caused by the extreme Antarctic conditions prevented them from driving all the way, the party achieved their scientific goals. About two months after leaving Troll, the expedition members arrived safely at South Pole Station. The second leg of the journey – back north to Troll by a different route – has now begun.

Top: The expedition has reached Plateau Station Camp, halfway between Troll and South Pole Station.
Bottom: Ice core drilling at 76'4"S 22'28"E. (Photos: Stein Tronstad © NPI)

New research centre to focus on ice and climate

Predictions of climate change are mainly based on computer models that rely on mathematical descriptions of biogeophysical processes. Some of those processes are known in great detail but others remain poorly understood. One of the main uncertainties in current computer models of climate change concerns the processes governing the behaviour of snow and ice. To help remedy this, the Norwegian Government has set aside

22 million NOK per year to establish a new competence centre for research on ice and climate.

"Norway possesses extensive knowledge about climate, glaciers and polar conditions, and has access to modern research infrastructure in both the Arctic and Antarctic. We will now strengthen and develop this scientific knowhow by establishing a new competence centre for ice and climate," said Erik Solheim, Minister of the Environment and International Development. "There is a great need for more knowledge about the consequences of melting ice. Not only for the environment, but also for society as a whole. The fourth report from the United Nations Intergovernmental Panel on Climate Change emphasizes the need for more knowledge."

The new center will be organized under the Norwegian Polar Institute in Tromsø. Its task will be to find out more about the problems posed by loss of ice, with special focus on sea ice and glaciers, and on the impact on polar ecosystems, particularly on ice-dependent species.

The Polar Environmental Centre celebrates its first decade

Ten years have now gone by since the magnificent building that houses the Polar Environmental Centre (POMI) first opened its doors. In October, two hundred employees and guests celebrated with a day-long seminar presenting both current research and reminiscences about the past. In the evening there was a banquet with entertainment and dancing to the beat of POMI's own the house orchestra "Anton's Aquarium".

The seminar highlighted environmental pollutants in the Arctic, ice in the Arctic Ocean, the myriad life forms at the ice edge, and challenging existence of the eider – the yo-yo dieter of the Arctic. Professor Tore Vorren gave an interesting talk on Tromsø's polar history and how POMI has contributed. The State Secretary from the Ministry of the Environment, Heidi Sørensen, rounded off the seminar with reflections on POMI's role in Norwegian environmental research.

The Polar Environmental Centre is permanent home to nine institutions, of which the Norwegian Polar Institute and Akvaplan-niva are the largest. Others include the Norwegian Institute for Nature Research, the Norwegian Institute for Air Research (NILU), the Norwegian Institute for Cultural Heritage Research (NIKU), the Geological Survey of Norway (NGU), the Norwegian Radiation Protection Authority, the Norwegian Mapping Authority, and the Norwegian Costal Administration. Polarmiljøsenteret AS is in charge of the Centre's communal resources.

Restructuring at the University of Tromsø

Following the merger between the University of Tromsø and Tromsø University College, the Board of the University has decided to streamline the University administration. Consequently, some of the smaller units - among them the Roald Amundsen Centre for Arctic Research - have been discontinued. The strong focus on Polar and Northern issues at the university is, however, continued in the new organization. As of 1 January 2009, this key element in the activity of the University is being coordinated directly by the Office of the University Director.

Furthermore, the University of Tromsø, the Norwegian Polar Institute, the Institute of Marine Research, NOFIMA, NORUT, and Akvaplan-niva are in the process of establishing Tromsø High North Cluster (THiNC) - an organization that will promote Polar projects and strategies that are important to these institutions, to the city of Tromsø, to the region of Northern Norway, and to Norway.

Norwegian Polar History goes online

In May, the Norwegian Polar Institute, Troms County Council and the University of Tromsø launched the website "Norsk polarhistorie". Through this electronic portal the general public has access to a rich store of information about Norway's long history as a polar nation. There are biographies, interactive maps, a time-line, images, radio programmes and videos. Most of the site is in Norwegian, but the pictures can be enjoyed in any language. http://polarhistorie.no

Doctorates in polar studies at the University of Tromsø

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Marit Anne Aure
Arbeidsmigrasjon fra Teriberka til Båtsfjord 1999-2002
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Else Grete Broderstad
The bridge-building role of political procedures. Indigenous rights and citizenship rights within and across the borders of the nation-state
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Dr.psychol.

Snefrid Møllersen
Mental health services and treatment in Sami and Non-Sami populations. A comparative study in a multiethnic rural area of North Norway
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Dr.scient.

Linda Anett Hansen
Social interactions in fish: Individual variation in behaviour during growth and reproduction in Arctic charr and Atlantic cod (2007)
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Christiane E. Hübner
Spring stopover in the Arctic: Implications for migrating geese and their food plants (2007)
Contact ssf@npolar.no

Christin Jensen
The dynamics of the boreal forest-line in response to Holocene climate variability. Palaeobotanical reconstructions from Dividalen, Norway (2007)
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Christina Alsvik Pedersen
Optical properties of snow and sea ice – field measurements, parameterization schemes and validation
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Stian Røberg
Extent and dynamics of changes in a high Arctic intertidal zones microbial community as a consequence of exposure to hydrocarbons
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Terese Solstad
Innate defence molecules of the Atlantic cod (*Gadus morhua* L.); BPI/LBP, lysozyme and hepcidin
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Marianne Vileid Uleberg
Winter survival and spring growth of white clover in a sub-arctic climate

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Bob Eric Helmuth van Oort
Biological rhythms in reindeer. Circadian clocks become redundant in polar photoperiods

PhD

Carla Marilia Abreu de Freitas
Habitat selection by Arctic pinnipeds: patterns, tactics and predictions in a dynamic environment
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Abdurhman Kelil Ali
Reproductive biology of the calanoid copepod, *Eudiaptomus graciloides* (Lilljeborg): polyandry, phenology and life cycle strategies (2007)
Contact ivar.folstad@ib.uit.no

Pieter Beck
Is northern Europe turning green? – an environmental audit of climate change (2007)
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Bjørn Tore Dragnes
Documentation and novel effects of marine by-products
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Karsten Eig
Onshore and offshore tectonic evolution of the Lofoten passive margin, North Norway
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Christopher Graham Fenton
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Karl Øystein Gjelland
Ecological interactions, light response and vertical habitat use in a subarctic pelagic freshwater community
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Eduardo Enrique Grimaldo Vela
Selectivity studies in the Northeast Arctic bottom trawl fisheries for shrimp (*Pandalus borealis*), cod (*Gadus morhua*), and haddock (*Melanugrammus aeglefinus*)
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Characterization of the p38 MAP kinase signalling pathway in Atlantic salmon
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Genetic aspects of the robustness of Atlantic cod (*Gadus morhua* L.) in aquaculture
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Effect of viral RNA mimics and ISA virus infection on expression of key genes of the Atlantic salmon interferon system
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Eirik Inge Mikkelsen
Economic analyses of user interactions in the Coastal Zone
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Gro Harlaug Olsen
Effects of petroleum-related compounds on Arctic and temperate species at multiple levels of biological organization (2007)
Further information at www.ssf.npolar.no/pages/news134.htm

Magne Olufsen
The molecular origin of cold adaptation: A comparative study of cold- and warm-active uracil DNA glycosylase (2007)
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Torbjørn Pedersen
Conflict and order in Svalbard waters
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Kim Præbel
Population discrimination, physiology, and diverging life history traits in a circum-arctic fish, the capelin (*Mallotus villosus*)
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Marit Kristine Seppola
Genes involved in the innate immunity of Atlantic cod
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Animal–habitat relationships in high altitude rangelands
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Ingrid Skjæveland
Toll-like receptors in Atlantic salmon. Cloning, characterization and regulation
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Kari Storaas
Finland er bak oss, Norge er vårt land. Konteksters betydning for etniske endringsprosesser i Sør-Varanger (2007)
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Doctorates in polar studies at other universities

PhD

Signe Aaboe
Circulation dynamics over sloping topography – Application to the Nordic Seas and Arctic Ocean
University of Bergen (Joint supervision with the Norwegian Polar Institute)
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Brage Bremset Hansen
The Svalbard reindeer (*Rangifer tarandus platyrhynchus*) and its food base: plant–herbivore interactions in a high-Arctic ecosystem
Norwegian University of Science and Technology (Joint supervision with the Norwegian Polar Institute)
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Snorre Henriksen
Spatial and temporal variation in herbivore resources at northern latitudes (2007)
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