Summary

This document is a preliminary Strategic Environmental Impact Assessment (SEIA) of activities related to exploration, development and exploitation of hydrocarbons in the eastern Davis Strait between 62° and 67° N.

The SEIA has been carried out by DCE - Danish Centre for Environment and Energy and the Greenland Institute of Natural Resources (GINR) for the Bureau of Minerals and Petroleum (BMP) to support the decision process concerning any further exclusive licences for exploration of hydrocarbons in the Greenland offshore areas of the Davis Strait. Based on existing published and unpublished sources, including three previous assessment reports that were prepared in connection with the existing licence blocks (Fig. 1.1.1), the SEIA describes the physical and biological environment including protected areas and threatened species, contaminent levels, and natural resource use. This description of the existing situation then forms the basis for assessment of the potential impacts of oil activities.

If more licences are granted in the assessment area implementation of an environmental background study programme is planned to fill the data gaps that have been identified and provide information required to support the environmental planning and regulation of the oil activities. The new information will be included in an updated SEIA, which will become the new reference document for the environmental work and substitute this preliminary version.

The assessment area is shown in Figure 1.1.1. This is the region that could potentially be impacted by a large oil spill deriving from activities within the expected licence areas; although the oil could drift beyond the borders of this area.

The expected activities in the 'full life cycle' of a petroleum field are briefly described. Because of harsh weather and extensive sea ice in the northern and western part of the assessment area, exploration activities would probably be hampered during winter and early spring (around December-April). However, if oil production is initiated activities will take place throughout the year.

The environment

The pelagic environment

The physical conditions of the study area are briefly described with focus on oceanography and ice conditions. The southern part of the assessment area generally has open water all year around, except for the most western part. In the north-western part sea ice is usually present from about February to April. Icebergs are occasionally present in late winter and early spring but rarely encountered north of Fyllas Banke. This is explained by the pattern of currents, the bathymetry and the distant iceberg sources.

Among the most important features of the environment are the shallow-water banks along the west coast of Greenland. High water velocity at these banks creates strong upwelling which in turn provides nutrients for sustained high primary productivity in these relatively shallow areas. The

banks are normally ice free or have open drift ice year round, except for the Store Hellefiskebanke in the northern part of the assessment area. The banks can sustain high productivity several months longer than the deep waters offshore. Another important feature of the area is the relationship between frontal hydrography and plankton communities at the transition between the waters of Arctic and temperate origin. Moreover, there are physical and chemical differences between (the shallow and freshwater influenced) inshore and the offshore area. Therefore, physical processes in the frontal zones affect planktonic organisms in a number of ways, including nutrient entrainment, elevated primary and secondary production and plankton aggregation.

The assessment area is situated within the sub-Arctic region of the marine environment. The pelagic environment of the offshore part of the assessment area has not been studied in detail. However, based on knowledge from the shelf area and elsewhere in West Greenland, the pelagic environment is characterised by low biodiversity with often numerous and dense animal populations; a relatively simple food web from primary producers to top predators; and a few species playing a key role in the ecology of the region. The most significant ecological event in the marine environment is the spring phytoplankton bloom of planktonic algae, the primary producers in the food web. These are grazed upon by zooplankton, including the important copepods Calanus (mainly *C. finmarchicus*), which represent one of the key species groups in the marine ecosystem.

Benthic fauna and flora

Benthic macrofauna species consume a significant proportion of the available production and, in turn, are an important food source for fish, seabirds and mammals. Some studies are available from the assessment area, but little is known about the spatial and temporal variation in community structure and there is a general lack of data from certain habitat types and from offshore areas. The macroalgae are found along shorelines attached to hard and stable substrate, and may occur at a depth of more than 50m. Biomass and production of littoral and sub-littoral macroalgae can be significant and are important for higher trophic levels of the food web as they provide substrate for sessile animals, shelter from predation, protection against wave action as well as currents and desiccation or are utilised directly as a food source. Existing knowledge of macroalgal diversity in the assessment area is very limited, and macroalgal species composition, biomass, production and spatial variation are largely unknown.

Fish

Fish fauna in the offshore areas, including the marine shelf, is dominated by demersal (bottom living) species such as Greenland halibut, Atlantic halibut, redfish, wolffish and several less commercially interesting species. For the Greenland halibut, which is highly important for the commercial fishery (see below), the main spawning ground is presumed to be located within the assessment area and is important for stock recruitment both within and outside the assessment area (Northwest Greenland and Canada). Sandeel occur in dense schools on the banks and are important prey for some species of fish, seabirds and baleen whales. In the coastal zone, three important species spawn: Atlantic cod, capelin and lumpsucker. The capelin is important prey for larger fish, marine mammals, seabirds and for human use. Both the Atlantic cod and lumpsucker (the eggs) are utilised on a commercial basis. Arctic char is also an important species of the coastal waters and is the target of

much recreational fishing. Other species utilised in small-scale commercial or subsistence fisheries include Atlantic salmon, Atlantic halibut and wolffish.

Seabirds

Seabird colonies are numerous in the assessment area, but typically smaller in size compared with more northern breeding areas in West Greenland. In total, 20 species are known as regular breeders in the assessment area and the highest density of colonies is found in the extensive archipelago between 63° and 66°, despite the fact that this area has not been thoroughly surveyed for breeding birds. Two species are rare breeders to Greenland – the Atlantic puffin and the common murre are listed as near-threatened and endangered, respectively, on the Greenland Red list.

For 13 bird species the importance of the assessment area is classified as 'high' on a national or international scale due to the number of breeding, moulting or wintering birds (Tab. 4.7.1). The assessment area is especially important as a wintering area. It makes up a large proportion of the open water region in Southwest Greenland, where large numbers of seabirds from Russia, Iceland, Svalbard and Canada assemble October-May. More than 3.5 million birds are estimated to winter in the coastal areas alone. The most abundant species are thick-billed murre, common eider, king eider and little auks. A large, but unknown number of seabirds also migrate through or winter in the offshore areas.

Marine mammals

Marine mammals are significant components of the marine ecosystem. Five species of seal occur in the assessment area, of which harp seals are numerous throughout the area during most of the year. Another species, the harbour seal, is listed as critically endangered in Greenland. The northernmost part of the assessment area overlaps with the southern edge of a key wintering habitat for walruses. Among the whales, several baleen whales, such as minke whales, fin whales, humpback whales and sei whales, are seasonal inhabitants of the assessment area and relatively abundant. The area is part of their foraging area during summer and the distribution of the whales often correlates with their main prey: capelin, krill and sandeel. The bowhead whale migrates through the area in the period January-February towards feeding and possibly mating grounds just north of the assessment area. Several toothed whales are common in the assessment area: harbour porpoise, long-finned pilot whale, northern bottlenose whale and white-beaked dolphin. The southern wintering grounds of beluga whales and narwhals extend into the northern part of the assessment area. Polar bears occur during winter and spring, depending on and in association with the very variable sea ice cover.

Human use

Human use of natural resources occurs throughout the assessment area; subsistence and small-scale use is extensive in the coastal areas, while there are substantial commercial fisheries in the offshore parts. Due to open water being present all year round in most coastal areas, commercial, subsistence and recreational hunting is possible throughout the year, except in various closed seasons. Seabirds are among the most popular hunted resources and are bagged in large numbers. The most important species are thick-billed murre and common eider, and in 2008 approx. 35,000 murres and 11,000 eiders were reported harvested in the assessment area. Seals are also harvest-

ed in large numbers in the assessment area. The skins are purchased and prepared for the international market by a tannery in South Greenland and the meat is consumed locally. The most important species is the harp seal and around 30,000 animals per year are currently reported to be harvested from the assessment area. Walruses, belugas and narwhals are caught during winter and spring in the northern part of the assessment area and regulated by quotas. Also harbour porpoises, minke whales, fin whales and humpback whales are caught in the assessment area, with harbour porpoise and minke whale as far the most numerous species. Minkes and humpback and fin whales are subject to annual quotas set by the IWC. Quotas also regulate polar bear catches, but only a few animals are shot every year in the assessment area.

Commercial fisheries represent the most important export industry in Greenland, accounting for 88% of the total Greenlandic export revenue (1.7 billion DKK in 2009). Greenland halibut, deep-sea shrimp and snow crab are the main commercially exploited species within the assessment area and annual catches make up a large proportion of total landings in Greenland. The Atlantic cod fishery has increased over the past decade, but recruitment appears to be very unstable. Compared with historical levels (1960s) catches are still negligible and in 2009-10 the offshore fishery was closed in the assessment area. In the coastal area, various species are exploited on a small-scale commercial, subsistence or recreational basis, such as lumpsucker, wolffish, redfish, Atlantic cod, Greenland cod, capelin and Atlantic salmon.

Tourism is a growing industry in Greenland and now counts as the third largest economic activity in the country. The total number of guests in 2008 was 82,000 or 250,000 'bed nights', of which the majority went to the assessment area, especially Nuuk. In addition, cruise ships bring in tourists in every increasing numbers. The coastal marine area is very important for tourist activity.

Climate change

Climate change has a large potential to modify marine ecosystems, particularly in high latitude regions. Alterations in the distribution and abundance of keystone species at various trophic levels could have significant and rapid consequences for the structure of the ecosystems in which they currently occur. Implications for fisheries and hunting are likely to occur. For some populations, climate change may act as an additional stressor in relation to existing impacting factors such as hunting, leading to higher sensitivity to oil spill incidents. Other populations may become more abundant and robust as a consequence of climate change. Finally, species composition may change, with some species disappearing or moving north and other species moving in from the south.

Contaminants

Knowledge on background levels of contaminants such as hydrocarbons and heavy metals is also important in assessing sensitivity and environmental impacts from petroleum activities.

The levels of certain contaminants, i.e. organochlorines, are still high in Greenland due to long-range transport into the Arctic, particular in the higher trophic level (e.g. whales, polar bears). In addition, new persistent pollutants, such as brominated flame retardants, are now appearing. Levels

of petroleum compounds, including PAHs, are relatively low, except in harbour areas, and are regarded as background concentrations.

However, our present knowledge concerning contaminants in marine organisms in Greenland, including the assessment area, is still limited, particular the relation between contaminant loads and potential biological impact, including sublethal health effects or impairments. More knowledge about species' sensitivity and adequate monitoring strategies are also needed.

Assessment

The assessments presented here are based on our present knowledge concerning the distribution of species and their tolerance and threshold levels toward human activities in relation to oil exploration and production. However, the Arctic is changing due to climate change and this process seems to be accelerating. This means that conclusions and assessments may need to be adjusted in the future. Furthermore, a large part of the assessment area is poorly studied and increased knowledge may lead to additional adjustments.

Normal operations – exploration

The main environmental impacts of exploration activities derive from noise generated either by seismic surveys or the drilling platforms and from cuttings and drilling mud if these are released to the sea during the drilling process.

The species most sensitive to noise from seismic surveys in the assessment area are the baleen whales (minke, fin, sei and humpback) and toothed whales such as sperm and bottlenose whales. These may be in risk of being displaced from parts of their critical summer habitats. A displacement would also impact the availability of whales to hunters if the habitats include traditionally hunting grounds. Narwhals, beluga whales, bowhead whales and walruses are also sensitive to seismic noise, but their occurrence in the assessment area only overlaps briefly with the time in which seismic surveys are expected to take place.

As seismic surveys are temporary, the risk for long-term population impacts from single surveys is low. But long-term impacts have to be assessed if several surveys are carried out simultaneously or in the same potentially critical habitats in consecutive years (cumulative effects). 3D seismic surveys, which are typically conducted in small areas, may cause more severe temporary impacts.

The fishery at risk of impact from noise from seismic surveys in the assessment area is the Greenland halibut fishery. The risk is temporary (days or weeks) displacement of fish and consequently reduced catches from the trawling grounds. Although the precise location of the Greenland halibut spawning grounds is not known, planning of seismic surveys in the area where spawning is expected to take place should consider avoiding overlap with the spawning period (early winter). The fishery for northern shrimp and snow crab will probably not be affected.

Noise from drilling rigs will also be temporary but locally more permanent than seismic surveys. The most vulnerable species in the assessment area are

cetaceans (whales and harbour porpoises) and the walruses. If alternative habitats are available to the whales no effects are expected, but if several rigs operate in the same region there is a risk of cumulative effects and displacement even from alternative habitats.

Drilling mud and cuttings that are released to the seabed will cause local impacts on the benthic fauna. Within the assessment area only very local effects on the benthos are expected from discharging the water-based muds with non-toxic additives from the drilling of an exploration well. Any drilling should be avoided in the most vulnerable areas. Baseline studies at drill sites must be conducted prior to drilling to document whether unique communities or species such as coldwater coral and sponge gardens are at risk of being harmed by increased sedimentation. Post-drilling studies should be carried out to document whether activities caused any specific effects.

Exploration drilling is an energy-intensive process emitting large amounts of greenhouse gases. Even a single drilling will increase the Greenland contribution to global emissions significantly.

Finally, there is a risk of oil spills during exploration drilling (see below).

Unacceptable environmental impacts from exploration activities are best mitigated by careful planning based on thorough environmental background studies, BEP, BAT and application of the Precautionary Principle and international standards (OSPAR); for example, by avoiding activities in the most sensitive areas and periods.

Normal operations – development and production

Activities during development, production and transport are long-lasting, and there are several activities which have the potential to cause severe environmental impacts.

Overall, impacts will depend on the number of activities, how far they are dispersed in the areas in question, and also on their duration. In this context it is important to consider cumulative impacts.

Emissions and discharges

Drilling will continue during development and production phases and drilling mud and cuttings will be produced in much larger quantities than during exploration. Discharges should be limited as much as possible by recycling and reinjection and only environmental safe substances (such as the 'green' and 'yellow' substances classified by OSPAR) tested for toxicity and degradability under arctic conditions should be permitted to be discharged. In Greenland the use of 'black' chemicals is not permitted and use of 'red' chemicals requires specific permission. Even the non-toxic discharges alter the sediment substrate and if these substances are released to the seabed impacts must be expected on the benthic communities near the release sites.

The release giving most reason for environmental concern, however, is residue of oil in produced water. Recent studies have indicated that small amounts of oil can impact birds, fish and primary production. The most obvious way to mitigate effects of produced water is better cleaning before discharge or even better to re-inject the water into the wells as the policy is in the Lofoten-Barents Sea area.

Also of concern is discharge of ballast water as this carries the risk of introducing non-native and invasive species. Ballast water must therefore be handled and discharged subject to specific rules. The problem is currently not severe in the Arctic, but risk will increase with climate change and the intensive tanker traffic associated with a producing oil field.

Development of an oil field and production of oil are energy-consuming activities that would contribute significantly to the Greenland emission of greenhouse gases. A single large Norwegian production field for example, emits more than twice the total Greenland CO_2 emission of today.

Noise

Noise from drilling and the positioning of machinery, which will continue during the development and production phase, may potentially lead to permanent loss or displacement of important summer habitats for cetaceans, especially if several production fields are active at the same time. Noise from ships (incl. ice-breaking) and helicopters, which becomes more persistent than in the exploratory phase, can both affect marine mammals and seabirds. The most sensitive species within the assessment area are the colonial seabirds, bowhead whales, narwhals, beluga whales, minke whales, fin whales, harbour porpoises and walruses – species that may associate noise with negative events (hunting). Traditional hunting grounds may also be affected. Applying fixed flying lanes and altitudes will reduce impacts from helicopter noise.

Placement of structures

Placement of offshore structures and infrastructure may locally impact seabed communities and there is a risk of spoiling important feeding grounds – walrus is highly sensitive, but occurs mainly north of the assessment area. However, feeding areas for king eiders wintering at the shallow-water shelf banks (especially Fyllas Banke) may also be at risk. Inland structures may locally impact breeding birds; obstruct rivers, with implications for anadromous Arctic char; damage coastal flora and fauna; and have an aesthetic impact on the pristine landscape, which in turn may impact the local tourism industry.

A specific impact on fisheries is the exclusion/safety zones (typically 500 m) that will be established both around temporary and permanent offshore installations. These may affect some of the important fishing areas for Greenland halibut and northern shrimp.

Illuminated structures and flares may attract seabirds in the hours of darkness, and there is a risk of mass mortality especially for eiders and possibly little auks.

Cumulative impacts

There will be a risk of cumulative impacts when several activities take place either simultaneously or consecutive. For example, seismic surveys have a high potential for cumulative impacts. Cumulative impacts may also occur in combination with other human activities, such as hunting, or in combination with climate change.

The best way of mitigating impacts from development and production activities is to combine a detailed background study of the environment (in order to locate sensitive ecosystem components) with careful planning of structure

placement and transport corridors. Subsequent application of BEP, BAT and compliance with international standards such as OSPAR and HOCNF can do much to reduce emissions to air and sea.

Accidents

The most environmentally severe accident from the activities described above would be a large oil spill. Accidental oil spills may occur either during drilling (blowouts) or from accidents when storing or transporting oil. Large oil spills are relatively rare events today due to ever-improving technical solutions and HSE policies. However, the risk of an accident cannot be eliminated.

Oil spill trajectory modelling was not carried out for this preliminary assessment.

Large oil spills have the potential to impact on all levels in the marine ecosystem, from primary production to the top predators. A large oil spill represents a threat at population and maybe even species level and the impacts may last for decades, as documented for Prince William Sound in Alaska. For some populations oil spill mortality can to an extent be compensatory (be partly compensated by reduced natural mortality due to less competition), while for others it will largely be additive to natural mortality. Some populations may recover quickly while others will recover to pre-spill conditions very slowly, depending on their life strategies and population status. For species which are vulnerable to oil spills and are also harvested, oil spill impacts could be mitigated by managing the harvest wisely and sustainably. The lack of efficient response methods in partly ice-covered waters and remoteness will add to the severity of an oil spill.

For this impact assessment the offshore areas are divided into eight subareas and classified according to their sensitivity to oil spill, taking into account the relative abundance of species/species groups; species or population specific oil sensitivity values; oil residency; human use ; and a few other parameters. During all seasons the offshore areas closest to the coastal zone covering the shelf bank areas are among the most sensitive areas. These areas are especially important for migrating/wintering seabirds, human use of northern shrimp and snow crab, and as foraging areas for baleen whales. During spring and winter the southwest corner of the assessment area is also classified as highly sensitive to oil spill due to extensive Greenland halibut fishery and whelping areas for hooded seals in the western pack ice in March and April.

A comparison of seasons, based on absolute sensitivity values and averaged across all offshore areas, shows that winter is most sensitive to oil spill, closely followed by spring and autumn, while summer is least sensitive to oil spill. The main reason for this difference is the large number of wintering/migrating seabirds during winter, spring and autumn, which are all very sensitive to oil (especially auks and seaducks).

The coastal zone of the assessment area is even more sensitive to oil spill due to a higher biodiversity and due to the fact that oil may be trapped in bays and fjords where high and toxic concentrations can build up in the water. There is the potential for a number of negative impacts – on spawning concentrations of fish, such as capelin and lumpsucker, in spring; Arctic char as-

sembling outside their spawning rivers; and on many seabird populations in summer, during migration periods and especially in winter when seabirds from a variety of breeding locations in the North Atlantic gather in South-west Greenland. Long-term impacts may occur in the coastal zone if oil is buried in sediments or among boulders, in mussel beds or is imbedded in crevices in rocks. Oil seeps from these sites and causes chronic pollution which may persist for decades. In Prince William Sound in Alaska such preserved oil has caused negative long-term effects on e.g. birds utilising the polluted coasts and several populations have not recovered. The coastal zone is also of crucial importance for local hunters and fishermen, and in the case of an oil spil, these activities may be adversely affected by closure zones and/or by changed distribution patterns of the targeted species. The tourist industry in the assessment area will probably also be impacted negatively by oil exposure in the coastal area.

Another vulnerable feature is the winter/spring period with ice- covered waters in the northern and western part of the assessment area. To begin with spilled oil would be contained between the ice floes and on the rough underside of the ice. However, oil in ice may be transported in an almost unweathered state over long distances and when the ice melts may impact the environment, e.g. seabirds and marine mammals, far from the spill site. Oil may also be caught along ice edges and in marginal ice zones with sensitive aggregations such as primary producers, seabirds and marine mammals.

In general, accidents are best mitigated by careful planning, strict Health, Safety and Environment (HSE) procedures and application of the Precautionary Principle in combination with BEP, BAT and international standards (OSPAR). However, knowledge of the behaviour of spilled oil in ice environments is very limited and the technology for cleaning up oil spills in ice-covered waters is inadequate and in need of further development.

Primary production and zooplankton

It is assessed that the impact of a surface oil spill in the assessment area on primary production and zooplankton in open waters will be low due to the large temporal and spatial variation in these events and occurrences. There is, however, a risk of impacts (reduced production) in localised primary production areas and the spring bloom will be the most sensitive period.

Experience learned from the Deepwater Horizon oil spill in the Mexican Gulf in 2010, where huge subsea plumes of dispersed oil were found at different depths, may change the conclusion of relatively mild impacts for extremely large subsea spills to more acute and severe impacts. It is too early to draw conclusions on the effects of a subsea spill like the spill from the Deepwater Horizon as there is still very little scientific information available on effects from this incident. But if large subsea plumes of dispersed oil in toxic concentrations occur, stronger impacts than from a surface spill must be expected, especially on primary producers, zooplankton and fish/shrimp larvae.

Fish and crustacean larvae

In general, eggs and larvae of fish and crustacean are more sensitive to oil than adults and may theoretically be impacted by reduced annual recruitment with some effect on subsequent populations and fisheries for a number of years. Atlantic cod is especially sensitive as their eggs and larvae can be concentrated in the upper 10m of the water column, whereas larvae of

shrimp and Greenland halibut, for instance, are found deeper and would therefore be less exposed to harmful oil concentrations from an oil spill at the surface. However, an extremely large subsea blowout may expose eggs and larvae over much larger areas and depth ranges and may potentially also impact the recruitment and stock size of other species, such as shrimp, Greenland halibut, snow crab and sandeel.

Benthos

Bottom-living organisms such as bivalves and crustaceans are vulnerable to oil spills; however, no effects are expected in the open water unless oil sinks to the seabed. In shallow waters (< 10-15m), highly toxic concentrations of hydrocarbons can reach the seafloor with possible severe consequences for local benthos and thereby also for species utilising the benthos – especially common eider, king eider, long-tailed duck, bearded seal and walrus. A subsea spill with the size and properties of the spill from the Deepwater Horizon in the Mexican Gulf has the potential to impact the seabed communities in deep waters too.

Adult fish

Impacts from a surface spill on adult fish stocks in the open sea are not expected. The situation is different however in coastal areas, where high and toxic oil concentrations can build up in sheltered bays and fjords resulting in high fish mortality (see above). Once more, a large subsea blowout could represent an exception as far as low impact is concerned. Considerable plumes of dispersed oil can occur in the water column from a subsea blowout and may impact the fish both directly or through the food chain. Greenland halibut would be exposed in both ways, because they move up from the seabed to the pelagic waters to feed.

Fisheries

An oil spill in the open sea will affect fisheries mainly by means of temporary closure in order to avoid contaminated catch. Closure time would depend on the duration of the oil spill, weather, etc. The offshore fishery for Greenland halibut within the assessment area is large and a closure zone would probably extend further west and cover Canadian fishing grounds too. The reason is that Greenland halibut moves considerable distances over a very short time and contaminated (tainted) fish may move out of the assessment area and be caught far from a spill site.

The assessment area is also among the most important fishing grounds in Greenland for northern shrimp and snow crab, and closure zones may also have significant economic consequences for this section of the fishing industry.

Oiled coastal areas would also be closed for fisheries for a period – the duration of the closure would depend on the behaviour of the oil. There are examples of closure for many months due to oil spills, particularly if oil is caught in sediments or on beaches. The commercial inshore fishery targets primarily lumpsucker and local populations of Atlantic cod, while capelin form part of the subsistence and recreational fishery.

Seabirds

Seabirds are extremely vulnerable to oil spills in the marine environment as they usually spend much time at the surface where most oil spills occur. Their plumage is highly sensitive to oil, as only small amounts can destroy

its insulation and buoyancy properties. Exposed birds usually die from hypothermia, starvation, drowning or intoxication. In the assessment area the coastal zone is particularly sensitive as high concentrations of seabirds are found all year around. A substantial number of these birds, including breeding birds, moulting birds as well as wintering birds, are associated with habitats along the highly exposed outer coastline. In these areas, oil spill response is hampered by remoteness, the complex coastal morphology and the often harsh weather conditions. The seabird species most vulnerable to oil spills are those with low reproductive capacity (low population turnover), a trait especially found among auks, fulmars and many seaducks. These species, e.g. thick-billed murres, little auks, eiders and long-tailed ducks, winter in the assessment area in large numbers as Southwest Greenland constitutes an international wintering area for seabirds from a range of breeding locations in the North Atlantic.

During autumn and winter, a number of species are also at risk further offshore in the assessment area, including the shelf areas; although birds tend to be more dispersed in the open water compared to coastal habitats. Some of the important species include northern fulmar, black-legged kittiwake, puffin, little auk, thick-billed murre, black guillemot and king eider. Especially the king eider is vulnerable in the offshore area as the birds assemble in large dense flocks on the shallow-water shelf banks during winter (Fyllas Banke and Store Hellefiskebanke). A major oil spill in these areas could seriously affect this population.

Marine mammals

Polar bears and seal pups are highly vulnerable to direct oiling and even short exposures can be lethal, as the oil affects the insulation properties of the fur. There are seal pup areas in the assessment area (see below), while polar bears are associated with the Davis Strait pack ice, of which the extent lying within the assessment area varies.

Whales, seals and walruses are vulnerable to surface oil spills. The baleens of the baleen whales may become smothered with oil. This may affect their filtration capability or lead to toxic effects and injuries in the gastrointestinal tract if oil is ingested. There is also the potential for inhalation of oil vapours and direct contact of the oil with eye tissues. The extent to which marine mammals actively avoid an oil slick and also how harmful the oil would be to fouled individuals is uncertain. However, observations indicate that at least some species do not perceive oil as a danger and have repeatedly been reported to swim directly into oil slicks.

Marine mammal species affected by an oil spill during winter in the assessment area could include bearded seal, hooded seal, ringed seal, harbour seal, bowhead whale, narwhal, white whale, polar bear, harbour porpoise, walrus, bottlenose whale and sperm whale. Harbour seals are especially vulnerable as they are endangered in Greenland, and hooded seals too, because whelping patches are located in the eastern Davis Strait pack ice. Marine mammals that use the area as a feeding ground during summer include harp seal, hooded seal, ringed seal, harbour seal, fin whale, humpback whale, minke whale, sei whale, harbour porpoise, white beaked dolphin, bottlenose whale, sperm whale, and pilot whale. Blue whale occurs only rarely in the assessment area but is vulnerable due to its very small population.

Mitigation

The risk of accidents and their environmental impacts can be minimised with high safety levels; planning to avoid the most sensitive areas and periods; and efficient contingency plans with access to adequate equipment and oil spill sensitivity maps where the most sensitive areas have been identified.

Knowledge gaps and new studies

There is a general lack of knowledge on many of the ecological components and processes in the Davis Strait area. A preliminary identification of information needs and knowledge gaps for environmental management and regulation of future oil activities in the Davis Strait can be found in chapter 12. To manage future oil activities, more information is required in order to: a) assess, plan and regulate activities to minimise the risk of impacts; b) identify the most sensitive areas and update the Oil Spill Sensitivity Mapping; c) establish a baseline to use in 'before and after' studies for impacts from any large oil spills.