ACCESS
Arctic Climate Change
Economy and Society

Project no. 265863

ACCESS

Arctic Climate Change, Economy and Society

Instrument: Collaborative Project
Thematic Priority: Ocean.2010-1 "Quantification of climate change impacts on economic sectors in the Arctic"

D4.54 – Identification of ecologically vulnerable areas

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Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Contents

Introduction

The Arctic Council's 2009 Arctic Marine Shipping Assessment (AMSA)[1] identified a number of recommendations to guide future action by the Arctic Council, Arctic States and others on current and future Arctic marine activity. Recommendation II C under the theme *Protecting Arctic People and the Environment* recommended:

"That the Arctic states should identify areas of heightened ecological and cultural significance in light of changing climate conditions and increasing multiple marine use and, where appropriate, should encourage implementation of measures to protect these areas from the impacts of Arctic marine shipping, in coordination with all stakeholders and consistent with international law."

The Arctic Marine Shipping Assessment (AMSA) 2009 Report reviewed environmental impacts and threats from current and future Arctic marine shipping activities. AMSA Recommendation IIC called for the Arctic States to identify areas of heightened ecological and cultural significance in light of changing climate conditions and increasing multiple marine uses, and where appropriate, to encourage the implementation of measures to protect these areas from the impacts of Arctic marine shipping. A group of core-drafters were selected to carry out the work of identifying and describing the areas of heightened ecological significance.

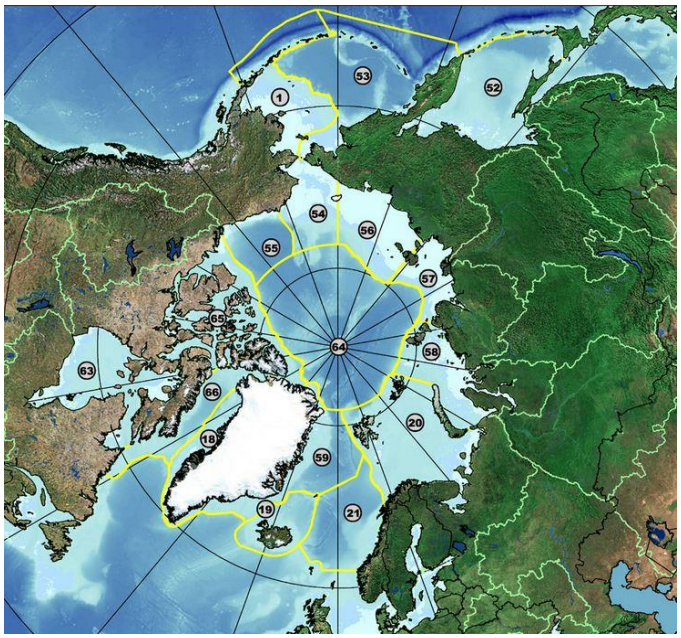
This report will briefly present the areas that were identified as being heightened ecological significance based on the latest release of the AMAP report[2], to the concentrate on the Barents Sea region where most of the data was collected under other ACCESS WPs and where an assessment on how radiated noise from shipping and Oil & Gas operations can affect marine mammal populations.

[1] Arctic Council Arctic Marine Shipping Assessment 2009 Report. www.pame.is/images/stories/PDF_Files/AMSA_2009_Report_2nd_print.pdf

[2] AMAP/CAFF/SDWG, 2013. Identification of Arctic marine areas of heightened ecological and cultural significance: Arctic Marine Shipping Assessment (AMSA) IIc. Arctic Monitoring and Assessment Programme (AMAP), Oslo. 114 pp.

Ecological significant areas

Areas of heightened ecological significance have been identified for each of the 16 Large Marine Ecosystems (LMEs) within the Arctic area. Three different approaches were used to identify such areas. (1) Areas identified as vulnerable areas in the AMAP Assessment of Oil and Gas Activities in the Arctic[3] were used as the basis for 'AMSA IIC' areas in 11 LMEs (located in the Northeast Atlantic sector, in the Russian Arctic, Bering and Chukchi Seas, and the Central Arctic Ocean). (2 and 3) Canada and Denmark/Greenland had separate national processes to identify areas of heightened ecological significance for their waters (five LMEs, from the Beaufort Sea to the Greenland Sea).

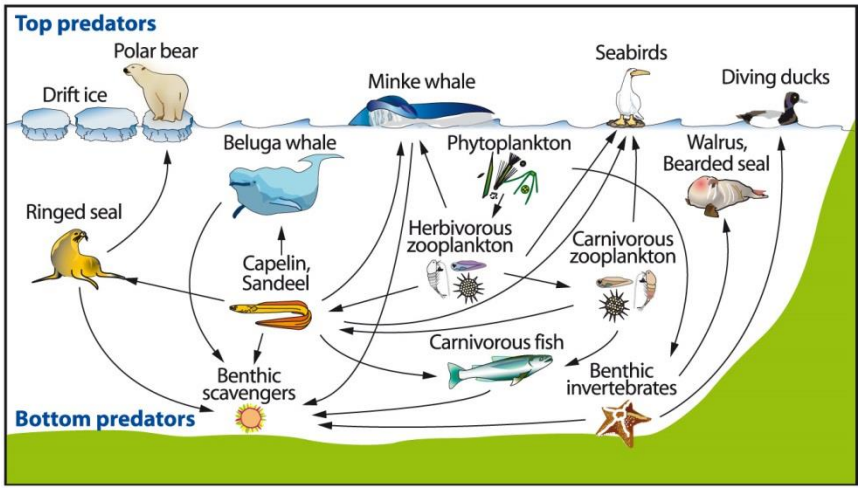


The 16 Arctic Large Marine Ecosystems. Source: Protection of the Marine Environment (PAME)

The AMSA report identified oil spills as the most significant threat associated with Arctic marine shipping. Other potential impacts include ship strikes on marine mammals, disruption of migratory patterns, noise disturbance, and introduction of alien species. Aggregations of fish, birds and mammals, for purposes such as migration, staging, breeding, feeding, and resting, are to varying degrees sensitive and potentially vulnerable to oil spills and disturbances. Such areas would also generally be considered ecologically important and thus of heightened ecological significance. While an area can be ecologically important without necessarily being particularly sensitive or vulnerable,

[3] www.amap.no/oil-and-gas-assessment-oga

there is a broad correspondence between ecological importance and sensitivity (and potential vulnerability) for areas used by aggregations of animals.



Simplified food web in the Barents Sea

A total of about 97 areas of heightened ecological significance have been identified within the Arctic Large Marine Ecosystems. The areas were identified primarily on the basis of their ecological importance to fish, birds and/or mammals, as these species are the most widely studied Arctic groups. The majority of areas identified are used by birds (85) and marine mammals (81), with a lower number used by fish (40, most of them spawning areas). About 70 areas are used both by birds and mammals, and only two of the areas identified are used only by fish.

The areas are essentially stationary habitats (even if they feature a current flowing through them) and the uses of the areas by aggregations of animals provide close links between species and habitats in a functional ecological sense. This is important in relation to use of the information in the context of the ecosystem approach to management.

Areas of heightened ecological significance are taken to mean that the areas are ecologically important. All areas of Nature have some ecological function for the animals, plants and microbes that occupy or use the areas, either permanently or seasonally. 'Heightened ecological significance' and 'ecologically important' are understood in a relative sense, as areas that are more important than other areas. This does not mean that those other areas are not ecologically significant or ecologically unimportant, only that they are less significant and less important than the identified 'important' areas.

Ecological sensitivity of an area is not strictly the same as ecological importance. An area may be ecologically important without necessarily being ecologically sensitive. However, the two aspects of sensitivity and ecological importance are often related in reality. This is particularly the case where the ecological sensitivity is reflected in the use of areas by animals for biological or ecological purposes such as breeding, feeding, migration, wintering, etc. Aggregations of fish, birds or mammals at particular geographical locations will often convey an ecological significance to those locations in that they may serve as important or critical habitats during the annual or life cycles of the animals.

The ecological sensitivity of an area is reflected in the way and extent by which it is used by animals or animal populations.

Table 1. Overview of environmental impacts associated with Arctic marine shipping. Source: based on PAME (2009).

Category	Activities/pressures	Impacts
Pollution	Accidental discharge of oil and toxic chemicals	Physical oiling and death of birds
		Toxicological effects
	Regular discharges to water (including garbage and illegal discharges)	Oiling (primarily from illegal discharges)
		Entanglement of whales and other wildlife (ropes, nets and other garbage)
		Ingestion of plastics by birds and mammals
	Emissions to air	Climate change (carbon dioxide and other greenhouse gases)
		Ozone and haze (nitrogen oxides)
		Decrease in local air quality
		Deterioration in ice conditions (black carbon; 'soot')
Disturbance	Sound and noise disturbance	Disruption of vital activities for mammals/bird
		Interference with communication among whales
	Ice breakers and disturbance	Effects on behaviour and communication between mammals
		Disturbance of wintering, migrating or staging birds and mammals in leads and polynyas
		Disruption of migration routes for terrestrial mammals crossing sea ice (e.g., caribou)
		Ice entrapment of whales in artificial leads
	Vessel strikes	Injury and death of whales by collision
	Light disturbance	Injury and death of birds attracted to lighted ships
Introductions	Introduction of invasive species through ballast Water, hull-fouling and cargo	Various biological and ecological effects

Vulnerability is related to sensitivity but the two are not the same. Vulnerability relates to specific pressures or threats. If there are no activities or threats, an area may be considered sensitive but not vulnerable. The properties of sensitivity and vulnerability of areas may be seen as comprising three levels. The first level relates to the intrinsic properties of organisms or habitat features that reflect whether they are sensitive or fragile to external disturbances. Animal species may be sensitive to disturbances through changes in behavior or other biological effects, and may be slow to recover should they be impacted due to low rates of reproduction. Habitat features may be physically fragile and easily impacted by physical stress, for example, cold water corals being impacted by bottom trawling. The second level relates to the ecological setting. An area where many sensitive organisms or habitat features are concentrated is more sensitive or fragile than a comparable area where they are more scarce and dispersed. The third level relates to the presence of pressures and impacts from human activities. Whether an area identified as sensitive should also be considered vulnerable depends on whether there are direct or potential threats.

Criteria for identifying sensitive and ecologically important areas

There are several sets of criteria for identifying sensitive and ecologically important areas. Of particular relevance in the present case are the IMO criteria for Particularly Sensitive Sea Areas (PSSA) (IMO, 2002), which are mentioned as an appropriate tool in AMSA Recommendation IID (PAME, 2009). The UN Convention on Biological Diversity has adopted another set of criteria for identifying Ecologically and Biologically Significant Areas (EBSAs). The International Union for the Conservation of Nature (IUCN) has also proposed criteria for selecting Marine Protected Areas (MPAs).

A comparison of the various sets of criteria shows that they are broadly similar (Table A.3; Skjoldal and Tolopova, 2010). One reason for the high degree of similarity is that the set of IUCN criteria for MPAs, published in 1992, has been used as the basis for the development of the other two sets. The fact that the criteria are similar for identifying 'sensitive areas' and 'ecologically significant areas' reflects the coincidence of these features; areas are considered sensitive because they support aggregations of wildlife or other features, which also are ecologically significant.

Table 2. Comparison of criteria for identifying Ecologically and Biologically Significant Areas (EBSAs), Marine Protected Areas (MPAs) and Particularly Sensitive Sea Areas (PSSAs). Source: Skjoldal and Toropova (2010).

CBD EBSA	**IUCN MPA**	**IMO PSSA**
Uniqueness or rarity ·· Species, populations, communities ·· Habitats or ecosystems ·· Geomorphological or oceanographic features	Rare biogeographic qualities Unique or unusual geological features Rare or unique habitat	Uniqueness or rarity
Special importance for lifehistory stages of species ·· Breeding grounds, spawning areas, nursery ·· Habitats of migratory species	Presence of nursery or juvenile areas Presence of feeding, breeding areas	Spawning, breeding Migratory routes Critical habitat for the survival, function, or recovery of fish stocks
Importance for threatened, endangered or declining species and/or habitats	Presence of habitat for rare or endangered species Rare or unique habitat for any species	Critical habitat: endangered species
Vulnerability, fragility, sensitivity, or slow recovery ·· Sensitive habitats, biotopes or species that are functionally fragile or with slow recovery		Fragility
Biological productivity	Ecological processes or life-support sys.	Productivity
Biological diversity ·· Ecosystems, habitats, communities ·· Species ·· Genetic diversity	The variety of habitats Degree of genetic diversity within species	Diversity
Naturalness	Naturalness Integrity	Naturalness Integrity Dependency
	Representative of a biogeographic “type” or types	Representativity - Bio-geographic importance, representative of a biogeographic “type” or types

The Barents Sea LME

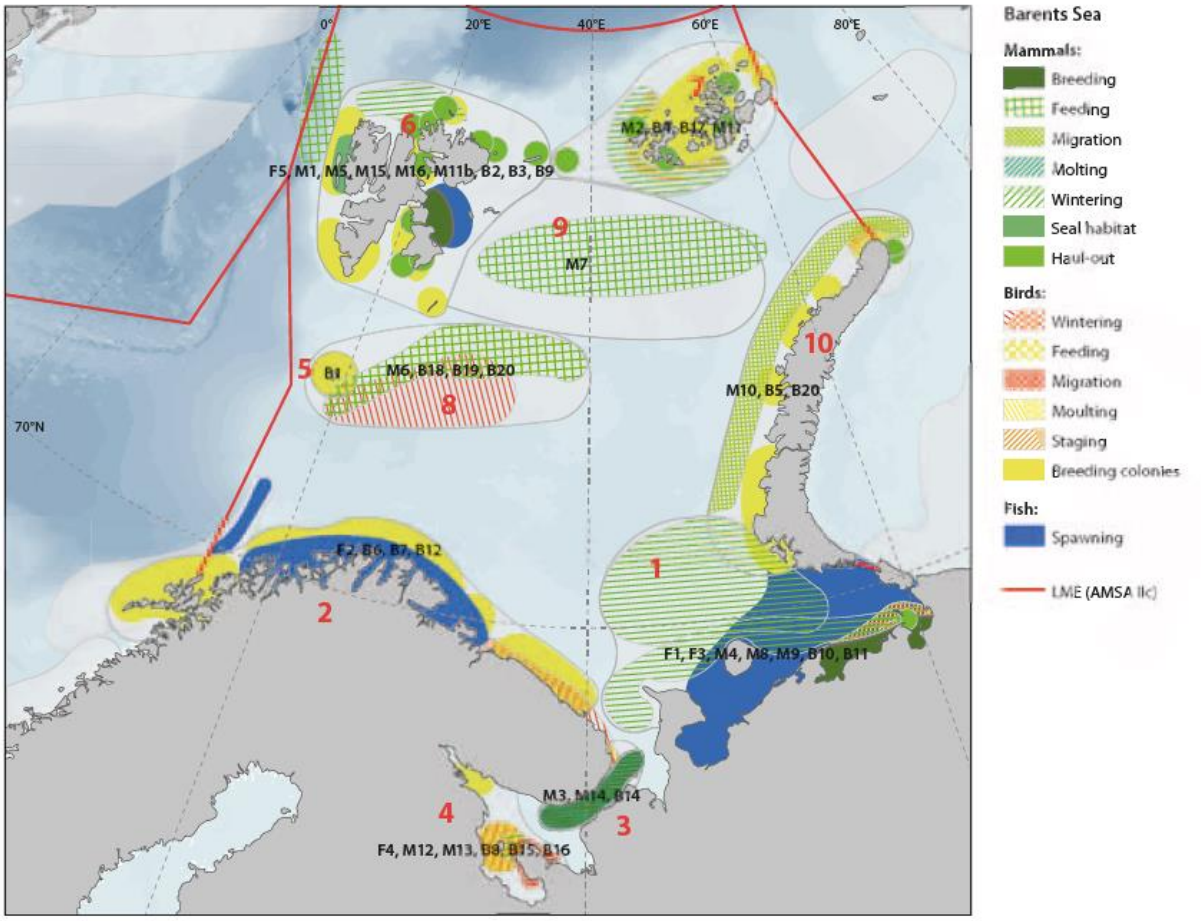


Figure 1 The Barents Sea Large Marine Ecosystems (LMEs)

Areas of heightened ecological significance in the Barents Sea LME are shown in Figure 1, with information on ecological function and the extent to which these areas meet the IMO ecological criteria for PSSAs shown in Table 3.

Area		OGA No.	Ecological function	Month/ Season	PSSA criteria										
No.	Location				Uniqueness or rarity	Critical habitat	Dependency	Representativeness	Diversity	Productivity	Spawning or breeding grounds	Naturalness	Integrity	Fragility	Biogeographic importance
1	Pechora Sea		Beluga wintering area	Winter		×					×	×		×	
		F1	Spawning area polar cod	I-II	×	×	×				×	×		×	×
		F3	Spawning area herring			×	×				×	×		×	
		M4	Ringed seal breeding area	Winter		×	×				×	×		×	
		M8	Walrus wintering area	Winter		×	×				×	×		×	
		M9	Walrus feeding and haul-out	Summer		×	×			×		×		×	
		B10	Molting and staging areas for waterfowl		×	×	×			×	×	×		×	×
		B11	Molting and staging area for seaducks, staging area for auks		×	×	×				×	×		×	×
2	Norwegian and Murman coasts	F2	Spawning area capelin	II-IV	×	×	×			×	×	×		×	×
		B6	Seabird breeding colonies			×					×	×		×	
		B7	Seabird breeding colonies			×					×	×		×	
		B12	Wintering area seaducks	Winter		×					×	×		×	
3	Entrance and northern White Sea	M3	Harp seal whelping and molting areas	Late winter	×	×	×				×	×		×	×
		M14	Beluga wintering area	Winter		×					×	×		×	
		B14	Seaducks molting and wintering area			×					×	×		×	
4	White Sea (Kandalaksha, Onega, Dvina bays)	F4	Spawning area herring			×	×				×	×		×	×
		M12	Beluga wintering area	Winter		×	×				×	×		×	×
		M13	Beluga summering area	Summer	×	×					×	×		×	×
		B8	Breeding colonies seabirds and elders			×			×		×	×		×	
		B15	Seaducks molting and wintering area			×	×				×	×		×	
		B16	Ducks, geese and swans - staging area during spring and autumn migration	Spring		×	×				×	×		×	×
5	Bear Island	B1	Seabirds breeding colonies			×					×	×		×	
6	Svalbard Archipelago	F5	Spawning area for polar cod	Winter		×	×				×	×		×	
		M1	Potential wintering area narwhal and bowhead	Winter	×	×	×				×	×		×	×
		M5	Harbor seal habitat year-round		×	×				×	×	×		×	×
		M11b	Walrus feeding and haul-out			×	×			×	×	×		×	
		M15	Ringed seal breeding area	Winter		×	×			×	×	×		×	
		M16	Feeding area for bowhead, blue whale, minke whale		×	×	×			×	×	×		×	×
		B2 a,b,c	Seabird breeding colonies	Summer		×				×	×	×		×	
		B3 a,b,c	Seabird breeding colonies	Summer	×	×				×	×	×		×	×
		B9	Molting areas seaducks and geese	Late summer		×	×			×		×		×	
7	Franz Josef Land	M2	Wintering area bowhead and walrus	Winter	×	×	×				×	×		×	×
		B4	Seabird breeding colonies		×	×	×				×	×		×	×
		M11	Walrus feeding and haul-out			×				×		×		×	
		B17	Staging area for seabirds	Spring		×	×				×	×		×	×

Area		OGA No.	Ecological function	Month/ Season	PSSA criteria									
No.	Location				Uniqueness or rarity	Critical habitat	Dependency	Representativeness	Diversity	Productivity	Spawning or breeding grounds	Naturalness	Integrity	Fragility	Bio-geographic importance
8	Western and central Barents Sea	M6	Feeding area - polar bear and harp seal	Spring-early Summer		×	×			×		×		×	
		B18	Feeding area for seabirds	Summer		×	×			×		×		×	
		B19	Seabird wintering area	Winter	×	×					×	×		×	
		B20	Molting area and swimming migration auks	Late summer		×					×	×		×	
9	Northern Barents Sea - marginal ice zone	M7	Polar bear feeding area	Summer-Autumn		×	×				×	×		×	
10	Western Novaya Zemlya	M10	Spring migration corridor for beluga and possibly walrus			×					×	×		×	
		B5	Seabird breeding colonies			×					×	×		×	
		B20	Swimming migration auks	Late summer		×					×	×		×	

Table 3. Areas of heightened ecological significance within the Barents Sea LME, their ecological function, and the extent to which these areas meet the IMO ecological criteria for particularly sensitive sea areas. An '°—' indicates that the criteria have been met, an empty cell indicates that the criteria are not met or not applicable.

Noise issues

This deliverable compares the LMEs of the Barents Sea with the presence of marine mammals and anthropogenic activities through several maps. The environmental impact of interest here is either an increased acoustic contribution, reducing the communication or sonar range of many cetaceans (as detailed in deliverables 4.5.1 and 4.5.2), and increased human presence in areas that used to be relatively calm, possibly causing displacement. ∑

Data source

- **Oil prospecting:** Data from the areas opened for oil industry explorations and the companies in charge of it was provided and converted from the Norwegian Petroleum Directorate (www.npd.no) as of June 20th, 2012.
- **Marine mammals:** All data from marine mammals distribution in the Barents Sea was found in the literature and converted to GCS_WGS_1984. Since the data was limited and, to the best of our knowledge, it was not published the distribution of the species over the months, we considered a global annual distribution of marine mammals species.
- **Maritime traffic:** One year of AIS data covering part of the Barents Sea has been made available by the Norwegian Coastal Administration (Kystverket). From their website density data containing the number of ship passages was downloaded for each month in 2012. Since December 2012 was not yet fully available, data from December 2011 has been added to correct for the missing days. The NetCDF density data was converted to a CSV format in Matlab® and then passed to ArcGIS®.

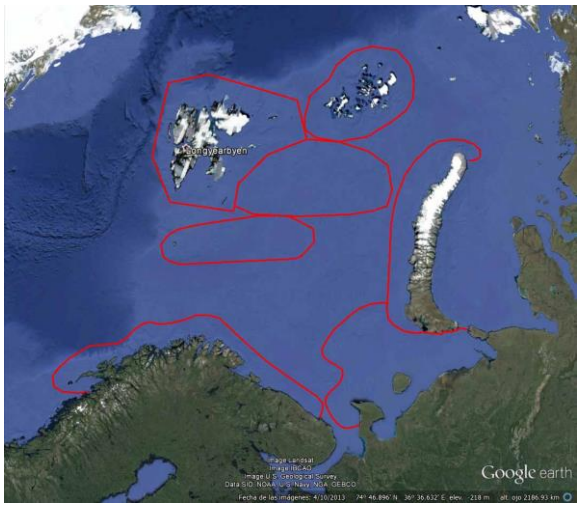


Figure 2. Areas of Heightened Ecological Significance

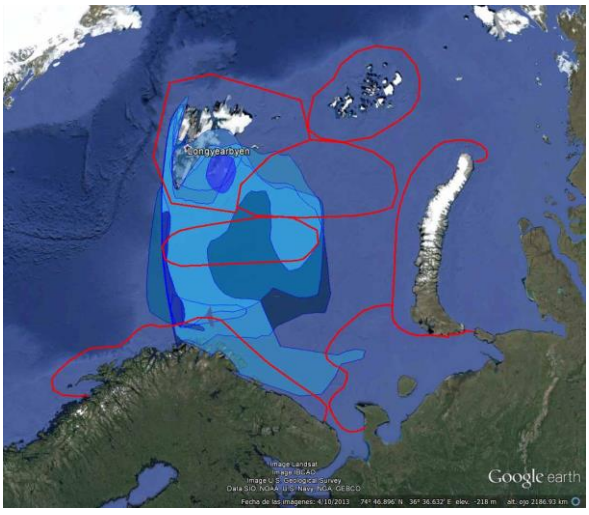


Figure 3. Areas of Heightened Ecological Significance + Cetaceans

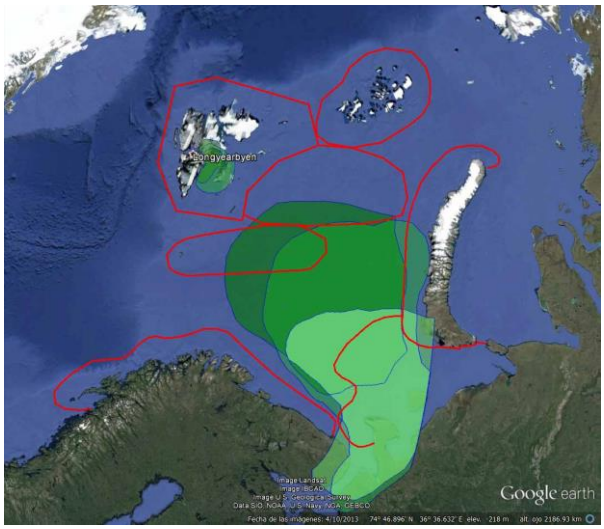


Figure 4. Areas of Heightened Ecological Significance + Seals

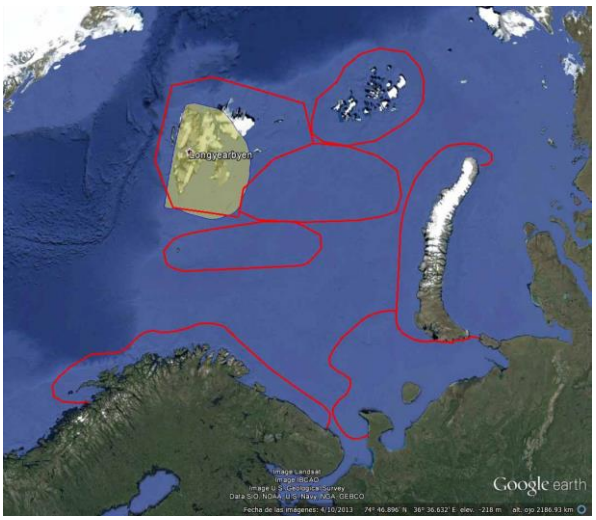


Figure 5. Areas of Heightened Ecological Significance + Polar Bears

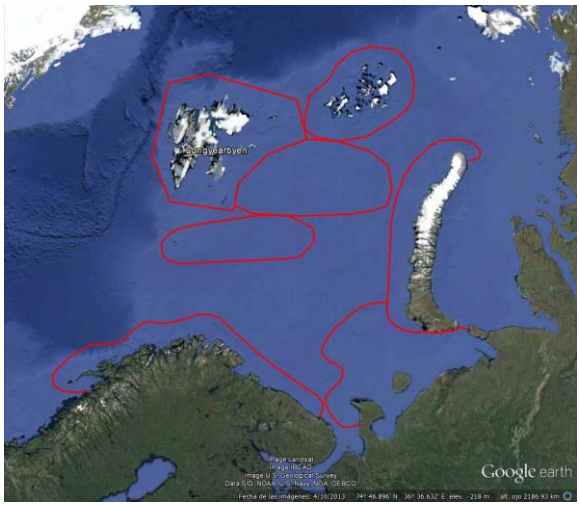


Figure 6. Areas of Heightened Ecological Significance

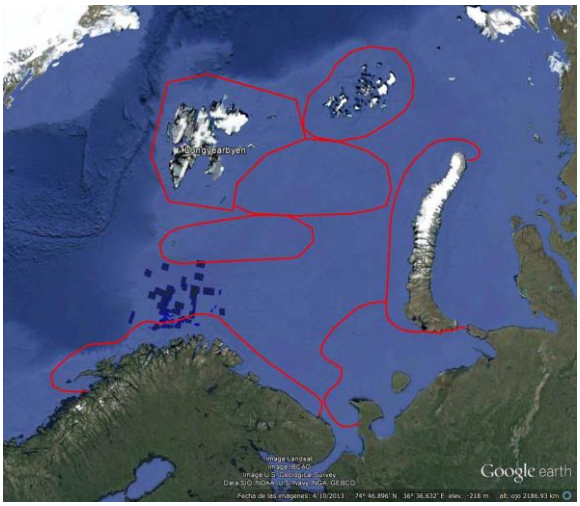


Figure 7. Areas of Heightened Ecological Significance + Oil & Gas Platforms

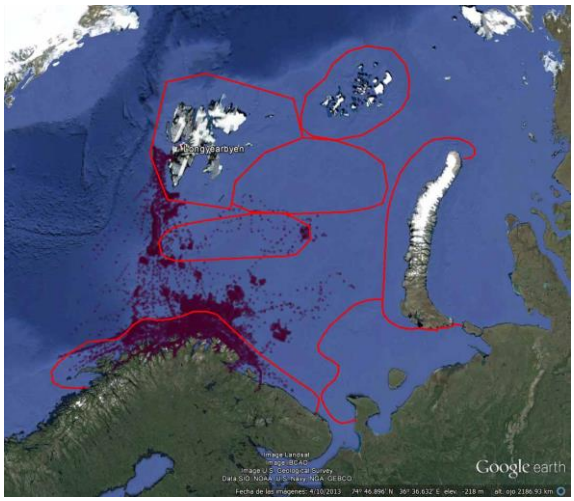


Figure 8.
Areas of Heightened Ecological Significance
Automatic Identification System – January 2012

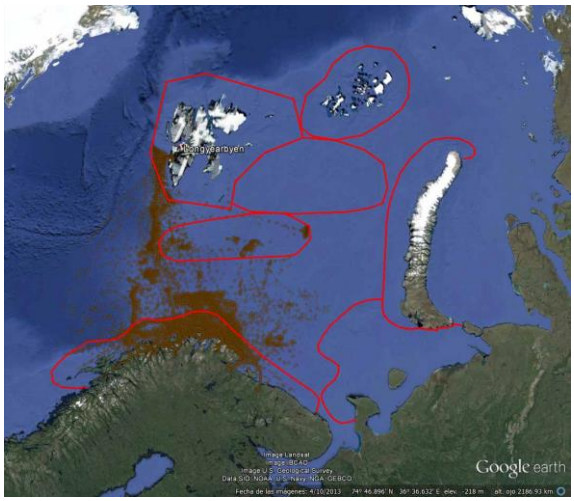


Figure 9.
Areas of Heightened Ecological Significance
Automatic Identification System – February 2102

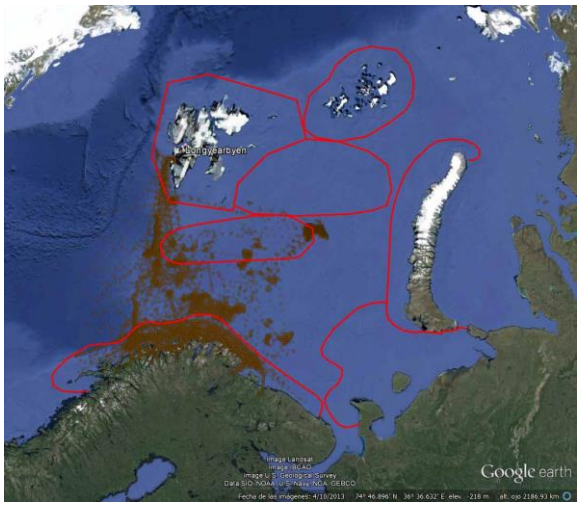


Figure 10.
Areas of Heightened Ecological Significance
Automatic Identification System – March

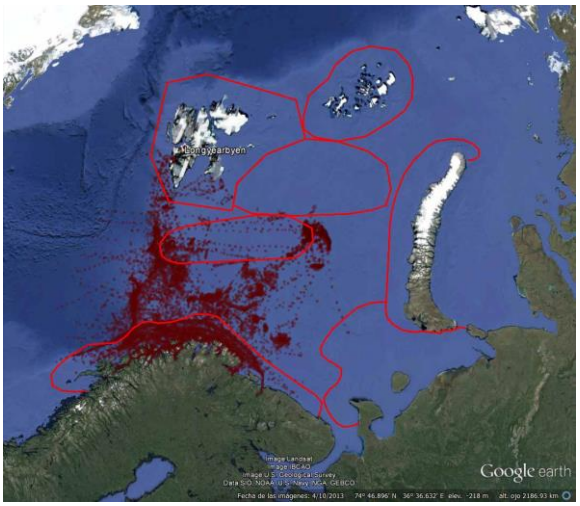


Figure 11.
Areas of Heightened Ecological Significance
Automatic Identification System – April

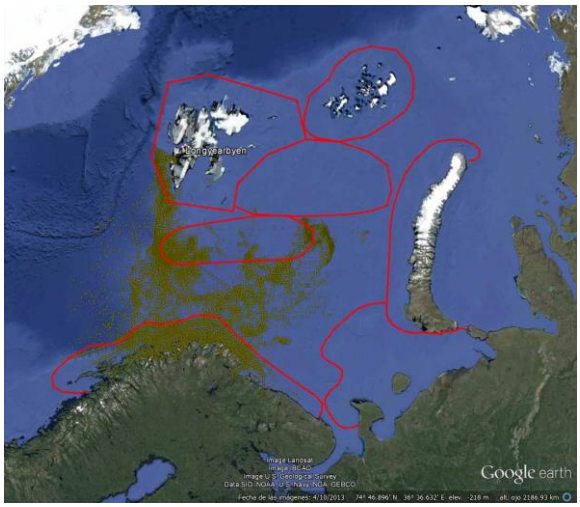


Figure 12.
Areas of Heightened Ecological Significance
Automatic Identification System – May

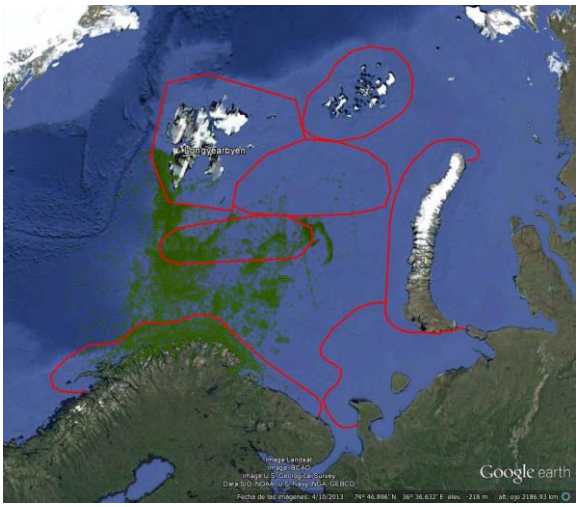


Figure 13.
Areas of Heightened Ecological Significance
Automatic Identification System – June

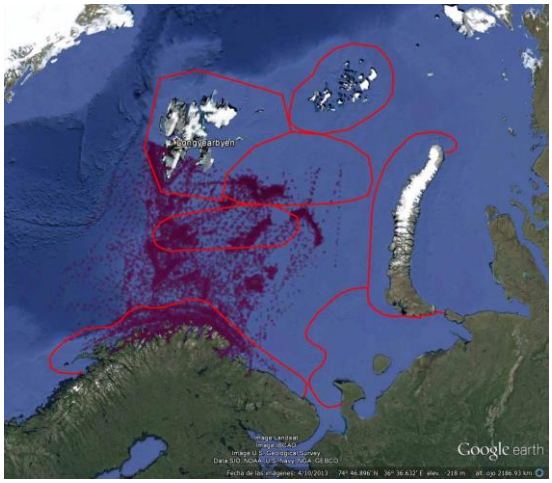


Figure 14.
Areas of Heightened Ecological Significance
Automatic Identification System – July

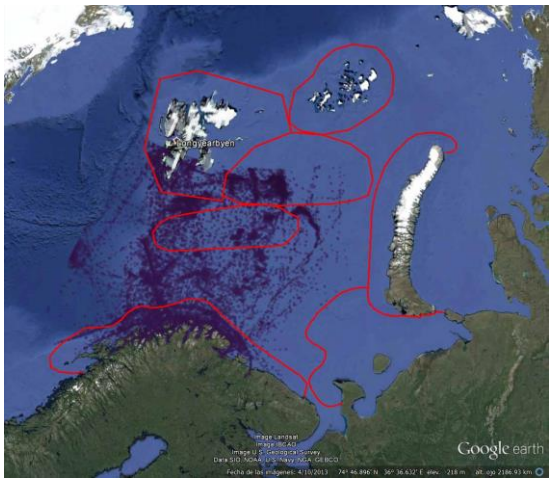


Figure 15.
Areas of Heightened Ecological Significance
Automatic Identification System – August

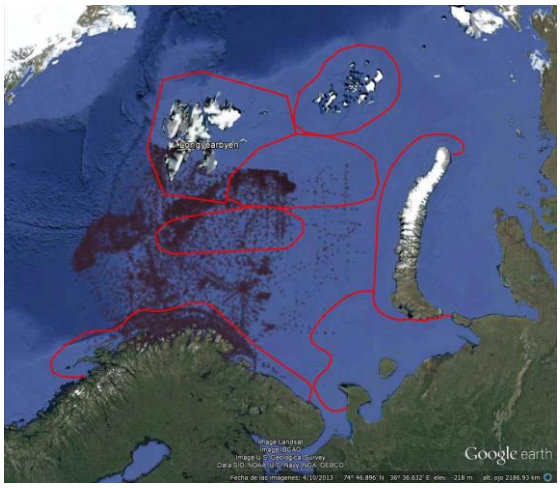


Figure 16.
Areas of Heightened Ecological Significance
Automatic Identification System – September

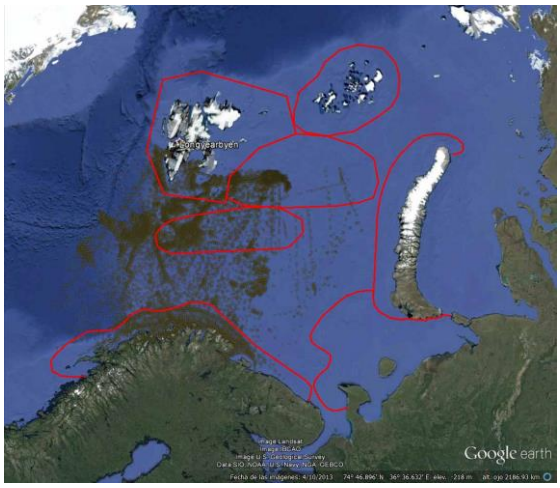


Figure 17.
Areas of Heightened Ecological Significance
Automatic Identification System – October

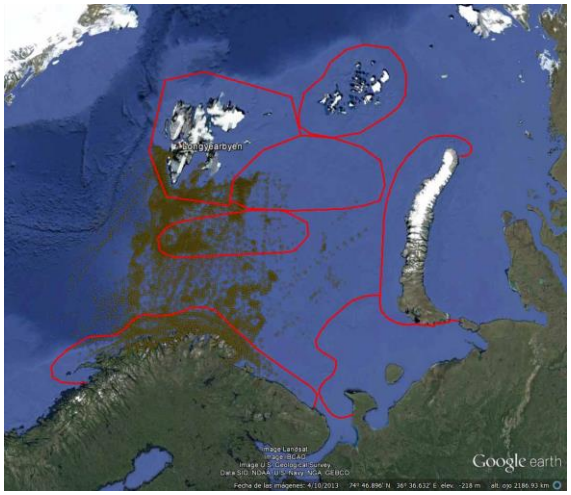


Figure 18.
Areas of Heightened Ecological Significance
Automatic Identification System – Novembre

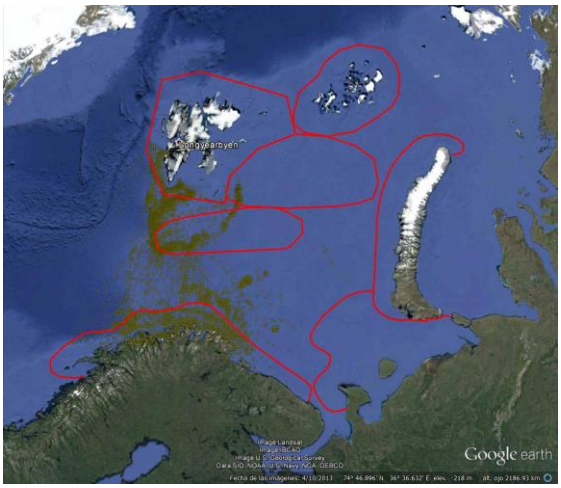


Figure 19.
Areas of Heightened Ecological Significance
Automatic Identification System – December

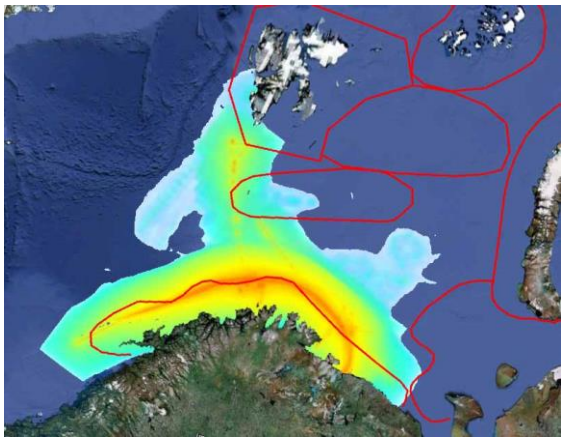


Figure 20.
Areas of Heightened Ecological Significance
Cumulative Noise – January

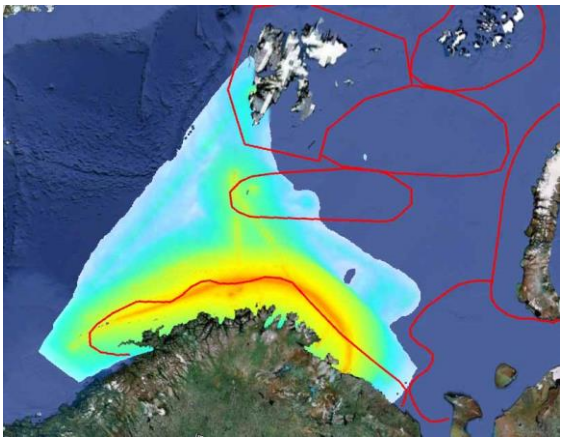


Figure 21.
Areas of Heightened Ecological Significance
Cumulative Noise - February

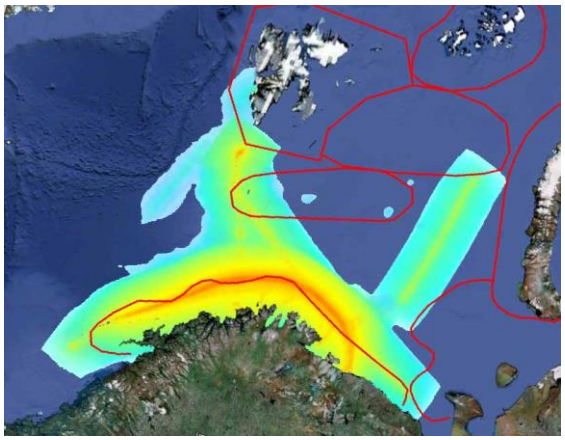


Figure 22.
Areas of Heightened Ecological Significance
Cumulative Noise – March

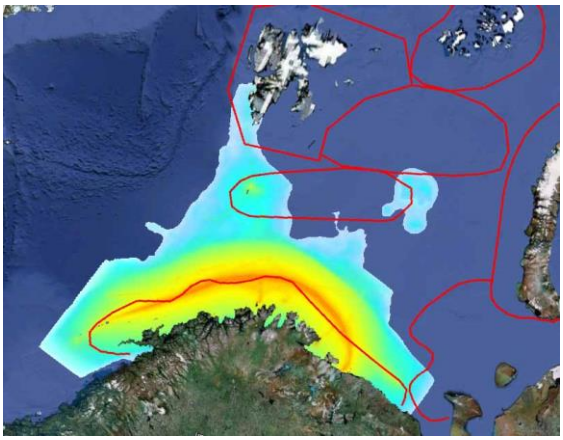


Figure 23.
Areas of Heightened Ecological Significance
Cumulative Noise – April

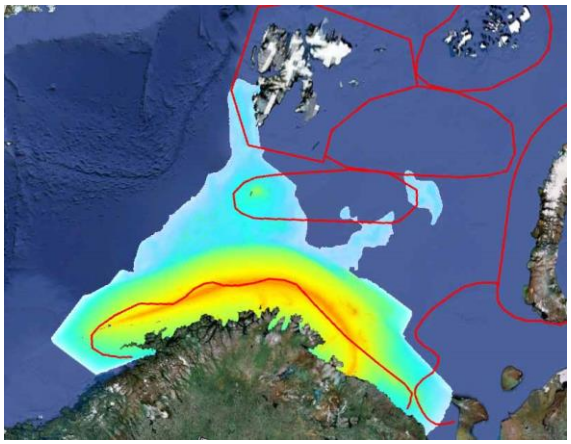


Figure 24.
Areas of Heightened Ecological Significance
Cumulative Noise – May

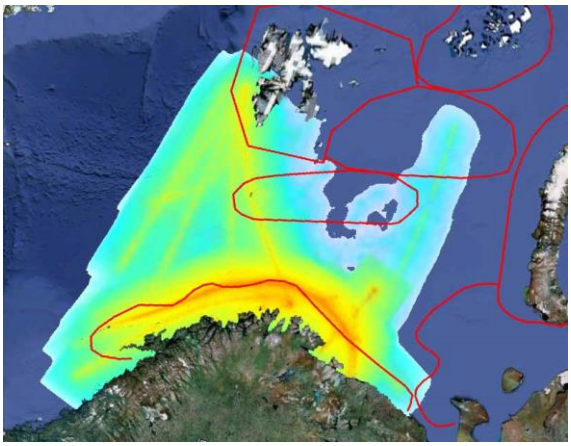


Figure 25.
Areas of Heightened Ecological Significance
Cumulative Noise – June

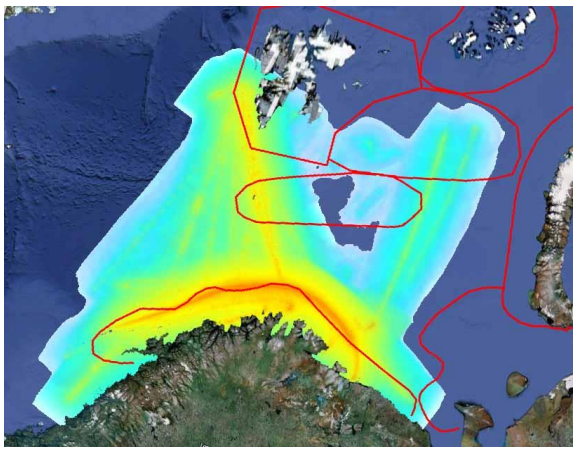


Figure 26.
Areas of Heightened Ecological Significance
Cumulative Noise – July

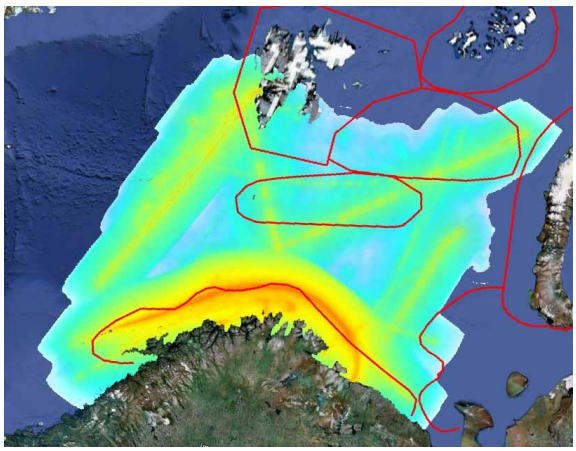


Figure 27.
Areas of Heightened Ecological Significance
Cumulative Noise – August

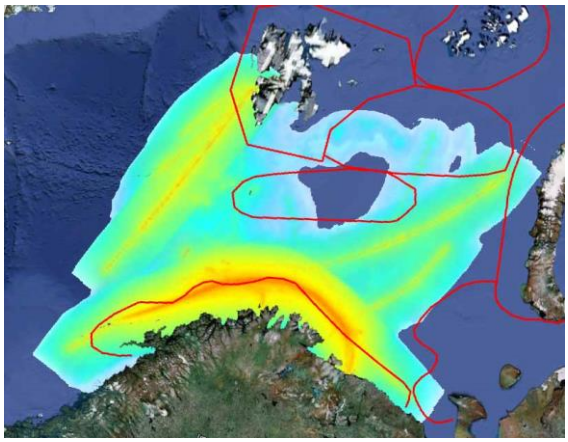


Figure 28.
Areas of Heightened Ecological Significance
Cumulative Noise – September

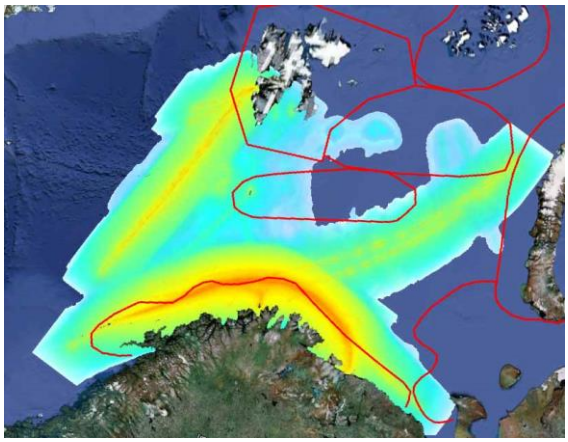


Figure 29.
Areas of Heightened Ecological Significance
Cumulative Noise – October

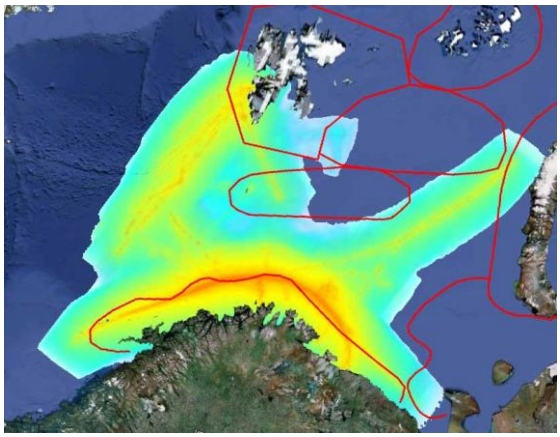


Figure 30.
Areas of Heightened Ecological Significance
Cumulative Noise – November

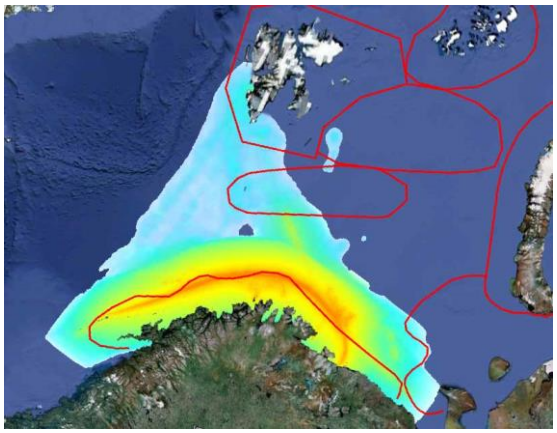


Figure 31.
Areas of Heightened Ecological Significance
Cumulative Noise – December

Conclusion

After describing the criteria used by the AMSA and the IMO to define ecological sensitive areas, three types of information were collected to illustrate the Arctic situation against noise issues for the area of the Barents Sea: 1) Presence of marine mammals; 2) Presence of Oil & Gas exploitation platforms; 3) Shipping traffic. This information was combined with sound exposure modeling, as performed under deliverable 2.4.3, to estimate the acoustic impact on the environment.

When superposing these maps to the existing Large Marine Ecosystems (LMEs) some regions appear to be presenting an acoustic budget that could influence marine mammal distribution and that are not currently taken into account by the AMSA criteria.

It is likely that these zones could be designated as Marine Protected Areas in a future re-classification of LMEs, while a better knowledge is gained regarding the effects of noise on marine fauna.

This example illustrates the need of further research in Arctic waters to extend the definition of ecological sensitive areas to regions overloaded with artificial noises.