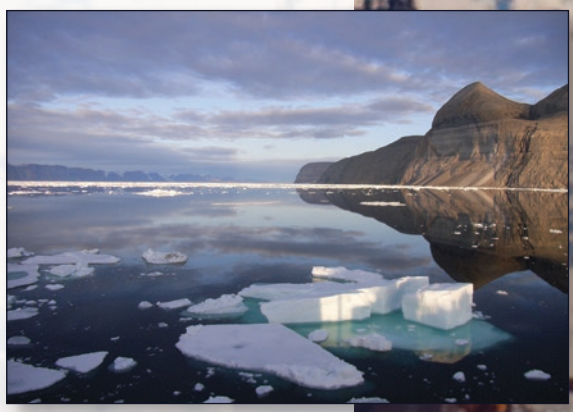
Natural Resources in Polar Oceans

Baseline documentation of polar marine environments and ecosystems is needed to effectively manage natural resources.

Recognising the potential and importance of polar marine resources, Europe must take on the challenges for sustainable management and use of living resources, alongside environmentally-sensitive extraction of mineral and hydrocarbon resources.

This requires increased multi-national and multi-sectorial collaboration and investment.which can be stimulated within Horizon 2020. The aim should be to establish **a comprehensive and sustained system for marine observation and data-exchange**, covering both the Arctic and Southern Oceans.



KEY ISSUES

1. The disappearance of summer sea-ice in the Arctic increases access to valuable sea-bed minerals and allows exploitation of hydrocarbons, as well as longer fishing seasons. Whilst Antarctica remains extensively protected from mineral resource exploitation through the internationally agreed Madrid Protocol, the Southern Ocean is a large marine resource capable of supplying 7% of the world's fish resources. **To protect and manage these natural resources we need to observe and understand the polar oceans and their ecosystems**, and the predicted system transformations – including increasing human activities.

2. The possibility of a **seasonally ice free** Arctic Ocean within a few decades, and **rapidly acidifying** upper water layers of both the Arctic and Southern Oceans, will have profound implications for the future of **polar marine living resources** that also include important commercial fisheries with substantial societal relevance.

   Regional warming, ocean acidification and changes in sea-ice distribution present a variety of challenges to polar ecosystems which have not yet been adequately quantified or understood.

   Marine resource extraction may exacerbate the threats to species and ecosystems. For example, the shrimp-like **krill** is a substantial commercial harvesting opportunity and critical to the entire Antarctic marine food web. Warming of Southern Ocean waters is likely to replace krill with other organisms from lower latitudes which are less valuable, or even damaging to the existing ecosystem. In the north we can anticipate changes in pelagic ecosystems, as several fish stocks will likely expand their feeding areas within higher latitudes and Atlantic fish species, some commercially relevant, will expand northwards with uncertain food web consequences.

3. **Fishing seasons are extended** by longer and more extensive open water periods, as are the opportunities for **pan-Arctic shipping routes that reduce transit routes between Europe and Asia**. There is also increased access to potentially substantial and valuable **mineral resources** from the bottom of the Arctic Ocean, including methane hydrates, oil, gas and poly-metallic nodules. A further development could be through **bio-prospecting** of polar extreme environments.

4. **Exploitation opportunities** have clear societal and energy security values, but could also bring disruption to polar wildlife migration routes, pollution threats and habitat destruction for **benthic and pelagic ecosystems**. All of these issues are still to be assessed as there is limited experience of such activities in polar waters.

   There is also a significant shortfall in **basic information about polar marine biodiversity** and ecosystems, including seafloor and sub-seafloor communities, in both the Arctic and Southern Oceans which is fundamental to investigating future impacts.

   The study of polar marine ecosystems and mineral resources must be conducted in international cooperation, to effectively address the circum-polar scale of issues in Polar Regions and to better **coordinate the necessary research and logistical infrastructure**.

5. The strong seasonality and significant uncertainties associated with changing polar ecosystems require **long-term environmental and biodiversity time-series observations**, and improved modelling to enhance **predictive capacities**. This will require a significant investment to upgrade and expand observing infrastructure, support research on modelling and forecasting and improve sharing of data and information. This knowledge base can then underpin and extend ecosystem-based management of Arctic and Southern Ocean living resources, alongside environmentally aware extraction of mineral/hydrocarbon resources in the future. It also provides scientific support for the establishment of Marine Protected Areas (MPA)and protecting certain areas from industrial use.

These issues raise significant questions for understanding polar marine resources:

1. How will polar marine ecosystems respond to a broader seasonal range of environmental temperatures?
2. What will be the consequences of rapid ocean acidification for polar ecosystems?
3. How will increased coastal erosion affect Arctic marine ecosystems?
4. What are the bio-geographical consequences of climate change for polar organisms and how will this impact the viability of existing commercial fisheries and bio-prospecting opportunities?
5. Is mineral and hydrocarbon extraction economically practical in the Arctic and what are the range and scale of impacts likely for polar marine ecosystems, particularly seafloor and sub-seafloor communities?
6. What are the implications for Arctic marine ecosystems of increased shipping and the associated land-based supporting physical infrastructure around the Arctic Ocean?

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