

**INITIAL ENVIRONMENTAL EVALUATION
- ARCTIC OCEAN 2002 -**



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SWEDISH POLAR RESEARCH SECRETARIAT

Arctic Ocean 2002
Initial Environmental Evaluation

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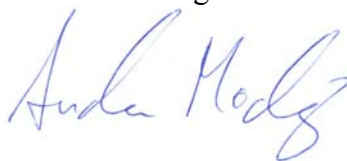
SUMMARY

The Arctic Ocean 2002 (AO-02) expedition, 20 April–7 June 2002, will focus on research into oceanography, environmental chemistry, and marine ecology/biology.

The expedition will primarily visit the area east of Greenland (c. 65°–80°N, 0°–45°W).

The expected environmental impacts of the activities planned for Arctic Ocean 2002 are considered to be limited. Furthermore, many of the scientific projects will increase general understanding of certain parameters important for climate change. In the long run this will have a positive impact on the environment. From an environmental point of view there are thus no reasons for not conducting the Arctic Ocean 2002 expedition.

Stockholm 26 March 2002
Anders Modig



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1. INTRODUCTION

The earth's climate is determined by the circulation of the atmosphere and the oceans, and our northern oceans are intimately involved in these circulation processes. Disturbances and changes in the large-scale circulation systems that regulate the climate and affect the environment can lead to palpable effects on societies and people, plants, and animals. Consequently, thorough understanding of the systems' functions, processes, and feedback mechanisms is vital. Several research expeditions with the icebreaker Oden over the last ten years have given Swedish polar research a leading position in marine arctic research.

In co-operation with the National Maritime Administration, the Polar Research Secretariat will be conducting a new expedition using Oden as a research platform, commencing 20 April and ending 7 June 2002. The expedition is unique in that it will be carried out so early in the year. For the first time, scientists will be able to study processes in these regions under winter conditions.

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2. LEGAL FRAMEWORK

A number of national and international laws and agreements aim to protect the marine/limnic environment. These agreements are referenced in Tables 1 and 2 below, and it is noted to which of these Oden adheres. Table 3 presents some extra cautions, as well as responses pertaining to practices on-board Oden.

2.1 TABLE 1. NATIONAL AGREEMENTS

Name of agreement	Adhered to by Oden	Notes
• Lag (1980:424) om åtgärder mot förorening från fartyg	X	The Swedish law regarding pollution from ships.
• Förordning (1980:789) om åtgärder mot förorening från fartyg	X	The Swedish ordinance regarding pollution from ships.

2.2 TABLE 2. INTERNATIONAL AGREEMENTS

Name of agreement	Adhered to by Oden	Notes
• MARPOL 73/78: International Convention for the Prevention of Pollution from Ships, 1973 / Protocol of 1978 relating to the International Convention for the Prevention of Pollution from Ships, 1973	X	
• MARPOL 73/78 Annex I (oil pollution)	X	
• MARPOL 73/78 Annex II (liquid noxious substances)	-	Applies only to ships carrying chemicals
• MARPOL 73/78 Annex IV (sewage)	X	
• MARPOL 73/78 Annex V (garbage)	X	

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Name of agreement	Adhered to by Oden	Notes
<ul style="list-style-type: none"> MARPOL 73/78 Annex VI (Prevention of Air Pollution from Ships) 	-	Not in force.
<ul style="list-style-type: none"> Pollution Prevention Equipment Required Under MARPOL 73/78 (1996) 	X	
<ul style="list-style-type: none"> International Guidelines for Preventing the Introduction of Unwanted Aquatic Organisms and Pathogens from Ship's Ballast Water and Sediment Discharges (IMO, 1998) 	-	Oden will follow instructions given by SPRS. ¹
<ul style="list-style-type: none"> IMO Resolution: Technical Code on Control of Emissions of Nitrogen Oxides from Marine Diesel Engines (NOx Technical Code) 	-	There are no exhaust emission controls on Oden.
<ul style="list-style-type: none"> International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC) 	-	Not in force.
<ul style="list-style-type: none"> Guidelines for the Development of Shipboard Oil Pollution Emergency Plans (1992) 	X	
<ul style="list-style-type: none"> IMO/UNEP Guidelines on Oil Spill Dispersant Application Including Environmental Considerations (1995) 	-	Not in force.
<ul style="list-style-type: none"> International Convention for the Safety of Life at Seas (SOLAS) 	X	
<ul style="list-style-type: none"> The International Safety Management (ISM) Code 	X	

¹ Swedish Polar Research Secretariat

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2.3 TABLE 3. OTHER

Issue	Notes
<ul style="list-style-type: none">• Antifouling paints	Oden does not use antifouling paints.
<ul style="list-style-type: none">• Waste management	All waste, sludge etc. will be discharged ashore for destruction.
<ul style="list-style-type: none">• SO₂ emissions	The bunker oil purchased will meet SPRS specification concerning sulphur contents. Oden uses bunker oil containing a maximum of 0.5% sulphur during icebreaking operations in Swedish waters of the Baltic.
<ul style="list-style-type: none">• The vessel captain is required to be familiar with environmentally sensitive areas in the sailing area, and is to exercise special caution in such areas.	Compliant

2.4 BEAR MANAGEMENT

2.4.1 The International Agreement on Conservation of Polar Bears and Their Habitat, 1973

This agreement states that the five polar-bear nations (Canada, Greenland, Norway, the United States, and Russia) shall: protect polar bear habitat, especially denning areas, feeding areas, and migratory routes; ban hunting of bears from aircraft and large motorised boats; conduct and co-ordinate management and research efforts; and exchange research results and data.

The agreement allows the taking of polar bears for scientific purposes, for the prevention of serious disturbances in the management of other resources, for use by local people using traditional methods and exercising traditional rights, and for protection of life and property.

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Each nation has voluntarily established its own regulations and conservation practices using the knowledge gained from the international community as a whole.

Sweden is not a signatory to the convention, but the content of the convention will nevertheless inform all encounters with polar bears during AO-02.

2.4.2 International Union for the Conservation of Nature and Natural Resources/World Conservation Union

The IUCN/World Conservation Union is a world-wide conservation organisation. This organisation links government agencies, non-governmental organisations, and independent states to encourage a world-wide approach to conservation.

The Polar Bear Specialist Group works under the auspices of the IUCN/World Conservation Union's Species Survival Commission. This group helps co-ordinate and identify the management and research efforts of the five polar-bear nations (Canada, Greenland, Norway, the United States, and Russia).

The IUCN/World Conservation Union categorises animal species they feel are threatened. It lists the polar bear as "vulnerable", meaning that the species is likely to move into the "endangered" category if negative factors continue affecting the population at the current rate.

2.5 ENVIRONMENTAL PRINCIPLES

According to the *Protocol on Environmental Protection*, all activities in the Antarctic region (south of 60°S) must be preceded by an *Environmental Impact Assessment* (EIA). Since a similar agreement for the Arctic region is lacking, Swedish expeditions to the Arctic will in most respects adhere to the intent of the *Protocol on Environmental Protection*. The following text is quoted from Annex I to the Protocol:

Article 2

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1. Unless it has been determined that an activity will have less than a minor or transitory impact, or unless a Comprehensive Environmental Evaluation is being prepared in accordance with Article 3, an Initial Environmental Evaluation shall be prepared. It shall contain sufficient detail to assess

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whether a proposed activity may have more than a minor or transitory impact and shall include:

(a) a description of the proposed activity, including its purpose, location, duration and intensity; and

(b) consideration of alternatives to the proposed activity and any impacts that the activity may have, including consideration of cumulative impacts in the light of existing and known planned activities.

2. If an Initial Environmental Evaluation indicates that a proposed activity is likely to have no more than a minor or transitory impact, the activity may proceed, provided that appropriate procedures, which may include monitoring, are put in place to assess and verify the impact of the activity.

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3. ENVIRONMENTAL IMPACT ASSESSMENT – LOGISTICS

3.1 GENERAL

The logistics issues examined in this EIA encompass all parts of AO-02 pertaining to transport by ship and helicopter. The base-line information is collected from the expedition leaders and personnel at the logistics centre.

In 1991 a comprehensive EIA was conducted for the icebreaker Oden (The Oden In Polar Operations – Environmental Impact Assessment, SSPA Report 6103-1, plus Appendices 1–6, 1991-01-18), and a post analysis was conducted in 1993 (Oden In Polar Operations – Environmental Impact Assessment, Post Analysis – Quantitative Summary from the International Arctic Ocean Expedition 1991, SSPA Report 6617-1, 1993-01-19). For all questions regarding the environmental impact of the icebreaker Oden, please consult these reports.

3.2 GEOGRAPHICAL AREAS OF CURRENT INTEREST

See attached map (Appendix 1).

3.3 NUMBER OF PARTICIPANTS

The total number of participants is 60, of whom 5 are logistics personnel, 32 are scientists, 1 is an artist, and 22 are crew. The expedition is divided into two legs and all participants will not be onboard at the same time. A few participants will be exchanged in Svalbard.

3.4 TRANSPORT

3.4.1 Helicopters

Helicopters will be used to exchange expedition participants at Svalbard. The total projected flight time will not exceed 10 hours.

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3.4.2 Zodiacs

One inflatable Zodiac boat will be used on some occasions. The engine is a 15-horsepower, 4-stroke Honda.

3.4.3 Projected fuel consumption

<u>Fuel</u>	<u>Projected consumption</u>
Bunker oil (Oden): 40 tonnes/day × 45 days	1800 tonnes
Marine diesel (Oden) 2 tonnes/day × 50 days	100 tonnes
Petrol (Zodiac): 2 litres/hour × 20 hours	40 litres
Mobile diesel generator: 10 hours × 5 litres	50 litres

3.5 WASTE MANAGEMENT

All waste will be handled by personnel on Oden, in accordance with the waste management systems in place on Oden.

3.6 FLORA AND FAUNA

Most of the expedition route will lie far from any terrestrial environments, and only marine flora and fauna may possibly be affected. These questions were considered in the EIA produced for Oden 1991, where it was concluded that the Oden's impact on flora and fauna is minor or negligible.

3.7 INDIGENOUS PEOPLE

The planned expedition route for AO-02 lies far from the traditional hunting grounds, travel routes, or living areas of any indigenous people.

3.8 CUMULATIVE IMPACTS

AO-02 will not visit any terrestrial areas. It is very difficult to estimate cumulative impacts on pelagic marine environments. There have been very few visits to the areas the Arctic Ocean expedition will visit, so the cumulative impacts will most likely be negligible.

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3.9 ALTERNATIVES

The EIA process shall always assess the consequences of alternatives to planned activities. This is especially important when the planned activities might produce impacts in especially sensitive areas. The current EIA describes possible alternatives based on the conditions likely to prevail during AO-02.

3.9.1 Alternative areas

No alternatives exist.

3.9.2 The zero alternative

The zero alternative entails no activities being carried out in the area, which would be the case if the AO-02 was cancelled. This alternative would have no consequences for the environment. However, since one important goal of the expedition is to understand processes involved in climate change, cancelling AO-02 would lead to the loss of important data and knowledge.

3.10 EVALUATION OF ENVIRONMENTAL IMPACTS – LOGISTICS

The logistics activities connected with AO-02 will be limited, as the planned scientific programmes will only entail limited logistics activities (except on Oden itself). Transport will, however, produce emissions. Oden will be the main source of these, but they are not considered to have significant impact on the environment.

Since the planned expedition route lies far from the traditional hunting grounds, travel routes, or living areas of any indigenous people, AO-02 is unlikely to interfere with the interests of indigenous people.

Since AO-02 will not visit any terrestrial areas, its cumulative impact on the terrestrial environment is considered as negligible, any effects being less than minor or transitory.

To sum up, logistics activities connected with AO-02 are likely to have only *minor or transitory impacts* on the environment. Therefore, there are no reasons why the expedition should not be carried out as planned

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4. ENVIRONMENTAL IMPACT ASSESSMENT – SCIENCE

4.1 GENERAL

This part of the EIA deals with the scientific programmes planned for the expedition. It does not cover logistics matters such as transport. The assessment is based on information obtained from the project leaders.

4.2 OCEANOGRAPHIC PROJECT

Project title:	<i>The East Greenland Current and world ocean circulation</i>
Principal investigators:	Leif Anderson, Bert Rudels
Short description:	The continuous, world-wide circulation of water through the oceans can be likened to a gigantic conveyor belt. The most powerful force in this circulation system is deep-water formation in both polar regions. When deep waters are formed, cold, salt-enriched water sinks towards the bottom due to its high density, displacing surrounding water masses.

The warm surface water of the Gulf Stream that flows northwards cools and divides, in the north, into two streams. One turns west between Iceland and Svalbard and flows back towards the south; the other stream continues northwards into the central Arctic Ocean, and part of that continues into the Barents Sea. The water masses that flow to the Arctic cool down further – making them heavier – and then sink to a depth of about a kilometre. They circulate counter clockwise in the Arctic Basin and mix with surrounding water masses. The main outflow of water from the Arctic Ocean to other oceans takes place afterwards, through the Fram Strait between Greenland and Svalbard.

The destination of Arctic Ocean 2002 is the East Greenland Current from the northern tip of Greenland to south of Iceland, where the current passes two regions of active deep-water formation, the Greenland Sea and the Iceland Sea. The

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main purpose of the research programme – an international collaboration among Sweden, Finland, Canada, Norway, and the United States – is to ascertain the origins of the various water masses that form deep water, their mix proportions, and how they change chemically and physically along the way. The expedition will be co-ordinated with an American research vessel operating in the corresponding ice-free parts of the seas north of Iceland.

Homepage:
<http://www.amc.chalmers.se/Anderson%20Research/index.html>

Project title:	<i>Radioactive substances as tools</i>
Principal investigator:	Ala Aldahan
Short description:	Iodine-129, beryllium-10, and carbon-14 are three radioactive isotopes with varying half-lives associated with both natural processes and human-produced pollution. By analysing water, air, and sediment samples from various stations along the expedition route, we can use the presence of these three substances to gain a good understanding of the movements of water masses and of the spread of human environmental pollutants in the form of chemical substances and radioactive waste. The samples will be analysed using ultra sensitive accelerator-based mass spectrometry.

4.3 ENVIRONMENTAL CHEMISTRY

Project title:	<i>Environmental toxins common in the Arctic</i>
Principal investigator:	Henrik Kylin
Short description:	Modern research has proved that organic environmental pollutants have spread even to remote and undisturbed regions of the earth. In certain parts of the Arctic Ocean, toxic chemical compounds have accumulated in higher concentrations than in any other ocean in the world. Samples taken from people who live in the Arctic also indicate high concentrations of persistent

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organic pollutants (POPs), and polar bears are demonstrating tendencies towards impaired reproductive success, likely due to environmental toxins. Scientists also suspect that the photosynthesis of ice algae may be negatively impacted, which may over the long term have devastating consequences for the Arctic ecosystem and biodiversity.

The expedition's environmental toxin project will include extensive sampling and analysis of surface and deep water, ice, and air.

4.4 MARINE ECOLOGY/BIOLOGY

Project title:	<i>Microorganisms and the carbon cycle</i>
Principal investigator:	Wilhem Granéli
Short description:	Researchers have relatively recently gained access to molecular biological technology for species determination of bacteria. As well, isotope-based methods assist in studying the role of micro-organisms in marine ecosystems and in studying biogeochemical cycles.

However, few studies of Arctic marine micro-organisms have been made using modern molecular methods. This project is oriented towards bacteria, viruses, and microscopic algae, how they interact with each other and their surroundings, and how they are affected by environmental disturbances.

One task is to determine which species of bacteria dominate and what their numbers are. Scientists have long believed the wealth of bacterial species to be enormous – perhaps several million species globally. Some doubt has been cast on that, however, partly due to the finding of identical bacteria in environments as disparate as Antarctic sea ice and Californian seawater. This has led to the hypothesis that bacteria are cosmopolitan by virtue of their ability to spread with ocean currents, airborne particles, and as stowaways on migratory birds.

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Project title: *Reduced ozone layer a threat to marine life*
Principal investigator: Katarina Abrahamsson
Short description: The thinning of the ozone layer above Antarctica caused by atmospheric pollutants, including freons, is well-known. But in the northern hemisphere as well, the depleted ozone layer in the stratosphere allows excessive UVB radiation from the sun to penetrate, constituting a threat to living organisms.

One of the expedition's projects focuses on phytoplankton at the ocean surface that are exposed to UVB radiation and copious light. Phytoplankton in the ocean are the base of the food web and important producers of atmospheric oxygen. In Antarctica, some phytoplankton have adapted to relatively high levels of UVB radiation by producing a kind of natural sunscreen made of compounds that absorb UVB. We do not fully understand these substances in arctic waters, so the project will study both the total production and composition of these sunscreens. In some cases, it seems that toxic phytoplankton produce more sunscreen than do non-toxic phytoplankton, which may mean that depletion of the ozone layer and higher UVB radiation are leading to higher incidence of toxic algae.

Project title: *Organic compounds from the ocean are affecting the ozone layer and climate*
Principal investigator: Angela Wulff
Short description: Halocarbons are volatile organic compounds containing chlorine, bromine, and iodine. They are produced by plankton in the Arctic Ocean and rise from the ocean water into the air. These natural halocarbons play a key role in atmospheric chemical processes. Along with human-produced freons, they contribute to the degradation of the ozone layer and can influence the greenhouse effect, in part through their impact on the incidence and lifetimes of certain greenhouse gases.

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The aim of the project is to use measurements and sampling to determine which organisms are most important in this context: that is, the quantities of halocarbons produced by various free-living plankton, ice algae, and snow organisms. The objective is also to gain understanding of the flow of halocarbons from the ocean to the atmosphere and the processes that control it.

Home page: <http://safari.gu.se/pages/925.html>

4.5 FLORA AND FAUNA

No sampling of macro flora or fauna will be performed. Only plankton will be sampled.

4.6 CHEMICALS

Chemicals will be handled with care and not dispersed into the environment.

4.7 CUMULATIVE IMPACTS

The scientific programmes are not considered as leading to any cumulative impacts.

4.8 ALTERNATIVES

There are no relevant alternatives to the chosen areas and methods. The zero alternative would entail the project not being carried out, which would be counterproductive.

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4.9 EVALUATION OF ENVIRONMENTAL IMPACTS – SCIENCE

The scientific programmes are not expected to lead to any environmental impacts.

This EIA indicate that only *less than minor or transitory impact* will result from the planned scientific activities. Therefore, from an environmental point of view, there are no reasons not to perform the scientific projects.

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5. SUMMARY TABLE

Field/ programme	Activity	Less than minor or transitory impact	Minor or transitory impact	More than minor or transitory impact
Logistics	Transport Cumulative impacts	X	X	
Scientific pro- grammes	Oceanographic projects	X		
	Environmental chemistry	X		
	Marine ecology/biology projects	X		
	Cumulative impacts	X		

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APPENDIX

1. GEOGRAPHICAL AREAS OF CURRENT INTEREST

