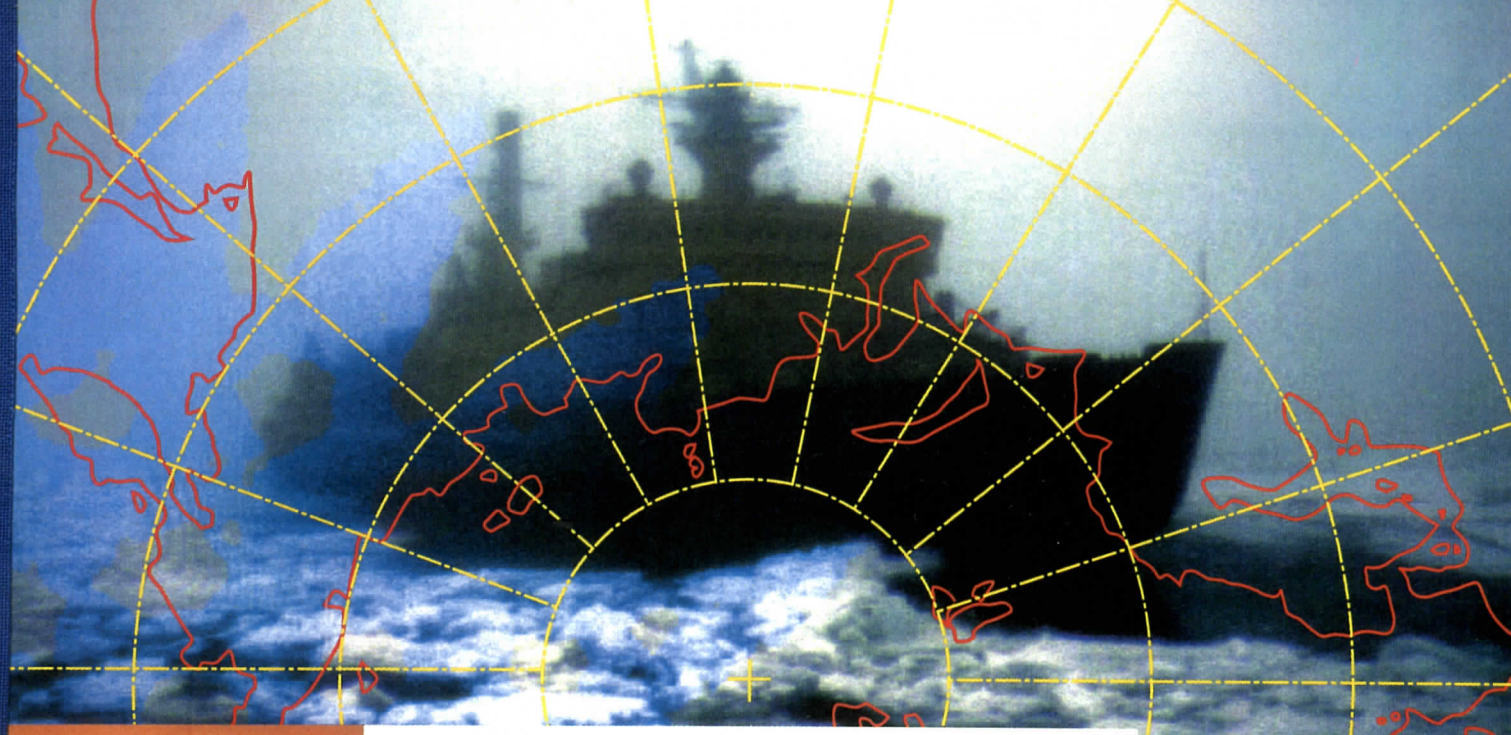

INSROP WORKING PAPER NO. 162 - 1999, II.5.10

Evaluation of INSROP Valued Ecosystem Components: Protected areas, Indigenous People, Domestic reindeer and Wild reindeer

By J. Thomassen, W. Dallmann, K. Isaksen, V. Khlebovich and Ø. Wiig

INSROP International Northern Sea Route Programme

Central Marine Research & Design Institute, Russia

The Fridtjof Nansen Institute, Norway

Ship and Ocean Foundation, Japan

International Northern Sea Route Programme (INSROP)

Central Marine Research & Design Institute, Russia | The Fridtjof Nansen Institute, Norway | Ship & Ocean Foundation, Japan

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Sub-programme II: Environmental Factors

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Supervisor: Jørn Thomassen

Title: **Evaluation of INSROP Valued Ecosystem Components: Protected areas, Indigenous People, Domestic reindeer and Wild reindeer**

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What is an INSROP Working Paper and how to handle it:

FOREWORD - INSROP WORKING PAPER

INSROP is a five-year multidisciplinary and multilateral research programme, the main phase of which commenced in June 1993. The three principal cooperating partners are **Central Marine Research & Design Institute (CNIIMF)**, St. Petersburg, Russia; **Ship and Ocean Foundation (SOF)**, Tokyo, Japan; and **Fridtjof Nansen Institute (FNI)**, Lysaker, Norway. The INSROP Secretariat is shared between CNIIMF and FNI and is located at FNI.

INSROP is split into four main projects: 1) Natural Conditions and Ice Navigation; 2) Environmental Factors; 3) Trade and Commercial Shipping Aspects of the NSR; and 4) Political, Legal and Strategic Factors. The aim of INSROP is to build up a knowledge base adequate to provide a foundation for long-term planning and decision-making by state agencies as well as private companies etc., for purposes of promoting rational decisionmaking concerning the use of the Northern Sea Route for transit and regional development.

INSROP is a direct result of the normalization of the international situation and the Murmansk initiatives of the former Soviet Union in 1987, when the readiness of the USSR to open the NSR for international shipping was officially declared. The Murmansk Initiatives enabled the continuation, expansion and intensification of traditional collaboration between the states in the Arctic, including safety and efficiency of shipping. Russia, being the successor state to the USSR, supports the Murmansk Initiatives. The initiatives stimulated contact and cooperation between CNIIMF and FNI in 1988 and resulted in a pilot study of the NSR in 1991. In 1992 SOF entered INSROP as a third partner on an equal basis with CNIIMF and FNI.

The complete series of publications may be obtained from the Fridtjof Nansen Institute.

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- The Norwegian Ministry of Foreign Affairs
- The Norwegian Ministry of Industry and Energy
- The Norwegian Ministry of the Environment
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- Murmansk Shipping Company, Russia
- Northern Sea Route Administration, Russia
- Arctic & Antarctic Research Institute, Russia
- Norwegian Polar Research Institute
- SINTEF (Foundation for Scientific and Industrial Research - Civil and Environmental Engineering), Norway.

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PREFACE

In the INSROP Environmental Impact Assessment focus has been put on selection and priorities of environmental components (Valued Ecosystem Components - VECs) which are assumed to be of significant importance for the decision makers (Thomassen *et al.* 1996, 1998) concerning an extended use of the Northern Sea Route (NSR).

In November 1993 a number of VECs were selected. Later on in INSROP Phase I additional VECs were brought into the system. These VECs are documented in Bakken *et al.* (1996), Larsen *et al.* (1995, 1996) and Wiig *et al.* (1996).

This paper documents the four last VECs identified in 1997 and 1998: VEC Protected areas, VEC Indigenous people, VEC Domestic reindeer and VEC Wild reindeer. It is important to notice that INSROP shall be terminated within March 1999, the budgets are almost empty, and this joint documentation process of the four last VECs have unfortunately been done in time shortage and almost without economical resources.

Trondheim 11. March 1999

Jørn Thomassen
supervisor

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1. Introduction

One of the main objectives in INSROP has been to establish a database containing *baseline* ecological and environmental selected components, so-called Valued Ecosystem Components (VECs) in the Northern Sea Route (NSR) area, and to present a discussion of possible impacts form proposed NSR activities on these components. This information is used as basis for an Environmental Impact Assessment (EIA) (see Thomassen et al 1996, 1998). The central point in the INSROP EIA has been to identify and evaluate key impacts from possible NSR activities on the VECs.

Another major objective has been to document all the results from the different steps towards an EIA. Thomassen *et al.* (1998) summarise the documentation process in INSROP so far. This paper is the documentation of 4 last VECs identified in INSROP Phase 2 in an EIA context, using the Adaptive Environmental Assessment and Management concept.

1.1 The Adaptive Environmental Assessment and Management concept in INSROP - a short summary

The INSROP EIA is based on an adjusted form of the Adaptive Environmental Assessment and Management (AEAM) - concept (derived from Holling 1978). The assessment design and the implementation of baseline data in the AEAM is described in detail in Thomassen *et al.* (1996, 1998), and only a limited description is given below.

1.1.1 Valued Ecosystem Components

In AEAM the impact predictions are derived from a procedure which includes the selection of VECs (Valued Ecosystem Components) that can be affected by the NSR activities.

A *Valued Ecosystem Component* is defined as *a resource or environmental feature that:*

⇒ *is important (not only economically) to a local human population, or*
⇒ *has a national or international profile, or*
⇒ *if altered from its existing status, will be important for the evaluation of environmental impacts of industrial developments, and the focusing of administrative efforts* (Hansson *et al.* 1990).

1.1.2 Schematic flow charts

The methodology also identifies major linkages between different components in the system by preparing Schematic Flow Charts including impact factors, which form the basis for the Impact Hypotheses (IHs). A *Schematic Flow Chart* is a diagram of boxes and arrows indicating in which context each of the VECs appears. It illustrates how a proposed activity may affect the VEC and how the impact may occur. Each linkage is explained in a brief text following the chart.

When constructing the schematic flow chart, four different symbols are used (Figure 1.1).

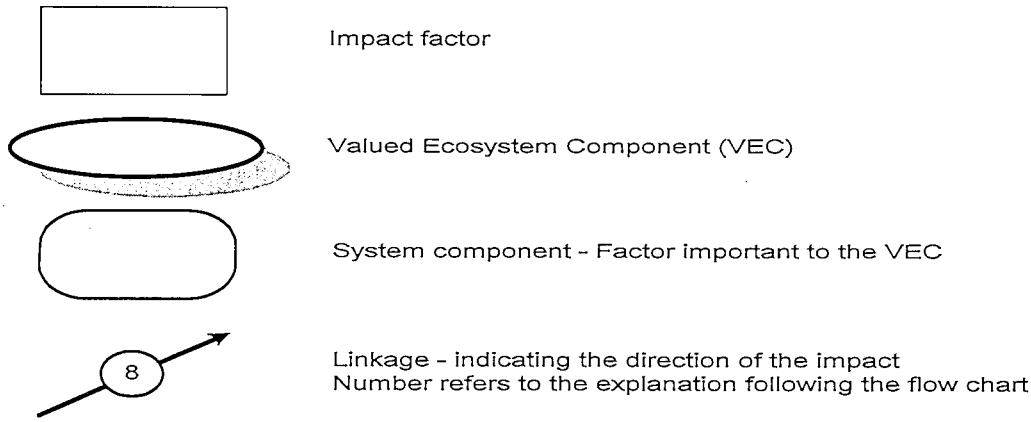

Figure 1.1. Symbols used for construction of schematic flow charts.

1.1.3 Impact factors

Five major impact factors were identified from the INSROP preliminary scenarios: *pollution, noise, waste, physical disturbance* and *change of development patterns* (initially named social and cultural factors). See Thomassen *et al.* (1998) for a summary of detailed impact factors concerning potential NSR activities.

1.1.4 Impact hypotheses

An *Impact hypothesis* (IH) is a hypothesis for testing the possible impacts arising from a given activity on the VEC. The impact hypothesis is illustrated by the schematic flow chart and should be explained and described preferably in scientific terms. The IH is also the basis for recommendations for research, investigations, monitoring and management actions, including mitigating measures. The impact hypotheses were evaluated according to the following categories:

A. The hypothesis is assumed not to be valid.
B. The hypothesis is valid and already verified. Research to validate or invalidate the hypothesis is not required. Surveys, monitoring, and/or management measures can possibly be recommended.
C. The hypothesis is assumed to be valid. Research, monitoring or surveys is recommended to validate or invalidate the hypothesis. Mitigating measures can be recommended if the hypothesis is proved to be valid.
D. The hypothesis may be valid, but is not worth testing for professional, logistic, economic or ethical reasons, or because it is assumed to be of minor environmental influence only or of insignificant value for decision making.

1.2 Selection of Valued Ecosystem Components

The selection of Valued Ecosystem Components in INSROP have been a 2-step process so far starting with the «Screening and focusing workshop» held in Oslo in November 1993 (Hansson *et al.* 1994). At this first meeting Russian and Norwegian specialists discussed the most significant components to be focused on in the INSROP-environmental subprogramme, and ended up with 13 VECs which were brought forward in the work. One year later the supervisors met for an evaluation of the VECs. The co-operation between the Rus-

sian and Norwegian specialists gave a somewhat different list of VECs. Most of the VECs had the same content, while some, mainly marine mammals, were new.

A total of 15 VECs were given priority for further data collection and storage in the Dynamic Environmental Atlas (see Brude *et al.* 1998), and for further use in the EIA. See Thomassen *et al.* (1996) for a summary of the VECs, and Bakken *et al.* (1996), Larsen *et al.* (1995, 1996) and Wiig *et al.* (1996) for a more detailed discussion of the selection of VECs in Phase I (see Table 1.1).

During Phase II, additional issues have been given status as VECs: Indigenous people (which is part of VEC Human settlements), VEC Domestic reindeer, VEC Wild reindeer and VEC Protected areas. The status background and the impact hypotheses for these four VECs are documented in this paper (but see also Dallmann 1997).

Table 1.1. Valued Ecosystem Components identified in INSROP. VECs E1, F1, G1 and G2 are documented in this paper.

No	Valued Ecosystem Components	When identified	Documentation
A1	VEC Benthic invertebrates	1993	Hansson *et al.* 1994, Larsen *et al.* 1996
A2	VEC Marine estuaries and anadromous fish	1993	Hansson *et al.* 1994, Larsen *et al.* 1996
A3	VEC Plant and animal life in polynyas	1993	Hansson *et al.* 1994, Larsen *et al.* 1996
B1	VEC Seabirds	1993	Hansson *et al.* 1994, Bakken *et al.* 1996
B2	VEC Marine wildfowl	1993	Hansson *et al.* 1994, Bakken *et al.* 1996
B3	VEC Waders in resting and feeding areas	1993	Hansson *et al.* 1994, Bakken *et al.* 1996
C	**Marine mammals**	**1993**	Hansson *et al.* 1994, Wiig *et al.* 1996
C1	VEC Polar bear	1993	Wiig *et al.* 1996
C2	VEC Walrus	1993	Wiig *et al.* 1996
C3	VEC Bearded seal	1995	Wiig *et al.* 1996
C4	VEC Ringed seal	1993	Wiig *et al.* 1996
C5	VEC White whale	1993	Wiig *et al.* 1996
C6	VEC Gray whale	1995	Wiig *et al.* 1996
C7	VEC Bowhead whale	1995	Wiig *et al.* 1996
D1	VEC Human settlement	1993	Hansson *et al.* 1994, Larsen *et al.* 1996
D2	VEC Water/land border zone	1993	Hansson *et al.* 1994, Larsen *et al.* 1996
E1	VEC Protected areas	1997	This paper + Thomassen *et al.* 1998
F1	VEC Indigenous people	1997	This paper + Dallmann 1997, Thomassen *et al.* 1998
G1	VEC Domestic reindeer	1998	This paper + Thomassen *et al.* 1998
G2	VEC Wild reindeer	1998	This paper + Thomassen *et al.* 1998

2. VEC Protected areas

Jørn Thomassen, Norwegian institute for nature research (NINA)
Vladimir Khlebovich, Zoological Institute, Russian Academy of Sciences

The protection of areas have been one important tool to take care of habitats and biotopes assessed to be of special value. Different classification system have been used throughout the world, but common for these systems is to gain better habitat management and conservation. Important, however, regardless classification system, is that an assessment and evaluation has been carried through for the particular habitat. Of several potential habitats, only some have been selected as important or valuable enough to get the status of protected. A scoping process has already been done. The value of a protected area as a VEC is composed of different attributes like its intrinsic value and the sum of all other selected VECs found within the protected area (Hansson *et al.* 1990).

In the NSR area, several protected areas exist, and it was decided in autumn 1997 to include protected areas as a VEC in the INSROP-EIA.

2.1 Protected areas along the NSR

The World Conservation Union (IUCN) has developed an international classification system for protected areas (CAFF 1994, 1996). Protected areas along NSR have, according to this system, been classified into four categories.

I. Strict Nature Reserve/Scientific Reserves
II. Managed Nature Reserve/Wildlife Sanctuary
III. Resource Reserve
IV. Anthropological Reserve/Natural Biotic Area

We find it adequate to use this classification in INSROP. A map of the protected areas in the northern part of Russia is shown in Figure 2.1. According to the Russian experts in INSROP EIA, however, the classification and number of protected areas differ slightly from the IUCN classification (Table 2.1).

Table 2.1. Protected areas along NSR according to IUCN classification (CAFF 1994, 1996) and Russian classification (review by V.V.Khlebovich).

IUCN category (as of 1996)	**Corresponding Russian category** (review by V.V.Khlebovich)
I. Strict Nature Reserve/Scientific Reserve *To protect nature and maintain natural processes in an undisturbed state in order to have ecologically representative examples of the natural environment available for scientific study, environmental monitoring, education, and for the maintenance of genetic resources in a dynamic and evolutionary state.* 1. Taymyrskiy NR 2. Putoranskiy NR 3. Lena Delta NR 4. Wrangel Island NR 5. Gydanskiy NR 6. Great Arctic NR 7. (Nenetskiy NR) The former Nenets sanctuary has recently changed status into National Reserve. The area is situated outside but near	**Strict natural reserves** *Maintenance requirements imposed on the territories prohibit any economic activities* 1. Cluster of islands in the Barents Sea being part of the territory of Kandalaksha state reserve, particularly Aynovye islands, Gavrilovskiye islands and Sem island. Within each of these clusters the reserve territory includes the whole interisland area as well as the area between the islands and the continent, plus 0.5 nautical mile along the sea perimeter. 2. Nenetskiy Reserve, a newly formed reserve which includes coastal areas close to where NSR activity probably will occur. 3. Bolshoy Arkticheskiy Zapovednik (Great Arctic Reserve), particular the coastal areas and clusters of islands in the Kara Sea between the river mouths of Taymyra and Yenisey. Note that the NSR in this area is close to land and

by the NSR area and should be considered important also in the NSR context.	water reserves and that the islands often are utilised by vessels for natural protection during ice shifts and when waiting for ice breaker towage across Vilkitskiy Strait, one of the most complicated NSR sections. Intricate shape of the territories and water areas of this reserve are illustrated on the map. 4. Taymyrskiy Zapovednik (Taymyr Reserve), a newly formed reserve which includes coastal areas at Eastern Taymyr close to where NSR activity will occur. 5. Ust-Lenskiy reserve in the Laptev Sea, covering vast spaces of the Lena delta (with a nearshore area in the west) including the New Siberian islands and the adjacent water line as a «protected zone». The inclusion of the area between the western part of the Lena delta and the Khatanga Bay into the reserve zone is under planning. The reserve is in close vicinity to the port of Tiksi. 6. Wrangel island reserve in the Chukchi Sea, which also includes a small eastward lying Herald island. The protected area represents a 12 nautical mile zone stretching around the islands.
IV. Managed Nature Reserve/Wildlife Sanctuary *To assure the natural conditions necessary to protect nationally significant species, group of species, biotic communities, or physical features of the environment where these may require specific human manipulation for their perturbation. Controlled harvesting of some resources can be permitted.* 1. **Lower Ob-river Sanctuary** 2. **Chaygurgino Sanctuary** 3. **Purinskiy Sanctuary** 4. **Vaygach Sanctuary** 5. **Yamal Sanctuary** 6. **Messo-Yakhinskiy Sanctuary** 7. **Ust'-Yanskiy Sanctuary** 8. **Franz Josef Land managed NR** 9. **Severo-Zemelskiy Federal Sanctuary**	**Special purpose reserves** *Certain types of activities are restricted at specified periods of time* 1. Franz Joseph Land. Data about protected areas around Franz Joseph Land are contradictory. According to oral information from Federal services no special protected zone has been identified, but existing maps demonstrates very wide protected aquatic areas around the archipelago.
VI. Resource Reserve *To protect the natural resources of the area for future use and prevent or contain development activities that could affect the resource pending the establishment of objectives which are based upon appropriate knowledge and planning. This is a «holding» category used until a permanent classification can be determined.* 1. **New-Siberian islands Resource Reserve**	
VII. Anthropological Reserve/ Natural Biotic Area *To allow the way of life of societies living in harmony with the environment to continue undisturbed by modern technology. This category is appropriate where resource extraction by indigenous people is conducted in a traditional manner.* 1. **Beringiya Ethno-Nature Park**	**National ethnic parks** *Protection and conservation of specific ethnic features of indigenous people* The Beringiya national ethnic park, currently a project without a specified legal status, incorporates large areas of Chukotka, accounting besides others for sea-oriented conventional economic activity of the Chukchi and Yupik; certain regulation in the utilisation of sea reserves and navigation conditions is to be expected.

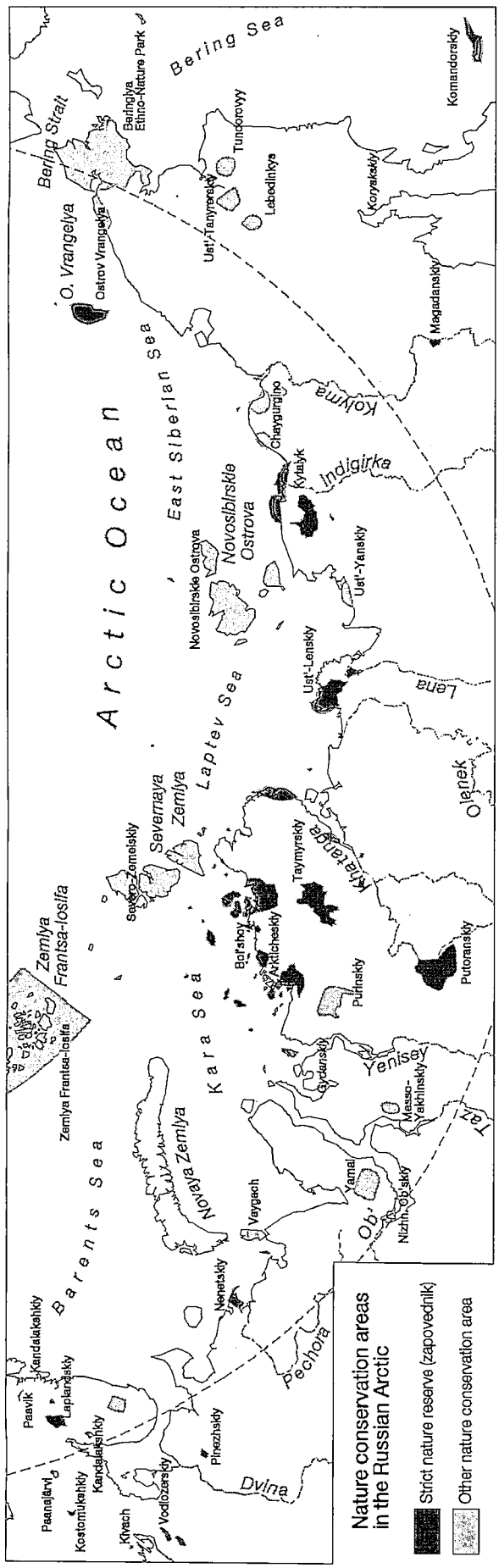

Figure 2.1. Protected areas in the northern part of Russia (compiled by W. Dallmann). Notice that the exact borders of «Koryakskiy» and «Gydanskiy» lack, and the locations are indicated roughly.

2.2 Russian legislation and management

According to Ivanov *et al.* (1998) several Russian laws come into force concerning the protected areas of NSR, particularly important is the *Federal law on specially protected territories* which was approved on 15. February 1995. Also areas adjacent to officially protected areas may acquire status of protected territories with controlled economic activities.

Dependent on their status, protected areas are managed and controlled on a local, regional or federally level. All data concerning protected areas are stored in official territorial cadastres. It is important to notice that national reserves and parks shall be managed in such a way that the natural ecosystems are protected from damage.

2.3 Environmental impacts

Protected areas have been classified in different categories according to different properties of the areas. The main cause of protection vary, extending from traditional habitat conservation and protection of single species to conservation of biological diversity and scientific purpose. Also, the vulnerability of protected areas can vary throughout the year; the breeding season is for instance in general more vulnerable than the winter season. Consequently, the potential environmental impacts from an extended use of NSR will also vary according to the characteristics of each single protected area and season (see also Figure 2.1). Most important, however, is the scenarios for an extended use of NSR, and the sort of impact factors following this. This is treated in detail in Thomassen *et al.* (1998), and will not be discussed any further here.

The cause of protection and the respective regulations of each protected area will be the frame for assessing environmental impacts from NSR. On a coarse level the main impact factors are pollution, noise, waste, physical disturbance and change of development patterns. In addition to ecological and environmental impacts in protected areas, an extended use of NSR also can come in conflict with Russian legislation and management of protected areas.

It is however, several fundamental dilemmas regarding protected areas, pointed out by the reviewer of this report, which we feel important cite here: (1) protected areas cannot protect against intentially or accidentally damaging activities which occur outside their boundaries; (2) infrastructural development and related habitat disturbance in some areas (e.g. Northwest Siberia) are going on all over the place, both within and outside protected areas, and the impacts to date have already been substantial in many areas; (3) regarding (2), it is clear that the past and present regulatory systems have been almost totally ineffective; (4) regarding (3), it is not clear how the recommended research will solve the indicated problems. A case in point is Impact Hypothesis E1-8: «*Increased industrial development, with construction of pipelines and transportation systems will disturb selected VECs in the terrestrial, aquatic or marine environment by making barriers and disturbance*». It is not stated, but I assume because of the context, that this refers to both protected and unprotected areas. The fact is that much of this disturbance has already taken place and is ongoing and it is clear that the hypothesis is valid. Additional rationale is that investigations are necessary to map the extent of damage. The recommendation research calls for area-, season and species dependent investigations to map the potential impacts. Without a fundamental restructuring of the entire regulatory system, it is not apparent that any policy-relevant recommendations to arise from such research would ever be implemented or enforced.

2.4 Schematic flow chart for protected areas

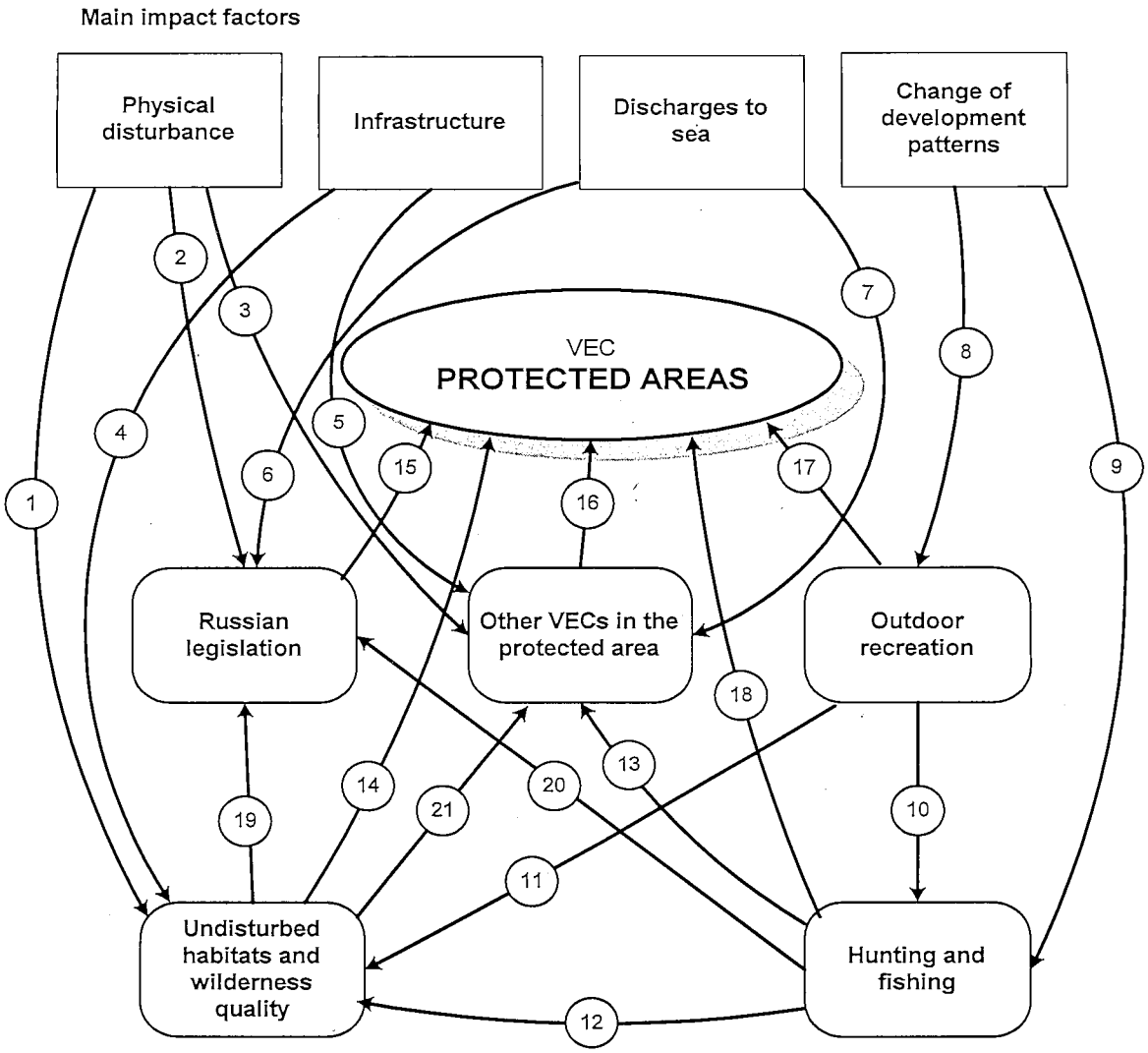

Figure 2.1. Schematic flow chart for VEC Protected areas.

Linkages (self explanatory linkages are not described)

1 Physical disturbance from operational ship traffic can disturb undisturbed habitats and the wilderness quality in protected areas.
2 Physical disturbance from operational ship traffic can come in conflict with Russian legislation of protected areas.
3 Physical disturbance from operational ship traffic can disturb other VECs in protected areas.
4 Infrastructure development (petroleum/mining) as a consequence of NSR can lead to disturbance of undisturbed habitats and the wilderness quality in protected areas.
5 Infrastructure development (petroleum/mining) as a consequence of NSR can lead to disturbance of other VECs in protected areas.
6 Accidental discharges to sea can come in severely conflict with Russian legislation of protected areas.
7 Accidental discharges to sea can have dramatic effects on other VECs in protected areas, especially in vulnerable seasons.
8 An increased use of NSR can lead to increased tourism and consequently increased outdoor recreation in protected areas.
9 An increased use of NSR can lead to increased tourism and consequently increased commercial hunting and fishing in protected areas.

10 Self explanatory.
11 Self explanatory.
12 Self explanatory.
13 Increased hunting and fishing in protected areas can affect other VECs in protected areas.
14 Disturbance of habitats and reduced wilderness quality can reduce the value of protected areas.
15 NSR activities which come in conflict with Russian legislation and aim of protection will be illegal and be a threat to protected areas.
16 Self explanatory.
17 Self explanatory.
18 Self explanatory.
19 Disturbance of valuable habitats and reduction of wilderness quality in protected areas will come in conflict with Russian legislation.
20 Increased hunting and fishing in protected areas can come in conflict with Russian legislation.
21 Disturbance of valuable habitats and reduction of wilderness quality in protected areas will directly have an negative impact on other VECs in the area.

2.5 Impact hypotheses for protected areas

VEC: PROTECTED AREAS	IH no.: E1-1
Impact hypothesis: Normal NSR operational traffic adjacent to protected areas will come in conflict with Russian legislation, regulations and aim of protection of protected areas.	
Explanation: Many of the protected areas also include adjacent marine environment, especially around islands and in straits, and can be disturbed by ship traffic.	
Category: C	
Rationale: It is necessary to investigate to what extent the disturbance will have on the values in focus in the protected areas in different seasons, and how this will come in conflict with the legislation and regulations of the areas.	
Recommended research: Investigations to what extent the disturbance will have on the values in focus in the protected areas in different seasons, and how this will come in conflict with the legislation and regulations of the areas. Investigations must be area specific.	
Recommended monitoring and/or surveys: Recommendations will be dependent on the results from the investigations above.	
Recommended management actions: Recommendations will be dependent on the results from the investigations above.	
Recommended mitigating measures: Recommendations will be dependent on the results from the investigations above.	
Literature cited: Ivanov *et al.* 1998	

VEC: PROTECTED AREAS	IH no.: E1-2
Impact hypothesis: Accidents in the vicinity to protected areas will come in conflict with Russian legislation, regulations and aim of protection of protected areas.	
Explanation: Many of the protected areas also include adjacent marine environment, especially around islands and in straits, and can be severely disturbed by ship accidents.	
Category: C	
Rationale: It is necessary to investigate to what extent the potential impacts from accidents will have on the values in focus in the protected areas in different seasons, and how this will come in conflict with the legislation and regulations of the areas.	
Recommended research: Investigations to what extent the accidents will have on the values in focus in the protected areas in different seasons, and how this will come in conflict with the legislation and regulations of the areas. Investigations must be area specific.	
Recommended monitoring and/or surveys: Recommendations will be dependent on the results from the investigations above.	
Recommended management actions: Recommendations will be dependent on the results from the investigations above.	
Recommended mitigating measures: Recommendations will be dependent on the results from the investigations above.	
Literature cited: Ivanov *et al.* 1998	

VEC: PROTECTED AREAS	IH no.: E1-3
Impact hypothesis: Normal NSR operational traffic adjacent to protected areas will disturb the wilderness quality of the areas significantly.	
Explanation: Undisturbed habitats and wilderness quality are part of natural processes in an undisturbed state of the protected areas, especially in IUCN category I protected areas, and can be disturbed by ship traffic.	
Category: B	
Rationale: Wilderness quality is a state of undisturbed nature and any disturbance of that state will reduce the quality. Investigations to validate the hypothesis should not be necessary.	
Recommended research: Investigations to determine the extent of disturbance and the reduction of wilderness quality of the areas, especially marine habitats directly affected by the sailing activity.	
Recommended monitoring and/or surveys: Recommendations will be dependent on the results from the investigations above.	
Recommended management actions: Recommendations will be dependent on the results from the investigations above.	
Recommended mitigating measures: Recommendations will be dependent on the results from the investigations above.	
Literature cited:	

VEC: PROTECTED AREAS	IH no.: E1-4
Impact hypothesis: Accidents in the vicinity to protected areas can lead to extensive discharges of cargo, fuel an ballast water, which will reduce the wilderness quality of the areas extensively.	
Explanation: Undisturbed habitats and wilderness quality are part of natural processes in an undisturbed state of the protected areas, especially concerning IUCN category I protected areas. Ship accidents can lead to serious impacts on the environment, in particular in vulnerable seasons (Rice *et al.* 1996).	
Category: B	
Rationale: Experience from other ship accidents confirm this statement.	
Recommended research: No investigations necessary to validate the hypothesis. Research to map consequences is highly recommended in case of an accident.	
Recommended monitoring and/or surveys: Recommendations will be dependent on the results from the investigations above.	
Recommended management actions: Contingency plans and training programmes must be established.	
Recommended mitigating measures: Contingency plans must be established.	
Literature cited: Rice *et al.* (1996)	

VEC: PROTECTED AREAS	IH no.: E1-5
Impact hypothesis: Normal NSR operational traffic adjacent to protected areas will disturb selected VECs, especially marine mammals.	
Explanation: Valued ecosystem components are often valuable elements in protected areas and special attention must be given to theses species. NSR sailing, especially close to islands and in straits, can consequently disturb key elements in protected areas. In this connection, special attention must be made to marine mammals in vulnerable seasons.	
Category: C	
Rationale: It is necessary to investigate to what extent the disturbance from NSR will have on the VECs in focus in the protected areas in different seasons.	
Recommended research: Investigations to what extent the disturbance will have on the VECs in focus in the protected areas in different seasons. Investigations must be area specific.	
Recommended monitoring and/or surveys: Recommendations will be dependent on the results from the investigations above.	
Recommended management actions: Recommendations will be dependent on the results from the investigations above.	
Recommended mitigating measures: Recommendations will be dependent on the results from the investigations above.	
Literature cited:	

VEC: PROTECTED AREAS	IH no.: E1-6
Impact hypothesis: Accidents in the vicinity to protected areas can lead to extensive discharges of cargo, fuel an ballast water, which will cause extensive damage to populations of VECs in vulnerable seasons.	
Explanation: Experience from other ship accidents in the Arctic environment show serious impacts on the environment, especially on selected VECs in vulnerable seasons (Rice *et al.* 1996).	
Category: B	
Rationale: Experience from other ship accidents confirm this statement.	
Recommended research: No further research is recommended to validate this hypothesis. Research to map consequences is highly recommended in case of an accident.	
Recommended monitoring and/or surveys: Recommendations will be dependent on the results from the investigations above.	
Recommended management actions: Contingency plans and training programmes must be established.	
Recommended mitigating measures: Contingency plans must be established.	
Literature cited: Rice *et al.* (1996)	

VEC: PROTECTED AREAS	IH no.: E1-7
Impact hypothesis: Clean-up operations following an ship accident will lead to physical disturbance and noise, which will cause serious disturbance to selected VECs in vulnerable seasons.	
Explanation: Clean-up operations normally involve a lot of people and extensive use of motor vehicles (ship, helicopter, plane) which clearly will disturb VECs.	
Category: C	
Rationale: It is necessary to make area and season specific investigations concerning the magnitude of damage in the NSR area to validate this hypothesis. In general, however, this hypothesis is valid.	
Recommended research: Research to validate the hypothesis and to determine the extent of damage from the disturbance sources is necessary.	
Recommended monitoring and/or surveys: Recommendations will be dependent on the results from the investigations above.	
Recommended management actions: Recommendations will be dependent on the results from the investigations above.	
Recommended mitigating measures: Recommendations will be dependent on the results from the investigations above.	
Literature cited:	

VEC: PROTECTED AREAS	IH no.: E1-8
Impact hypothesis: Increased industrial development, with constructions of pipelines and transportation systems will disturb selected VECs in the terrestrial, aquatic and marine environment by making barriers and disturbance.	
Explanation: Investigations from other industrial developments show that barriers (pipelines, roads, transmission lines) and disturbance can have serious impacts on selected animals. The extent of impacts are area-, season and species dependent (see for example Gildart 1997).	
Category: C	
Rationale: In general, the hypothesis is valid, but investigations are necessary to map the extent of damage.	
Recommended research: Area-, season and species dependent investigations to map the potential impacts.	
Recommended monitoring and/or surveys: Recommendations will be dependent on the results from the investigations above.	
Recommended management actions: Recommendations will be dependent on the results from the investigations above.	
Recommended mitigating measures: Recommendations will be dependent on the results from the investigations above.	
Literature cited: Gildart (1997)	

VEC: PROTECTED AREAS	IH no.: E1-9
Impact hypothesis: Pipeline accidents will destroy terrestrial, aquatic and marine habitats severely and reduce the environmental quality of protected areas.	
Explanation: Self explanatory	
Category: B	
Rationale: Other accidents confirm that the hypothesis is valid. Investigations must be made to map the potential magnitude.	
Recommended research: Area-, season and species dependent investigations to map the potential impacts.	
Recommended monitoring and/or surveys: Recommendations will be dependent on the results from the investigations above.	
Recommended management actions: Recommendations will be dependent on the results from the investigations above.	
Recommended mitigating measures: Recommendations will be dependent on the results from the investigations above.	
Literature cited:	

VEC: PROTECTED AREAS	IH no.: E1-10
Impact hypothesis: Increased use of NSR will lead to increased population, tourism, hunting and fishing in protected areas, which will be a threat to selected VECs in special and to biological diversity in general.	
Explanation: The NSR area is an exclusive goal for the tourism industry, and exclusivity in tourism is an increasing phenomenon. Together with increased population and better infrastructure this will lead to an increased use of protected areas as recreation-, fishing- and hunting grounds, and consequently an increased threat to species and habitats.	
Category: C	
Rationale: The hypothesis is probably valid, but area specific investigations to map the potential magnitude is necessary.	
Recommended research: Area specific investigations to map the potential impact magnitude.	
Recommended monitoring and/or surveys: Recommendations will be dependent on the results from the investigations above.	
Recommended management actions: Recommendations will be dependent on the results from the investigations above.	
Recommended mitigating measures: Recommendations will be dependent on the results from the investigations above.	
Literature cited:	

3. VEC Indigenous people

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3.1 Indigenous peoples as a VEC

Indigenous People of the Russian Arctic are presently treated as a Valued Ecosystem Component (VEC) in the Environmental Impact Assessment (EIA) for an extended use of the Northern Sea Route (NSR).

The vast majority of hitherto defined VECs are animal species and ecosystems. Direct effects on the human population are only addressed through the VEC «Human settlement». While this is an important issue, it does not take into account the special effects on - as well as social and cultural consequences for - the indigenous population of the tundra and taiga areas adjacent to the NSR.

Indigenous cultures are subject to a special vulnerability because of their close dependence on the natural environment, which forms the basis of their cultural identity. As to the Russian population, severe impacts on the resource base of the North will devaluate local societies, but not endanger the Russian culture. In contrast, they may easily endanger - or in the worst case wipe out - small indigenous cultures, when their members are forced to emigrate and/or assimilate into the main society.

It is today generally accepted by the industrialised nations that indigenous cultures are valuable parts of the human society. International agendas and organisations realise their vulnerability and point out the importance of specially protecting them (e.g. ILO Convention 169 [1989], UN Universal Declaration of Rights of Indigenous Peoples [draft 1994], Agenda 21 [Earth Summit, Rio Declaration 1992], Arctic Council statutes [1996]). This is why indigenous people and their subsistence-related needs in the Russian North are important factors that must be considered in special when evaluating the environment of the Russian Arctic.

3.2 Indigenous people and the Arctic environment

This chapter is mainly from Dallmann (1997). Indigenous cultures are based on the awareness of an unconditional balance in nature. Every action or event affects this balance, and causes a response - a meanwhile well-known fact that our modern societies did not fully accept prior to the break-through of the environmental movement only about two decades ago. While the «modern» understanding of this is based on *experience*, *experimental practices* and *ecological knowledge*, the indigenous approach was through *experience*, *shamanistic practices* and *animistic beliefs*. The latter resulted in the belief in spirits within all elements of the natural world that would punish all offences against traditional laws that for centuries had proven to be sustainable. For the indigenous peoples, reciprocity with nature has thus always been a major obligation, leading automatically to preventative actions to avoid disasters, while the ecological approach of the modern society suffers from loss of time while awaiting scientific proof before acting.

Indigenous peoples therefore have very strong ties to their natural environment, and strong aversions against unsustainable exploitation and devastation of lands, water and other resources. Their demand to maintain reciprocity with nature is a combination of spiritual and subsistence-related needs, and their cultural identity is thus directly dependent on intact ecosystems within their residence and subsistence areas. This may explain the enormous difficulties many indigenous peoples have into adopting «modern ways of life», and the social disaster that resulted from the attempt by various modern states to settle nomads, reverse social structures, reorganise subsistence into commercial economies, etc. These new structures are

basically not accepted as sustainable ways of life by the indigenous societies, although centuries of assimilation policies have resulted in the willingness to use modern facilities and to adapt certain social and economic ways from the main society.

Indigenous peoples do not necessarily reject development, although their views on this issue are admittedly varying a lot. They know in general that they need to adapt to the fact that they are part of the global society and find their place in it. They need medical care, modern education, and certain material standards. Still, land and water resource issues - aiming at preserving nature for traditional use - are found among the top priorities of all indigenous organisations around the circumpolar world. Indigenous societies today have in common the fundamental fear of an environmental disaster. For many of them, it has already happened.

3.3 Geographical distribution

The geographical distribution of the ethnic populations and their subsistence areas is described in Dallmann (1997; INSROP Working Paper No. 90), together with the political, historical and ethnographic background. 19 (17) ethnic groups occupy residence and subsistence areas close to the Arctic coast of the Russian Federation (Eastern Saami, Nenets, Enets, Nganasans, Khants, Dolgans, Evenks, Evens, Yukagirs, Chuvans, Chukchi, Siberian Yupik, Aleuts, Koryaks [with Kereks and Alutors], Itelmens/Kamchadals, as well as the northern subgroups of the Yakuts and Komi).

For the 30 (earlier officially recognised: 26) indigenous minorities of the Russian North, the average portion of the total population of the North is 1.5%. Their portion of the rural population, especially in sparsely populated areas, is much higher, and reaches 100% in large areas. Some of these peoples are severely threatened by extinction, due to their extremely low population number. Others experience continuously decreasing living space and resources due to pollution and changing land use. Still, the major part of the tundra and taiga areas are considered as indigenous subsistence areas, while areas occupied or polluted by industry, military installations or extensive alien settlement are excluded (see also Dallmann in Brude et al., 1998, p. 54).

3.4 Subsistence

In the map area, main carried-on traditional trade branches are reindeer breeding, fishery in freshwater and estuaries, trapping, hunting of game and sea mammals, gathering, fur-farming (initiated through colonial Russian tax collection), traditional arts and crafts. Within many indigenous groups, distinctly different subsistence cultures developed dependent on the natural conditions. Most of the groups live across two or several vegetation zones and have developed a twofold culture; either a tundra and a taiga culture, or a coastal and an inland culture. During the Soviet Era, indigenous subsistence was transformed into economic branches, with negative long-term results. Most indigenous societies are now on their way back to traditional, subsistence-related land use, partly forced by the continuous socio-economic crises affecting the entire Russian Federation.

Reindeer breeding in both tundra and taiga is the most characteristic and distinguished occupation of the northern minorities among those still having economical significance. It is by them not only considered as an economic branch, but as a way of life closely connected with their ethnic identity. The trade is very sensible to environmental changes and depends on vast, free migration areas, the availability of summer and winter pastures and suitable calving sites. Modern environmental and social changes create a severe threat towards reindeer breeding and all its related cultures. Most of the northern areas from Kola to Kamchatka - except for the polar desert areas of Taymyr and some high alpine areas - is pasture land,

unless it is now used for industry, mining or oil production, infrastructure, military purposes, urban settlements, or is devastated or polluted.

Hunting of game, predators and birds is a traditional land use that has lost much of its importance in many areas due to the depletion of wildlife. It still forms an important subsidiary occupation. The most important hunting area is the Taymyr Peninsula, where the increasing wild reindeer population offers a basis for subsistence.

Sea mammal hunting and to a lesser degree *marine fishing*, is the main occupation along the coast of the Bering Strait and the Pacific Ocean. Coastal cultures are dependent on areas with significant sea mammal resources, like walrus, whale and various seals. They have developed within ethnic groups, whose territories reach to the Far Eastern shores. The Siberian north coast from the Kolyma mouth to the eastern Barents Sea does not provide a subsistence basis for distinct coastal cultures, although some hunting has locally been done.

Inland and estuarine fishing is a major subsistence branch throughout the Russian North. Salmon and various freshwater fish occur in large amounts. The main catches are made in estuaries and lower parts of rivers. The branch competes on uneven terms with commercial offshore salmon fishing.

Trapping of fur animals locally has a tradition for procurement of clothing. Since colonisation, it has been modified into a tax-procurement and trade branch. The wild fur animal population has declined severely. Trapping is still important locally. In many places, fur farms have taken over.

Gathering (berries, herbs, roots, mushrooms) is one of the oldest subsistence branches in the world, which has still a fundamental - now increasing - importance in the North. It has in general not been economised, and is still yielding important supplementary provisions for individual families.

Other primary economic branches (stock farming, horse breeding, vegetable gardening, fur farming) have taken over in areas, where traditional Northern indigenous occupations are given up, or where they have been introduced by the state for commercial reasons.

Modern trade branches (e.g. forestry, mining, industry, service, teaching, science, modern arts) have gained importance for the urban population.

3.5 Environmental impacts

Since the colonisation of the North, parts of these areas have gradually been converted into areas for alien settlement, transportation routes, industry, forestry, mining and oil production, as well as devastated through pollution, irresponsibly-managed oil and mineral prospecting, and military activity. These impact processes are going on, and the NSR - if extensively realised - is one of them. The NSR can, consequently, not be regarded as an isolated factor. Several effects on the indigenous peoples will also be implied from other development projects indirectly or not related to the NSR.

Environmental impacts on indigenous subsistence can be subdivided into three main groups. Items (a) and (b) are direct impacts by the NSR, while (c) summarises indirect impacts. The latter are considered to have the most important consequences for the indigenous environment.

(a) Pollution through operational traffic, shipwreck and other possible accidents
(b) Change of wildlife population, distribution and migration pattern due to traffic
(c) Various impacts through development or extension of infrastructure and industry

Already existing environmental impact sources are sorted by a number of factors (below). Most of them will change the degree or sort of impact (mostly to the worse) during the development expected in the wake of the NSR (see also Figure 3.1)

(1) Oil and gas development
(2) Radioactive pollution
(3) Pollution from river traffic, industry and mining
(4) Redisposal of land for industrial or construction purposes
(5) Transportation lines (boat traffic through ice, oil pipelines)
(6) Shipwreck
(7) Military activity
(8) Commercialisation of hunting, trapping and fishing (competition for subsistence)
(9) Tourism
(10) Environmental laws (mostly positive, though locally negative influence)

Documentation of these impact factors and references are provided by Dallmann (1997), arranged both according to ethnic groups and to administrative units. Impact hypotheses are summarised in Chapter 3.7.

The possibly most hazardous and acute of the ongoing development projects is the oil and gas development in Western Siberia and North-western Russia. There is some hope that modern environmental understanding combined with international participation and western investment in production and transportation technology as well as modern environmental conduct may avoid a similarly immense damage like that experienced during the Soviet development of the Middle Ob and Yamal areas.

3.6 Basic needs

It seems the most important milestones towards control of development and further environmental devaluation are

(1) a new or extended legislation with considerable respect to indigenous land use,

(2) an effective law enforcement and implementation of environmental regulations.

Another important approach is to try to convince both Russian and foreign commercial players on the Arctic scene that concern to indigenous resources and needs is an important issue. Most important of all, the indigenous societies need to be part of the process of creating the framework for the development, and their premises need to be viewed and treated on an equal basis.

If such a framework is not implemented, exercises such as those outlined below in the 'Recommended Research' and 'Recommended Monitoring' components of the Impact Hypotheses will be largely in vain. In some places, such as Northwest Siberia, state companies comprise the *de facto* local, regional and federal authorities all in one. It seems like they often see no need for environmental regulations, and the situation is therefore unsustainable. If these companies become a partner in the NSR, they must be held accountable for any damages they cause, according to a legal framework to be established and implemented.

3.7 Schematic flow chart for indigenous people

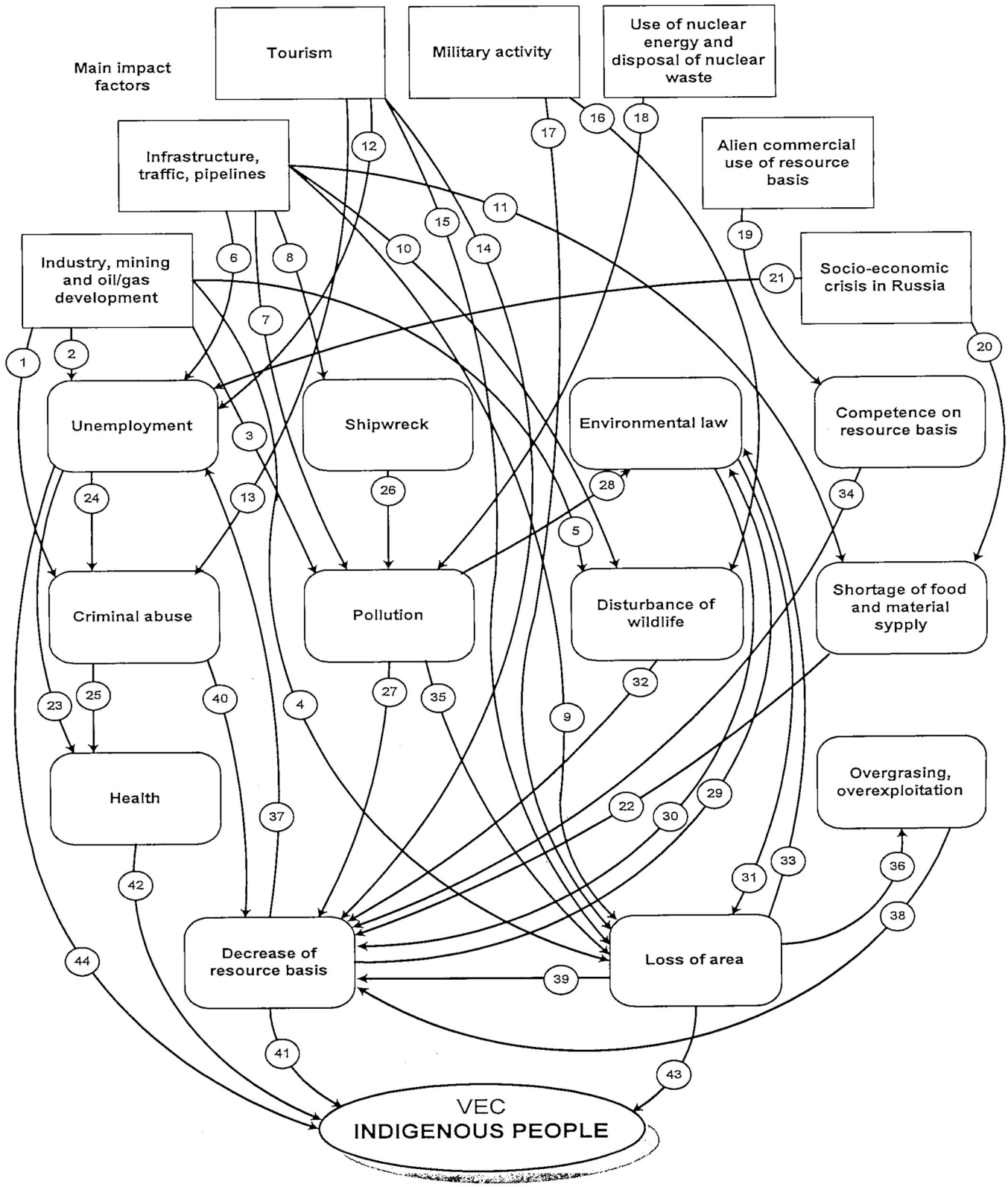

Figure 3.1. Schematic flow chart for VEC Indigenous People.

Linkages

1. Industry, mining and oil/gas development attract many foreign workers, many of whom commit criminal acts (e.g. reindeer theft, pillage, rape) against indigenous people
2. Industry, mining and oil/gas development may create jobs for local people, though indigenous people normally draw benefit of this only to a very minor extent
3. Industry, mining and oil/gas development leads to pollution of pasture lands, hunting and fishing grounds as well as spawning areas
4. Industry, mining and oil/gas development occupies or physically destroys areas used by indigenous people
5. Industry, mining and oil/gas development disturbs wildlife and causes game to migrate to other areas
6. Infrastructure development and pipeline construction may create jobs for local people, though indigenous people normally draw benefit of this only to a very minor extent
7. Infrastructure development, pipeline construction and traffic lead to pollution of pasture lands, hunting and fishing grounds as well as spawning areas
8. Ship traffic may lead to shipwreck and other accidents in offshore and coastal areas
9. Infrastructure development and pipeline construction occupies or physically destroys areas used by indigenous people
10. Infrastructure development, pipeline construction and traffic disturbs wildlife and causes game to migrate to other areas
11. Infrastructure development may counteract shortage of food and material supply
12. Tourism may counteract unemployment if the indigenous people are involved in the business
13. Development of tourism may lead and has led to criminal abuse from entrepreneurs against indigenous people who object against selling their resources to tourists
14. Tourism (hunting, fishing) leads to a decrease of natural resources left for the indigenous people
15. Development of tourism may lead to loss of areas for indigenous subsistence
16. Military activity disturbs wildlife and causes game to migrate to other areas
17. Military activity may lead to loss of areas for indigenous subsistence
18. Nuclear tests, nuclear explosives and leakage from nuclear reactors, waste disposals and nuclear power stations has polluted and is polluting large areas
19. Alien (Russian and international) trawlers are subtracting parts of the marine (incl. salmon) resource basis from indigenous people
20. The socio-economic crisis in Russia has led to shortage of supplies (food, equipment, fuel) from industrial and urban areas
21. The socio-economic crisis in Russia has led to unemployment and lack of salary payment, especially in rural and eastern areas of the Russian Federation
22. Shortage of supplies (equipment, fuel) from industrial and urban areas diminishes the available resource basis of indigenous people
23. Large unemployment leads to closure of health services and health problems among the population
24. Unemployment and lack of salary payment amplifies criminal abuses against the resource basis (reindeer theft and others)
25. Health problems, especially mental ones, often arise from criminal abuse
26. Shipwreck leads to pollution of the marine and coastal environment and their resources
27. Pollution of land and water leads to a decrease of the biological resources (fish, game, domestic reindeer)
28. The threat of pollution may lead to legal acts resulting in laws that are supposed to protect the environment
29. Decrease of the resource basis may lead to legal acts resulting in laws that are supposed to protect the environment
30. Environmental laws are supposed to protect the environment and its resource basis and may also negatively affect indigenous people's resource needs (e.g. prohibit hunting)
31. Protected areas or species may (though not necessarily) close areas for indigenous resource exploitation
32. Disturbance of wildlife and migration to other areas leads to a decrease in the local resource basis
33. A decrease in the total of intact environment leads to efforts in protecting the remaining intact areas
34. Resources used by alien exploiters (e.g. trawlers) are not available for the indigenous population
35. Polluted areas are temporarily or continuously lost for indigenous subsistence
36. Loss of pasture lands may lead to overgrazing on the remaining pastures; similar for other resources
37. A decrease of the resource basis leads to unemployment in traditional subsistence branches
38. Overgrazing of pastures and overexploitation of game or fish diminishes the total available resource basis
39. Loss of area for indigenous subsistence leads automatically to a depletion of the resource basis
40. Criminal abuse (e.g. reindeer theft) leads to a depletion of the resource basis
41. A decrease of the resource basis counteracts traditional subsistence and threatens the cultural survival of indigenous peoples
42. Health problems physically affect the potential of survival of indigenous peoples
43. Loss of area for subsistence counteracts traditional subsistence and threatens the cultural survival of indigenous peoples
44. Unemployment leads to emigration and thus threatens the cultural survival of indigenous peoples

3.8 Impact hypotheses for indigenous people

Impact hypotheses for indigenous peoples are sorted according to the general subdivision applied in the EIA for the Northern Sea Route:

a) Impact hypotheses for ship traffic (F1-1 through F1-6)

b) Impact hypotheses for harbour facilities

Indigenous populations in harbour towns and industrial centres are very sparsely distributed, and those individuals living there normally have adopted to an urban way of life. Operations and other activities in already existing harbours will therefore have no significant, additional direct impacts on indigenous cultures. They have, however, social impacts on the society of the North in general, and consequently also on the indigenous population living outside the urban areas. This issue is treated in section d).

The construction of new harbours and of supply facilities (e.g. quarries, power stations) outside the urban areas, may certainly have significant impacts. These impacts are not different from those of other development that is independent of proper harbour facilities. They are treated in section c) (infrastructure).

If the structure of the planned EIA does not make this connection clear, many of the impact factors outlined in section c) should be copied into here.

c) Impact hypotheses for infrastructure development (F1-7 through F1-12)

d) Impact hypotheses for social impacts with retroactive impacts on natural resources (F1-13 through F1-18)

The individual impact factors and hypotheses will probably have to be treated in a different way than those of sections a) to c), but are still important to add to the EIA at another level. They also create a connection to issues treated by INSROP subprogram IV.

VEC: INDIGENOUS PEOPLE	IH no.: F1-1
Impact hypothesis: Boat traffic on frozen rivers disturbs migration of wild reindeer (and other wildlife) and affects the effectiveness of hunting as a major subsidence	
Explanation: This has been documented for the lower Yenisey river and its estuary by Anderson (1995a). It is especially problematic today, where the shortage of fuel and transportation facilities does not allow the hunters to search for the animals. Expected to be valid to a minor extent throughout the Siberian North.	
Category: B	
Rationale: Hunting of wild reindeer is a major subsistence of the indigenous people of the Taymyr area, and of other indigenous peoples to a somewhat minor extent.	
Recommended research:	
Recommended monitoring and/or surveys: Monitoring of migration routes of game across river mouths and estuaries, where ship traffic during the winter is planned	
Recommended management actions: Regulate ship traffic during the winter in a way that migration routes of game are unaffected	
Recommended mitigating measures: Avoid ship traffic in river mouths and estuaries during the ice-covered period	
Literature cited: Anderson (1995a)	

VEC: INDIGENOUS PEOPLE	IH no.: F1-2
Impact hypothesis: Boat traffic on frozen rivers disturbs migration of domestic reindeer and affects the ecological basis of reindeer breeding	
Explanation: A problem which probably arises where trafficked rivers cross migration routes of the annual breeding cycle.	
Category: C	
Rationale: Reindeer breeding is the most important subsistence of most indigenous groups of the Russian North, and disturbed migration routes could prevent the animals to reach calving grounds in time, etc.	
Recommended research:	
Recommended monitoring and/or surveys: Monitoring of migrations routes of domestic reindeer in areas, where they cross rivers or estuaries wit planned ship traffic. Data probably exist, but are not summarised with respect to this purpose	
Recommended management actions: Regulate ship traffic during the winter in a way that migration routes of domestic reindeer are unaffected	
Recommended mitigating measures: Avoid ship traffic in river mouths and estuaries during the ice-covered period	
Literature cited:	

VEC: Indigenous people	IH no.: F1-3
Impact hypothesis: Intensive traffic in coastal waters may cause emigration of marine mammals (walrus, seals) (Belikov et al. 1998c).	
Explanation: Valid for the Bering Strait and Chukchi Sea, and outside the NSR along the Pacific coast of Chukotka and Kamchatka. Walrus gathering places in the Bering Strait have changed in recent years, but it is not proven that this caused by ship traffic (Zimen 1994).	
Category: C	
Rationale: Sea mammals are a major food source for the indigenous people of the Bering Strait and Chukotka.	
Recommended research: Find out if changing haul outs and feeding grounds of walrus and seals in fact are caused by ship traffic	
Recommended monitoring and/or surveys: Survey of change of haul outs and feeding grounds of walruses and seals	
Recommended management actions: Regulate ship traffic in the Chukchi Sea and Bering Strait in a way that avoids haul out and feeding areas of walruses and seals	
Recommended mitigating measures: Avoid ship traffic near haul outs and feeding grounds of walruses and seals	
Literature cited: Belikov et al. (1998c) Zimen (1994)	

VEC: INDIGENOUS PEOPLE	IH no.: F1-4
Impact hypothesis: Pollution from ships affects the habitat of sea mammals and other marine resources causing relocalisation of feeding, breeding, and/or resting areas or decrease of populations, leading to loss of resources for indigenous subsistence.	
Explanation: Valid for the Bering Strait and Chukchi Sea, and outside the NSR along the Pacific coast of Chukotka and Kamchatka, where this may lead to loss of food resources for indigenous subsistence.	
Category: C	
Rationale: Sea mammals are a major food source for the indigenous people of the Bering Strait and Chukotka.	
Recommended research: Documentation from the respective other VECs (walruses, seals) is needed.	
Recommended monitoring and/or surveys: Survey of change of haul outs and feeding grounds of walruses and seals	
Recommended management actions: Regulate ship traffic in the Chukchi Sea and Bering Strait in a way that avoids haul out and feeding areas of walruses and seals	
Recommended mitigating measures: Avoid ship traffic near haul outs and feeding grounds of walruses and seals	
Literature cited:	

VEC: INDIGENOUS PEOPLE	IH no.: F1-5
Impact hypothesis: Accidental pollution from shipwreck affects the habitat of sea mammals and other marine resources causing relocalisation of feeding, breeding, and/or resting areas or decrease of populations, leading to loss of resources for indigenous subsistence.	
Explanation: Extensively documented from the Exxon Valdez accident in Alaska (1989).	
Category: B	
Rationale: Sea mammals are a major food source for the indigenous people of the Bering Strait and Chukotka.	
Recommended research:	
Recommended monitoring and/or surveys:	
Recommended management actions: Secure strict safety regulations and their implementation	
Recommended mitigating measures: Build up a good emergency response	
Literature cited: Extensive documentation of damage and social consequences for indigenous societies (from the Exxon Valdez Disaster) is available on Internet web site: http://www.oilspill.state.ak.us/exxon.html	

VEC: INDIGENOUS PEOPLE	IH no.: F1-6
Impact hypothesis: Littering of beaches (waste from shipping) may lead to depletion of coastal gathering grounds	
Explanation: Intensive littering of Arctic beaches is described from many places, e.g. in the Sakha Republic (Boyakova et al. 1996).	
Category: C	
Rationale: Beaches are in many areas gathering grounds for indigenous people, and feeding grounds of sea birds (geese) that in return are a food resource for the people.	
Recommended research:	
Recommended monitoring and/or surveys: Monitor the environmental effect of littered beaches on gathering grounds for indigenous people.	
Recommended management actions: Strengthen regulations and their implementation about release of litter from ships	
Recommended mitigating measures: Avoid to release litter into the sea	
Literature cited: Boyakova et al. (1996)	

VEC: INDIGENOUS PEOPLE	IH no.: F1-7
Impact hypothesis: The NSR will favour hydrocarbon development, industry development and mining in northern areas, leading to land devastation and loss of hunting, fishing and breeding grounds.	
Explanation: Experience from oil and gas development in the lower Ob area since the 1960s. Suffering of the indigenous population is extensively described by several articles and essays of Ajpin, e.g. summarised by GfbV (1996).	
Category: B	
Rationale: Hunting and fishing grounds as well as pasture lands are the resource bases of Arctic indigenous peoples' subsistence. They form the basis of their welfare and of their cultural identity. Extensive loss of these areas is presently leading to the cultural extinction of many indigenous groups.	
Recommended research:	
Recommended monitoring and/or surveys: Monitoring of still intact and usable hunting and fishing grounds as well as pasture lands in order to take administrative measures to preserve them	
Recommended management actions: Forward regulations to protect still intact and usable hunting and fishing grounds as well as pasture lands from negative impacts through industrial and infrastructure development	
Recommended mitigating measures: Avoid industrial and infrastructure development in still intact and usable hunting and fishing grounds as well as pasture lands	
Literature cited: GfbV (1996)	

VEC: INDIGENOUS PEOPLE	IH no.: F1-8
Impact hypothesis: Oil/gas pipelines connecting hydrocarbon fields with northern harbours may lead to area segmentation as a hinder for wildlife migration and a general decrease of wildlife resources.	
Explanation: Experience from the Alaska Pipeline. Extensive documentation in the literature, e.g. Gildart (1997).	
Category: B	
Rationale: Hunting grounds and pasture lands are the resource bases of Arctic indigenous peoples' subsistence. They form the basis of their welfare and of their cultural identity. Extensive loss of these areas is presently leading to the cultural extinction of many indigenous groups.	
Recommended research:	
Recommended monitoring and/or surveys: Monitoring of still intact and usable hunting grounds and pasture lands in order to take administrative measures to preserve them	
Recommended management actions: Forward regulations to protect intact and usable hunting grounds, pasture lands and wildlife migration routes from pipeline construction	
Recommended mitigating measures: Avoid pipeline construction through intact and usable hunting grounds, pasture lands and wildlife migration routes	
Literature cited: Gildart (1997)	

VEC: INDIGENOUS PEOPLE	IH no.: F1-9
Impact hypothesis: The NSR will favour hydrocarbon development, industry development and mining in northern areas, leading to toxic spills that may destroy spawning areas and fishing grounds.	
Explanation: Experience from oil and gas development in the lower Ob area since the 1960s. Suffering of the indigenous population is extensively described by several articles and essays of Ajpin, e.g. summarised in GfbV (1996).	
Category: B	
Rationale: Fishing grounds and spawning areas are important resource bases of Arctic indigenous peoples' subsistence. They form the basis of their welfare and of their cultural identity. Extensive loss of such areas is presently leading to the cultural extinction of many indigenous groups.	
Recommended research:	
Recommended monitoring and/or surveys: Monitoring of still intact and usable fishing grounds and spawning areas in order to take administrative measures to preserve them	
Recommended management actions: Forward regulations to protect intact and fishing grounds and spawning areas from industrial and infrastructure development	
Recommended mitigating measures: Avoid toxic spills during all sorts of industrial and infrastructure development	
Literature cited: GfbV (1996)	

VEC: INDIGENOUS PEOPLE	IH no.: F1-10
Impact hypothesis: Pipelines connecting oil fields with northern harbours may have accidental leakage and spills causing local degradation or destruction of subsistence areas.	
Explanation: Recent example from Uzinsk (Komi Republic), 1994	
Category: B	
Rationale: Hunting grounds and pasture lands are the resource bases of Arctic indigenous peoples' subsistence. They form the basis of their welfare and of their cultural identity. Extensive loss of these areas is presently leading to the cultural extinction of many indigenous groups.	
Recommended research:	
Recommended monitoring and/or surveys: Monitoring of still intact and usable hunting grounds and pasture lands in order to take administrative measures to preserve them	
Recommended management actions: Forward regulations on safe pipeline constructions	
Recommended mitigating measures: Avoid pipeline construction through intact and usable hunting grounds, pasture lands and wildlife migration routes; if pipelines are still build, use modern technology and make any effort to maintain them in order to avoid leakage	
Literature cited:	

VEC: INDIGENOUS PEOPLE	IH no.: F1-11

Impact hypothesis:
The NSR will favour industry development leading to SO_2 and other air pollution which will degrade or destroy subsistence areas.

Explanation:
Degradation of pastures and wildlife by SO_2 emission from industrial areas in Russia is extensively documented by AMAP (1998). See also Anderson (1995a) for effects on reindeer breeding in the Norilsk area.

Category: B

Rationale:
Hunting and fishing grounds as well as pasture lands are the resource bases of Arctic indigenous peoples' subsistence. They form the basis of their welfare and of their cultural identity. Extensive loss of these areas is presently leading to the cultural extinction of many indigenous groups.

Recommended research:

Recommended monitoring and/or surveys:
Monitoring of still intact and usable hunting and fishing grounds as well as pasture lands in order to take administrative measures to preserve them

Recommended management actions:
Forward regulations to protect still intact and usable hunting and fishing grounds as well as pasture lands from negative impacts through industrial and infrastructure development;
Regulate SO_2 and other toxic emission in industrial areas and find implementation methods.

Recommended mitigating measures:
Avoid industrial and infrastructure development in and close to intact and usable hunting and fishing grounds as well as pasture lands; if still done, avoid SO_2 and other toxic emission as far as possible.

Literature cited:
AMAP (1998)
Anderson (1995a)

VEC: INDIGENOUS PEOPLE	IH no.: F1-12
Impact hypothesis: With an increased infrastructure, commercial fishing and hunting tourism may take subsistence areas from indigenous population.	
Explanation: Examples are known from the Kola Peninsula (documented by TV documentaries)	
Category: B	
Rationale: Fishing is an important resource bases of Arctic indigenous peoples' subsistence. It forms a basis of their welfare and of their cultural identity. Extensive loss of such areas is presently leading to the cultural extinction of many indigenous groups.	
Recommended research:	
Recommended monitoring and/or surveys: Monitoring of indigenous fishing areas in order to take administrative measures to preserve them for this purpose	
Recommended management actions: Forward regulations to protect indigenous fishing grounds from alien commercial exploitation and find measures to implement them	
Recommended mitigating measures: Secure by law indigenous fishing rights in their traditional areas and give them compensation for fishing grounds that might still be lost	
Literature cited:	

VEC: INDIGENOUS PEOPLE	IH no.: F1-13
Impact hypothesis: Increased infrastructure, through consequent alien settlement and industrialisation, will forward cultural decay among indigenous people.	
Explanation: Experience made during earlier development in the Siberian North and other indigenous areas, summarised by Dallmann (1997), where literature references are provided.	
Category: B	
Rationale: Indigenous cultures are subject to a special vulnerability because of their close dependence on the natural environment, which forms the basis of their cultural identity.	
Recommended research: Research into community-based strategies in order to find ways of cultural survival of indigenous societies in co-existence with industrial societies	
Recommended monitoring and/or surveys:	
Recommended management actions: Negative experiences from the past are a challenge for legislature and law enforcement in order to avoid negative impacts from similar processes in the future. Involve the indigenous communities in decision-making.	
Recommended mitigating measures: Keep infrastructure and industrial development at a minimum and turn as much as possible of its benefits into the support of the indigenous communities.	
Literature cited: Dallmann (1997)	

VEC: INDIGENOUS PEOPLE	IH no.: F1-14
Impact hypothesis: Increased infrastructure, alien settlement and industrialisation will lead to an increase of criminal acts against the indigenous population, and partly against their resource base and their means to use the resources (e.g. reindeer theft, robbery, threat).	
Explanation: Experience made during earlier development in the Siberian North and other indigenous areas, summarised by Dallmann (1997), where literature references are provided.	
Category: B	
Rationale: Indigenous cultures are subject to a special vulnerability because of their close dependence on the natural environment, which forms the basis of their cultural identity.	
Recommended research: Research into community-based strategies in order to find ways of cultural survival of indigenous societies in co-existence with industrial societies	
Recommended monitoring and/or surveys:	
Recommended management actions: Negative experiences from the past are a challenge for legislature and law enforcement in order to avoid negative impacts from similar processes in the future. Involve the indigenous communities in decision-making.	
Recommended mitigating measures: Keep infrastructure and industrial development at a minimum and turn as much as possible of its benefits into the support of the indigenous communities.	
Literature cited: Dallmann (1997)	

VEC: INDIGENOUS PEOPLE	IH no.: F1-15
Impact hypothesis: With increased accessibility and transport facilities, commercial fisheries and hunters may utterly take the resource basis for indigenous subsidence.	
Explanation: Experience made during earlier development in the Siberian North and other indigenous areas, summarised by Dallmann (1997), where literature references are provided.	
Category: B	
Rationale: Indigenous cultures are subject to a special vulnerability because of their close dependence on the natural environment, which forms the basis of their cultural identity.	
Recommended research: Research into community-based strategies in order to find ways of cultural survival of indigenous societies in co-existence with industrial societies	
Recommended monitoring and/or surveys:	
Recommended management actions: Negative experiences from the past are a challenge for legislature and law enforcement in order to avoid negative impacts from similar processes in the future. Involve the indigenous communities in decision-making.	
Recommended mitigating measures: Keep infrastructure and industrial development at a minimum and turn as much as possible of its benefits into the support of the indigenous communities.	
Literature cited: Dallmann (1997)	

VEC: INDIGENOUS PEOPLE	IH no.: F1-16a
Impact hypothesis: With an increased infrastructure, increased protection interests may lead to the closure of certain areas for indigenous subsidence.	
Explanation: Experience made during earlier development in the Siberian North and other indigenous areas, summarised by Dallmann (1997), where literature references are provided. The option of 4a. and 4b. depends on the law regulation of the protected areas.	
Category: B	
Rationale: Indigenous cultures are subject to a special vulnerability because of their close dependence on the natural environment, which forms the basis of their cultural identity.	
Recommended research: Research into community-based strategies in order to find ways of cultural survival of indigenous societies in co-existence with industrial societies	
Recommended monitoring and/or surveys:	
Recommended management actions: Negative experiences from the past are a challenge for legislature and law enforcement in order to avoid negative impacts from similar processes in the future. Involve the indigenous communities in decision-making.	
Recommended mitigating measures: Keep infrastructure and industrial development at a minimum and turn as much as possible of its benefits into the support of the indigenous communities.	
Literature cited: Dallmann (1997)	

VEC: INDIGENOUS PEOPLE	IH no.: F1-16b
Impact hypothesis: With an increased infrastructure, increased protection interests may lead to an increased protection of indigenous resources from alien devastation.	
Explanation: Experience made during earlier development in the Siberian North and other indigenous areas, summarised by Dallmann (1997), where literature references are provided. The option of 4a. and 4b. depends on the law regulation of the protected areas.	
Category: B	
Rationale: Indigenous cultures are subject to a special vulnerability because of their close dependence on the natural environment, which forms the basis of their cultural identity.	
Recommended research: Research into community-based strategies in order to find ways of cultural survival of indigenous societies in co-existence with industrial societies	
Recommended monitoring and/or surveys:	
Recommended management actions: Involve the indigenous communities in decision-making to secure that area protection serves their interests.	
Recommended mitigating measures:	
Literature cited: Dallmann (1997)	

VEC: INDIGENOUS PEOPLE	IH no.: F1-17
Impact hypothesis: A possible economic rehabilitation of the northern areas supported by an increased infrastructure may create a marked for indigenous products and thus help to raise indigenous peoples' economic situation.	
Explanation:	
Category: C	
Rationale:	
Recommended research: Market research for indigenous arts and crafts	
Recommended monitoring and/or surveys:	
Recommended management actions: Protect indigenous arts and crafts by law (good example: USA) and assist with market campaigns	
Recommended mitigating measures:	
Literature cited:	

VEC: INDIGENOUS PEOPLE	IH no.: F1-18
Impact hypothesis: Tourism may induce a renovation of traditional indigenous arts and crafts and thus increase the economic base for indigenous subsistence.	
Explanation:	
Category: C	
Rationale:	
Recommended research: Market research for indigenous arts and crafts	
Recommended monitoring and/or surveys:	
Recommended management actions: Protect indigenous arts and crafts by law (good example: USA) and assist with market campaigns	
Recommended mitigating measures:	
Literature cited:	

4. VEC Domestic reindeer and VEC Wild reindeer

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Concerning schematic flow chart (see Figure 4.1) and impact hypotheses for domestic and wild reindeer, we find it appropriate to treat the VECs together (chapter 4.3 and 4.4). Their ecology and the potential impacts on the animals from NSR will be almost identical. The consequences for indigenous people, however, are totally different and are treated within the section dealing with the VEC Indigenous people.

4.1 VEC Domestic reindeer

4.1.1 Distribution

The distribution of domestic reindeer in the Russian north is not even. The majority of the domestic reindeer population (60-70%) is concentrated in the tundra and semi-forest zones of north-western regions of the Russian North (European North and Western Siberia), and in the tundra zone of Chukotskiy Autonomous Okrug (Belikov *et al.* 1998a). According to Syroechkovskii (1995) about 2.2 million of domestic reindeers were bred in Russia in the beginning of 1980s. The total population has decrease significantly the last 15 years and was in 1996 about 1.7 million (Dallmann 1997, Belikov *et al.* 1998a).

4.1.2 Habitat and food

Six periods are distinguished in the grazing cycle of domestic reindeers - winter, early spring, late spring, summer, early autumn, late autumn (Belikov *et al.* 1998a). Wintering grounds are situated in inland areas usually in semi-forest zone. In spring herds migrate north following the development of the vegetation. The northern parts of the grazing areas including the shoreline of the Arctic Sea are used only in a short summer period from July to September. In this part of the year seaboard pastures are of high value because bloodsucking insects are not so numerous as they are in inland areas. However islands in the NSR area are not pastures for domestic reindeers. After the summer period of grazing reindeer herds are moved to inland pastures providing more food and not so exposed to strong winds and blizzards.

4.1.3 Life cycle

Most mating occurs in October. Young are born in late May and early June. There is usually only one offspring. The young is able to follow its mother after one hour of life. The nursing period is about one month or sometimes into summer. Sexual maturity is attained after 1.5 – 2.5 year. Average longevity is about 4.5 years.

4.1.4 Evaluation

Ecology. The distribution of domestic reindeer in the extreme north of Russia is not even. The large herds have major impact on the ecology in high density areas. They are important as grazers on the vegetation and as food for carnivores and man. Domestic reindeer is regarded as moderately important for the ecology in the area as a whole.

Economy. Reindeer breeding can be regarded as the fundamental, substance-related occupation of most indigenous people of the part of northern Russia related to NSR activity.

Other human affairs. Same as above.

Environmental effects of NSR. Modern environmental and social changes create a severe threat to reindeer breeding and the related cultures.

Data availability. Data on distribution, population size and trends of domestic reindeer in Russia are relatively easy available. The quality of the data is however uncertain.

4.2 VEC Wild reindeer

4.2.1 Distribution

The distribution of wild reindeer in Russia has changed considerably during the last 150 years. Its southern boundary has advanced to the north in many areas, primarily due to anthropogenic factors. In particular this relates to an increased population of domestic reindeer in Yamal and Chokotka (Nazarov and Shubnikova 1994). Syroyechkovski (1986) estimated the total number of wild reindeer in Russia to be 900,000. About 800.000 of these are found in Arctic region (Belikov *et al.* 1998a). Most of the wild reindeer are found in the Taymyr peninsula.

4.2.2 Habitat and food

The optimum habitat for wild reindeer (e.g. Taymyr Peninsula) is subarctic areas with shaply continental climate. This area is dominated by medium and low plains and gently sloping hills with tundra vegetation (Nazarov and Shubnikova 1994). Wild reindeer are also found on the Arctic islands (Belikov *et al.* 1998a). In some instanses these animals migrate between the mainland and the islands.

4.2.3 Life cycle

Most mating occurs in October. Young are born in late May and early June. There is usually only one offspring. The young is able to follow its mother after one hour of life. The nursing period is about one month or sometimes into summer. Sexual maturity is attained after 1.5 – 2.5 year. Average longevity is about 4.5 years.

4.2.4 Evaluation

Ecology. The distribution of wild reindeer in Russia has changed considerably during the last 150 years. Its southern boundary has advanced to the north in many areas, primarily due to anthropogenic factors. In particular this relates to an increased population of domestic reindeer in Yamal and Chokotka. In some areas, especially Taymyr, the wild reindeer has a major impact on the ecology of the area. As a whole its importance for the ecology of the NSR affected area is classified as medium.

Economy. Reindeer hunting forms an important subsidiary occupation in the Russian north, especially in central and eastern areas related to NSR. The most important hunting area is the Taymyr Peninsula

Other human affairs. Same as above.

Environmental effects of NSR. NSR activity will probably increase the anthropogenic impact on the terrestrial ecosystem especially in the vicinity of ports, along roads and gas and oil-lines. Damage of reindeer grass land, disturbance of migration routs and illegal hunt will increase. The impact is classified as medium.

Data availability. Data on distribution, population size and trends of wild reindeer in Russia are available. The quality of the data is however uncertain.

4.3 Schematic flow chart for domestic and wild reindeer

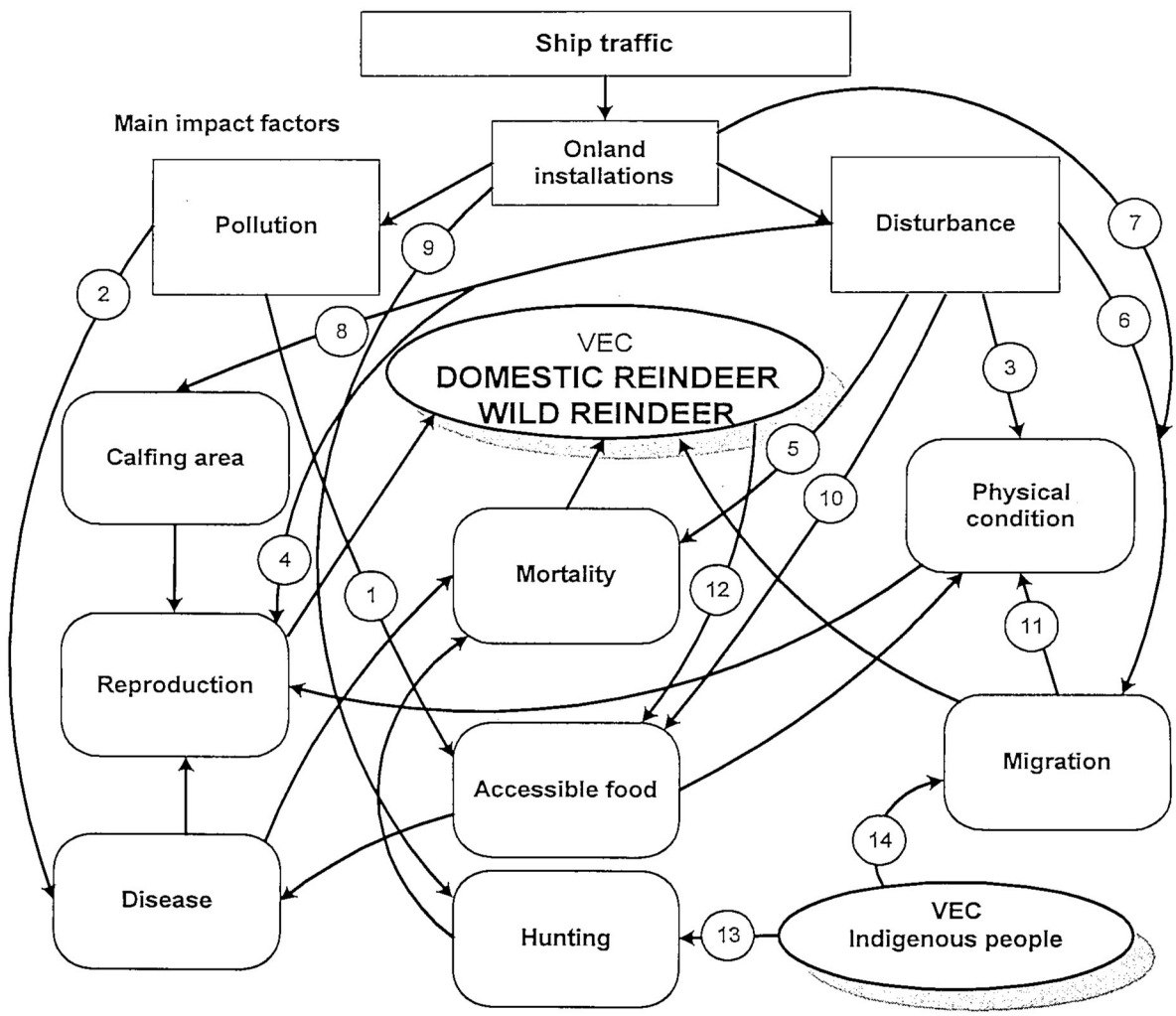

Figure 4.1. Schematic flow chart for VEC Domestic reindeer and VEC Wild reindeer.
Linkages (self explanatory linkages are not described)

1. Pollution can affect the quality of grazing ranges
2. Direct uptake of toxic pollutants can cause diseases.
3. Disturbance will cause an increase in flight induced energy expenditures and accordingly impaired condition.

4. Disturbance can cause reduced reproduction because of abortions and resorptions.
5. Disturbance can directly cause increased mortality.
6. Disturbance results in migration.
7. Installations like pipeline corridors, roads, etc., can affect the migration pattern of reindeer.
8. Disturbance in calving habitats during the calving period can cause reduced calf survival, and in the long term, reduced use of the area.
9. Onland installations can lead to more human traffic with increased hunting and poaching.
10. Disturbance from traffic will influence the productivity of grazing rang by wear, erosion etc.
11. Migration requires energy and will impair the physical condition.
12. The grazing pressure will affect available vegetation.
13. Indigenous people hunt wild reindeer.
14. Indigenous people have effect on the migration of domestic reindeer.

4.4 Impact hypotheses for domestic and wild reindeer

Four different hypotheses concerning potential impacts of NSR activities on reindeer were evaluated (actually 8 hypotheses, 4 on domestic reindeer and 4 equal on wild reindeer). The validity of two hypotheses (G1-3/G2-3 and G1-4/G2-4) has been documented through previous research. Two hypotheses (G1-1/G2-1 and G1-2/G2-2) were considered to be valid but deserving of continued research for verification and monitoring. The impact hypotheses have been listed in classified priorities (A - C).

A.

G1-2/G2-2
Physical encroachment and installations will obstruct the movements of reindeer, may hinder their access to grazing and calving areas and increase their energy needs so that local populations may decrease.

Operational activities like ice breaking in rivers and straits and active installations will occupy areas and may accordingly reduce the access to grazing ranges and habitats and force animals to leave important areas. They can also function as physical or psychological obstacles to migrations between seasonal habitats, e.g. calving areas, and accordingly affect reproduction and survival.

According to Klein and Kuzyakin (1994) the western heard of wild reindeer has been affected by northern industrial development. Above ground gas-pipeline from Messoyakha gas field to Norilsk made in 1969 effected the migration of 75.000 of the heard of 300.000. The pipeline was later elevated in some areas to allow reindeer pass under. This was effective for 25% of the population. A new line was constructed and fences set up to guide deers away from the line. Today the animals are herded away from Norilsk by fences and have therefore shifted grazing area..

Movement of wild reindeer has been affected by icebreaking in Yenesey river in autumn to prolong shipping to Dudinka. This has caused an increased mortality for reindeer migrating to winter ranges west of Yenesei (Klein and Kuzyakin 1994). Historically wild reindeer migrated between the mainland and the Novosibisrski Islands in summer. In the 1920's the island population was 25.000-30.000 animals. Ice free summers in 1924 and 1930 made many animals to winter at the islands and most of them died. The population decreased to some hundreds and the migration to the mainland stopped. Today the population is about 5.000 and there is still no migration to the mainland (Klein and Kuzyakin 1994). Although this was not an anthropogenic disturbance, it shows how disturbance of migratory routs might have large impact on the population.

Anderson (1995b) concluded that open sea lanes maintained by ice-breakers have formed a new barrier for the migration of wild reindeer at Taymyr. The resulting chaotic migratory behaviour has threatened the source of staple foods for natives living through the Lower Yenisey Valley and can be blamed for destroying the local economy of reindeer herding of the Dolgan and Ngo. Further, Dallmann (1997) concluded that oil and gas, ass well as associated infrastructure development are the most severe environmental threats towards reindeer breeding culture.

According to Syroechkovskii (1995) warning signals of population reduction of wild reindeer in Komi have appeared. This reduction is probably due to intense felling of lichen-bearing pine forests.

G1-4/G2-4
Pollution from ship traffic and industrial activity will be accumulated in grazing vegetation and will affect the health condition of local reindeer populations.

Emissions into air of pollutants will gradually be assimilated into the vegetation and be found in concentrations in the internal organs of reindeer feeding on these plants. High concentrations can cause illness and reduce fertility of reindeer and reindeer consumers. Sulfides, fluorides, heavy metals, stable chlorides, PCBs are relevant substances in addition to radioactivity. The effects is known and substantiated on various animal species exposed to high levels of pollution. This was especially through for radioactivity after the Chernobyl accident (AMAP 1998).

Dallmann (1997) concluded that radioactive pollution of pastures and subsequent health problems of the reindeer and human populations have been documented in several areas in northern Russia.

C.

G1-3/G2-3
Increased ship traffic and industrial activity will lead to increased illegal hunting and decreased reindeer populations.

Poaching and uncontrolled hunting of domestic as well as wild reindeer is known to take place in northern Russia. Increased industrial activity will bring more people to places where poaching is easy and tempting. According to Syroechkovskii (1995) the wild reindeer at Kola increased after 1968 while the domestic reindeer decreased. At that time the total population was about 20.000. The hunting of wild reindeer increased. Helicopters were used in hunting and the poaching increased. In 1984 the total population had decreased to 2.000 animals.

In western Siberia the wild reindeer population hardly not exceed 20.000 by the early 1980's. Later it has decreased due to hunting from vehicles and helicopters (Syroechkovskii 1995). Organised hunting of wild reindeer in Taymyr was in the period from 1971 to 1981 500.000 animals. In addition were 200.000 killed by poaching. Surprisingly the rate of increase of the population increased from 14.4% in 1975 to 23.8% in 1981. At Severnaya Zemlya there were only about 100 wild reindeer in 1984. Poaching has greatly diminished the population. According to Belikov *et al.*(1998a) poaching has become one of the strongest negative factors affecting many reindeer populations in northern Russia.

D.

GG1-1/G2-1
Disturbances and traffic will cause increased energy expenditure and reduced grazing time of reindeer, and accordingly reduced survival and calf production in the affected local populations.

Traffic affects population distribution and accordingly vegetation availability. This is decisive to physical condition and mortality. Disturbances occurring in late winter might cause a sharp increase in energy expenditure during period of negative energy balance. This will increase the danger of adult mortality and of females throwing their calves/aborting.

Dallmann (1997) concluded that loss of pasture to other land use like, industry, infrastructure, mining etc. are major threats. Then reindeer pasture shrink, leading to overgrazing of the remaining area like in Yamal Peninsula. In Alaska and Arctic Canada a number of studies have been made on the impact of disturbances and motorised traffic on caribou (see Hansson *et al.* 1990). The result varied in different studies. It seems that season, races and environmental conditions will determine the relative significance of the reaction. Investigations have shown that reindeer often run away from noisy traffic. It seems, however, that thy habituate easier to traffic in the areas that they stay for longer time than in migration areas. Reindeer that have not become habituated to traffic generally avoid areas of disturbance but can gradually become habituated to it and ignore it. Reindeer that are unhabituated to traffic/nice can react with flight/panic when disturbed, sometimes far from the source of disturbance. Cronin *et al.* (1998) showed that the Central Arctic caribou herd, which spends June and July in and around oil fields in the Prudhoe Bay region, has increased since the inception of oil field development.

Recommended research, monitoring and/or surveys. The following studies can be implemented in connection with developments potentially resulting in the impacts described above. The studies are not listed after priority. The three first suggested studies only involve literature studies and interviews so that the costs involved are low. The fourth study is expensive but is very important especially in relation to reindeer breeders.

I. (To be implemented in connection with G1-1/G2-1).
Survey population size of selected local reindeer populations
Objectives: Find the present size of populations that might be affected by increased ship traffic and industrial development.
Methods: Aerial and ground surveys.

II. (To be implemented in connection with G1-1/G2-1).
Document effects of disturbance from traffic and industrial activity on local reindeer population in Russia.
Objective: Find whether traffic and industrial activity have had effect on the behaviour and distribution of reindeer populations in Russia in the past.
Method: Literature surveys and interviews with local game authorities and reindeer breeders.

III. (To be implemented in connection with all G1-2/G2-2)
Document effects of physical encroachment and installations on the movement of reindeer populations in Russia.
Objective: Find whether activities like ice-braking on rivers and in straits and industrial activity have had effect on the movement patterns of local reindeer populations in Russia in the past. Also document effect of natural variation in ice condition on rivers and in straits.
Method: Literature surveys and interviews with local game authorities and reindeer breeders.

IV. (To be implemented in connection with G1-3/G2-3).
Document effect of hunting on local reindeer populations in Russia
Objective: Find the effect of legal and illegal hunting on local reindeer populations in Russia in the past.
Method: Literature surveys and interviews with local game authorities and reindeer breeders.

V. (To be implemented in connection with G1-4/G2-4).
Document present level of pollutants in reindeer in northern Russia.
Objective: Find the present level of pollutants in local reindeer populations so that the effects of increased industrial activity and accidents can be measured.
Methods: Tissues from representative samples of selected local reindeer populations must be analysed for a set of selected substances included heavy metals, organochlorines and radioactivity.

VEC: DOMESTIC & WILD REINDEER	IH no.: G1-1/G2-1
Impact hypothesis: Disturbances and traffic will cause increased energy expenditure and reduced grazing time, and accordingly reduced survival and calf production in the affected local reindeer populations.	
Explanation: Traffic affects population distribution and accordingly vegetation availability. This is decisive to physical condition and mortality. Disturbances occurring in late winter cause a sharp increase in energy expenditure during period of negative energy balance. This will increase the danger of adult mortality and of females throwing their calves/aborting (Hansson *et al.* 1990).	
Category: C	
Rationale: Investigations have shown that reindeer often run away from noisy traffic. It seems, however, that thy habituate easier to traffic in the areas that they stay for longer time than in migration areas. Reindeer that have not become habituated to traffic generally avoid areas of disturbance but can gradually become habituated to it and ignore it. Reindeer that are unhabituated to traffic/nice can react with flight/panic when disturbed, sometimes far from the source of disturbance.	
Recommended research: Data on such disturbance from northern Russia should be gathered and evaluated.	
Recommended monitoring and/or surveys: Distribution and numbers are surveyed in areas relevant for development/activity. The surveys should be differentiated according to physical condition, sex and age.	
Recommended management actions: Traffic and other human activities should be located in distance from reindeer migration areas and winter grazing ranges.	
Recommended mitigating measures:	
Literature cited: Hansson *et al.* (1990)	

VEC: DOMESTIC & WILD REINDEER	IH no.: G1-2/2-2
Impact hypothesis: Physical encroachment and installations will obstruct the movements of reindeer, may hinder their access to grazing and calving areas so that local populations may decrease.	
Explanation: Operational activities like ice breaking in rivers and straits and active installations will occupy areas and may accordingly reduce the access to grazing ranges and habitats and force animals to affect areas. They can also function as physical or psychological obstacles to migrations between seasonal habitats, e.g. calving areas, and accordingly affect reproduction and survival (Hansson *et al.* 1990).	
Category: C	
Rationale: The loss of grazing ranges is a likely outcome of physical encroachments, but the loss will generally be minimal and the effect will be problematic to test. Installations and open rivers and straits in winter are likely to become physical or mental migration barriers if unfavourably located. Such exclusions from important migration and grazing(calving areas can be negative for the population.	
Recommended research: Data on such disturbance from northern Russia should be gathered and evaluated.	
Recommended monitoring and/or surveys: Seasonal habitats and migratory patterns in relevant development areas should be surveyed. The surveys must be differentiated with respect to sex, age and variation in physical condition etc.	
Recommended management actions: Reindeer habitat and migration areas must be considered when decisions are made concerning location of ship routs and installations on land.	
Recommended mitigating measures:	
Literature cited: Hansson *et al.* (1990).	

VEC: DOMESTIC & WILD REINDEER	IH no.: G1-3/G2-3
Impact hypothesis: Increased ship traffic and industrial activity will lead to increased illegal hunting and decreased local reindeer populations.	
Explanation: Poaching and uncontrolled hunting of domestic as well as wild reindeer is known to take place in northern Russia (Dallmann 1997).	
Category: B	
Rationale: Increased industrial activity will bring more people to places where poaching is easy ant tempting.	
Recommended research: Compile hunting statistics an populations development in local populations.	
Recommended monitoring and/or surveys: Control with the local hunt must be set up by local game authorities.	
Recommended management actions: Control with the local populations must be set up by local game authorities.	
Recommended mitigating measures:	
Literature cited: Dallmann (1997)	

VEC: DOMESTIC & WILD REINDEER	IH no.: G1-4/G2-4
Impact hypothesis: Pollution from ship traffic and industrial activity will be accumulated in grazing vegetation and will affect the health condition of local reindeer populations.	
Explanation: Emissions into air of pollutants will gradually be assimilated into the vegetation and be found in concentrations in the internal organs of reindeer feeding on these plants. High concentrations can cause illness and reduce fertility of reindeer and reindeer consumers. Sulphides, fluorides, heavy metals, stable chlorides, PCBs are relevant substances in addition to radioactivity (AMAP 1998).	
Category: B	
Rationale: The effects is known and substantiated on various animal species exposed to high levels of pollution. This is especially through for radioactivity after the Chernobyl accident (AMAP 1998).	
Recommended research: Present pollution level in reindeer should be documented.	
Recommended monitoring and/or surveys: A standard procedure should be established for the sampling and analyses of tissue, vital organs etc. from reindeer in the NSR area.	
Recommended management actions: Regulations concerning emissions and safety related to use of nuclear power and taking care of waste.	
Recommended mitigating measures: Special procedures must be planned in case of nuclear accidents from ships or power plants.	
Literature cited: AMAP (1998).	

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Appendix 1: Review of the Discussion Paper

REVIEW OF INSROP DISCUSSION PAPER
"EVALUATION OF INSROP VALUED ECOSYSTEM COMPONENTS: PROTECTED AREAS, INDIGENOUS PEOPLES, DOMESTIC REINDEER AND WILD REINDEER"
BY THOMASSEN ET AL.

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For me, this was an interesting and informative review of the use of Valued Ecosystem Components (VECs) as part of the 'Adaptive Environmental Assessment and Management' concept in INSROP. This report documented four types of VECs: protected areas, indigenous people, domestic and wild reindeer. Most of my questions about the purpose and potential utility of such a program were answered during the course of the report. The strengths of the report are its clarity and ease of use. A lot of information is made available at a glance. The main, rather minor, weakness is that some important points are unclear or simply buried in the text and should be clarified and/or emphasized

The first section deals with protected areas. There are some fundamental problems here, but these are not really the failings of the authors. As a biogeographer, I have to admit my skepticism of the protected areas concept. It is well known that biotic and abiotic ecosystem components pay no attention to artificial boundaries, political or otherwise, in either terrestrial, aquatic or marine ecosystems. People are often the same way. Virtually all of the Impact Hypotheses stress this fact by noting that if impact type X occurs »adjacent to» or »in the vicinity of» a protected area, it will come into conflict with Russian legislation, regulations and the aims of protected areas.

This are thus several fundamental dilemmas here: (1) protected areas cannot protect against intentially or accidentally damaging activities which occur outside their boundaries; (2) infrastructural development and related habitat disturbance in some areas (e.g. Northwest Siberia) are going on all over the place, both within and outside protected areas, and the impacts to date have already been substantial in many areas; (3) regarding (2), it is clear that the past and present regulatory systems have been almost totally ineffective; (4) regarding (3), it is not clear how the recommended research will solve the indicated problems.

A case in point is Impact Hypothesis E1-8. Increased industrial development, with construction of pipelines and transportation systems will disturb selected VECs in the terrestrial, aquatic or marine environment by making barriers and disturbance. It is not stated, but I assume because of the context, that this refers to both protected and unprotected areas. The fact is that much of this disturbance has already taken place and is ongoing and it is clear that the hypothesis is valid. Additional rationale is that investigations are necessary to map the extent of damage. The recommendation research calls for area-, season and species dependent investigations to map the potential impacts. Without a fundamental restructuring of the entire regulatory system, it is not apparent that any policy-relevant recommendations to arise from such research would ever be implemented or enforced.

Another important issue is poaching, or illegal hunting of both domestic reindeer and wildlife, including fish. This importance is implied at several places in the text, for example on p. 13 (increased hunting and fishing in protected areas); p. 23 (increased tourism, hunting and fishing in protected areas); p. 27 (commercialization of hunting, trapping and fishing, competition for subsistence), p. 42 (increased commercial of fishing and hunting tourism). Yet only on p. 54 (subsection G1-3/G2-3) is there a clear statement that »increased ... activity will lead to increased illegal hunting and decreased reindeer populations». I will discuss this further below.

The second section deals with indigenous people. I would reject the generalization (p. 25, subsection 3.2) that »indigenous peoples do not reject development». Among the 4000 or so migratory Yamal Nenets there are many who perceive more damage than benefits from the petroleum development taking place there. There is a clear division, and concomitant tensions, developing between the 'urban' indigenous populations and those who still live with the reindeer on the land.

Buried on p. 27 is what I find to be the most salient paragraph of the whole report, which gets right to the root cause of my above criticisms and the basis for INSROP as a whole. It reads as follows: »It seems the most important milestones towards control of development and further environmental devaluation are (1) a new or extended legislation with considerable respect to indigenous land use, and (2) an *effective law enforcement* and

implementation of environmental regulations. Another important approach is to try to convince both Russian and foreign commercial players on the Arctic scene that concern to indigenous resources and needs is an important issue. Most important of all, the indigenous societies need to be part of the process of creating the framework for the development, and their premises need to be viewed and treated on an equal basis.» This material should be moved to the fore in the report.

To be perfectly frank, if such a framework is NOT implemented, I feel strongly that exercises such as those outlined in the 'Recommended Research' and 'Monitoring' components of the Impact Hypotheses will be largely in vain. Like it or not, in some places, such as Northwest Siberia, state companies like Gazprom may comprise the *de facto* local, regional and federal authorities all in one. At present, Gazprom apparently sees no need for any environmental regulation and thinks it is doing a wonderful job. This situation is therefore unsustainable for all four of the VECs documented here. If Gazprom becomes a partner in NSR, it MUST be held accountable for any damages it causes. This points up another essential dilemma. Impacts that have gone on for many years, perhaps decades, before NSR will/may be 'connected' to the realm of relevant environmental impacts once NSR begins. For example, as far as I understand it, if gas and gas condensates are taken out of the Yamal Region via NSR, rather than via pipeline to eastern Europe, then all of Yamal, both within and outside of any protected areas, becomes subject to NSR regulation. Yet how, in fact, does NSR intend to deal with this? Where does responsibility for damage begin and end, in both space and time? This is a critical and extremely complex question, but it must be asked at the very outset of such an undertaking. I think the authors could include mention of the importance of this difficult task.

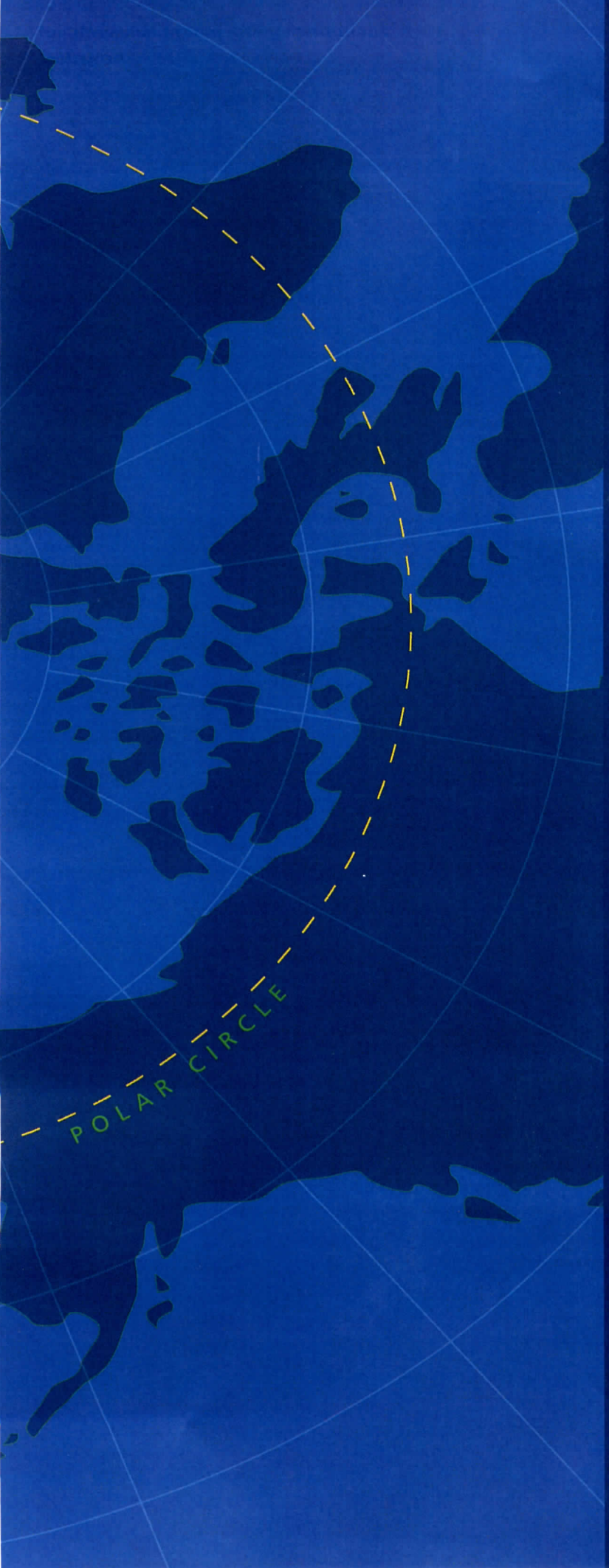
The third section deals with wild and domestic reindeer. In the subsection on Life cycle (4.1.3) there is an error. The third sentence should read «The nursing period is about one month, or sometimes into *summer*» (not winter). In the next subsection on Evaluation (4.1.4), with regard to Economy it is stated that «Reindeer breeding can be regarded as *the* fundamental, substance-related occupation of *most* indigenous people of the part of northern Russia related to NSR activity» (italics mine). Then, I would argue, it follows that extra special care should be taken to preserve reindeer breeding, both within and outside of protected areas. With regard to Data availability (same subsection) I would note that data on population size and trends of domestic reindeer, while perhaps easily available, are inherently unreliable. This is partly due to chronic under-reporting from reindeer herders when providing data to authorities. I would not place too much stock in the accuracy of such data, but I would emphasise the importance of preserving reindeer breeding, and the habitats it depends on.

In the schematic flow chart (4.3) on p. 52, I would note very clearly that there is a direct relationship between the establishment of onshore installations and increased poaching of wild and domestic reindeer, as well as many other species (polar fox, fish, etc.). This is shown at present only in the text, in the following subsection on Linkages, where there is stated to be a direct relationship between increasing access, via pipeline corridors and roads/railways, and increases in poaching.

Appendix 2: The authors response to the review

We would like to thank Bruce C. Forbes for his valuable comments to this documentation report of the four VECs. We have revised it almost in accordance with his review. Some of his comments, however, are definitely dealing with important issues of a more fundamental nature, which would lead far beyond the scope of this report to handle in an appropriate way.

The authors



The three main cooperating institutions of INSROP

Ship & Ocean Foundation (SOF), Tokyo, Japan.

SOF was established in 1975 as a non-profit organization to advance modernization and rationalization of Japan's shipbuilding and related industries, and to give assistance to non-profit organizations associated with these industries. SOF is provided with operation funds by the Nippon Foundation, the world's largest foundation operated with revenue from motorboat racing. An integral part of SOF, the Tsukuba Institute, carries out experimental research into ocean environment protection and ocean development.

Central Marine Research & Design Institute (CNIIMF), St. Petersburg, Russia.

CNIIMF was founded in 1929. The institute's research focus is applied and technological with four main goals: the improvment of merchant fleet efficiency; shipping safety; technical development of the merchant fleet; and design support for future fleet development. CNIIMF was a Russian state institution up to 1993, when it was converted into a stock-holding company.

The Fridtjof Nansen Institute (FNI), Lysaker, Norway.

FNI was founded in 1958 and is based at Polhøgda, the home of Fridtjof Nansen, famous Norwegian polar explorer, scientist, humanist and statesman. The institute spesializes in applied social science research, with special focus on international resource and environmental management. In addition to INSROP, the research is organized in six integrated programmes. Typical of FNI research is a multi-disciplinary approach, entailing extensive cooperation with other research institutions both at home and abroad. The INSROP Secretariat is located at FNI.