New Era in Far East Russia & Asia

Perspective of Northern Sea Route

Development of Far East Russia & JANSROP-GIS

Protection of Environment for the Sea of Okhotsk

February, 2006

Ocean Policy Research Foundation

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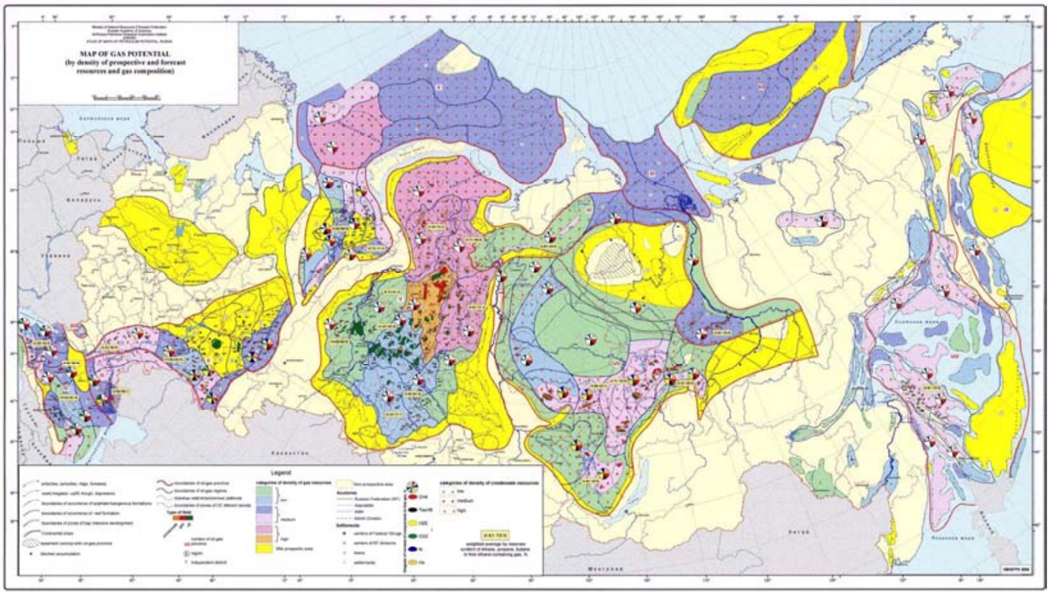

Gas Potential in Russia (Refer to JANSROP-GIS)

Foreword

Mr. Yohei Sasakawa
Chairman, The Nippon Foundation
Former Chairman of INSROP Board

From 1993 to 1999, in collaboration with research institutions in Russia and Norway, we undertook research under the International Northern Sea Route Programme (INSROP) towards the dream of establishing a new sea route. In order to share the results of these studies with the international community, we held a User's Conference in Oslo in 1999, and demonstrated the technical feasibility of utilizing the Northern Sea Route as a commercial sea-lane year round. These findings opened up new possibilities for use of the Arctic Ocean, which had previously been largely underutilized.

The Northern Sea Route is the shortest route between Europe and the Far East, and is just over half the length of the Southern Route through the Suez Canal and Malacca Straits. Given the importance of securing sea routes in emergencies and as an alternative means for transporting resources, all of Asia has great expectations for the Northern Sea Route.

In response to these expectations, the Ocean Policy Research Foundation recently conducted a study into the world's first multidisciplinary geographic information system (JANSROP-GIS) in Far Eastern Russia. Until recently, all that most people in Northeast Asia knew of Far East Russia and its geography, resources, and transport infrastructure, was what little information they had gathered through general hearsay. However, this information is now available to the world through this new information system (JANSROP-GIS) that can be accessed via the Web. I have no doubt that this achievement will contribute greatly to the effective utilization of NSR in the future.

I believe that we are no longer in an age when we can independently address various ocean issues ranging from technology, environment to the use of the seas. We now live in a world where we must take a comprehensive approach to issues in order to connect people via the oceans and enable them to coexist in harmony.

The Sea of Okhotsk, which was one of the areas targeted by this study, has contributed greatly over the years to surrounding regions and communities with its abundant resources and high productivity. We must not sacrifice this abundant sea to shortsighted development plans. It is my sincere hope that this conference will provide the key to solving a major issue facing the world today - the coexistence of development and environmental preservation.

In closing, I would like to express my sincere appreciation to the Japanese researchers and specialists as well as the research institutions from Russia, Norway, and Canada for their valuable cooperation and contribution to this project.

（Greetings to the International Northern Sea Route Conference 2005）

Foreword

Alexander Losyukov
Ambassador of the Russian Federation to Japan

It is a pleasure to greet the participants and organizers of the JANSROP conference. I would like to highly appreciate the profound support to the Conference and long term research provided by the Ocean Policy Research Foundation and The Nippon Foundation.

As the Ambassador of the Russian Federation I welcome the main theme of the Conference which is “New Era in Far East Russia & Asia”. Moving from the study of potential of the Northern Sea Route, that was the prime object of research at the first stage of the project, to more comprehensive and complex issues demonstrates the growing cooperation and mutual interest of the countries taking part in this activities, first of all Japan and Russia.

As President of Russia Vladimir Putin stressed at the opening ceremony of the 9-th International Economic Forum in Saint-Petersburg recently speaking about Arctic region, “It is our purpose to form a balanced approach aimed at achieving a sustainable development of this region”. It is certainly of vital importance for Russia as well as for neighboring countries to draw an optimal scheme of development of the regions of Siberia, Russian Far East and the Sea of Okhotsk. The intellectual potential of the participants of this forum in this respect can be relied on.

We are following with great interest joint efforts of the participants of JANSROP Phase II putting forward scenarios of effective infrastructure for ship operations and transportation complex. It is our hope that in your research activities you will give due attention also to issues of developing partnership in the fields of information technologies, environmental sustainability, preservation of unique cultures of the Northern ingenious peoples.

Russia is ready to share its mineral and other natural resources with other countries. It is even more important these days when rapid growth of consumption and prices for raw materials in the world attracts more attention to the necessity of having stable supply of them, by way of using vast undeveloped deposits of natural resources in Northern and Eastern regions of Russia. Geographical closeness of Russian Arctic and Far East to major consumers, such as the USA, Japan, China and the European Union, is an obvious advantage for future local projects in oil, gas, coal, ore and etc. exploration, development and transportation.

In this context I wish to express the hope that your Conference will find ways to promote economic and social development of Northern and Eastern regions of Russia and their integration in the international economy. That would, in turn, strengthen ties and cooperation between Russia, Japan and other participants of this promising project and provide a substantial input in world economic and political stability and security.

（Greetings to the International Northern Sea Route Conference 2005）

Foreword

Åge B. Grutle
Ambassador of Norway to Japan

I take great pleasure in greeting the participants and the organizers of the JANSROP conference 2005. I would also like to pay my respect to The Nippon Foundation and the Ocean Policy Research Foundation whose unfailing support of JANSROP has made this conference possible. The conference brings together the outcome of 3-year research programme - "Development and Operation Programme for Environmental Sustainability in East Eurasia" -, which will result in the "Geographic Information System" (JANSROP-GIS) and an "Environmental Security Regime" for the sub-arctic region including the Sea of Okhotsk.

In carrying out this unique research programme, individual researchers and institutions from Japan, Russia, Canada, and Norway, have contributed in developing research-data related to the Russian Far East's natural resources, the Northern Sea Route, and the Sea of Okhotsk. I would like to congratulate all of them for their efforts and their remarkable teamwork. Their pioneering achievements will have great significance for future generations.

A sound, sustainable management of the enormous natural resources of the Arctic, respectful of the sensitive environment, will clearly have global significance.

Sustainable development in harmony with the preservation of the environment in the regions of eastern Eurasia is the programme's primary concept. I sincerely wish that all the great hopes for this unique project will be fulfilled, and I am confident that this conference will be a significant step towards that end.

(Greetings to the International Northern Sea Route Conference 2005)

Preface

Masahiro Akiyama

Chairman,

Ocean Policy Research Foundation, Japan

The Northern Sea Route (NSR), or in other historical words, the Northeast Passage, has captured humankind's imagination throughout the ages. At one time, seafarers put their lives at stake embarking for the icy ocean in their small sailing vessels. Since then the history of Arctic exploration has been a fascinating tale of humankind's struggle for environmental expansion, which is also a history of geography and the methods of sailing. Commercial voyages have been making tremendous contributions towards the understanding of the ocean and the earth. Although purely scientific investigations by exploratory voyages still occupy an important role, even in the age of satellites, the emphasis is increasingly on knowledge which can be applied to the management of ocean resources and the environment, including the promotion of safety at sea. The continuing success of a sea route depends on the existence of well-constructed commercial ports and efficient inland communications at those ports by road, rail or inland waterways to hinterlands of high production or consumption.

The ocean is often regarded as the last major frontier on earth for exploration, exploitation and development of natural resources, as well as a space for human activities to sustain mankind in the future. The NSR has been developed for this particular reason. The International Northern Sea Route Programme (INSROP) was carried out by world experts in their respective fields covering the technical, ecological, environmental, economic, political and strategic aspects of the NSR. The numerical simulation conceived for the navigation of cargo vessels conceptually designed for the NSR by computer clearly indicated that the NSR can be technically feasible.

Since the INSROP came to a successful end, the development of energy resources both in the eastern and western rims of the NSR and in the Barents and Okhotsk Seas, has emerged from the planning stages under considerable shifts in the political and socio-economic system of Russia, but the NSR remains the fringe of the international shipping market. In response to this, the Ocean Policy Research Foundation (OPRF), formerly the Ship & Ocean Foundation, carried out a research project on the NSR with particular emphasis on development in the Far East Russian regions and the Sea of Okhotsk. The project gained the enthusiastic support of The Nippon Foundation and was named the "Development and Operation Programme for Environmental Sustainability in the East Eurasia Enforcement Plan", or "JANSROP II" after the JANSROP which had worked hand in hand with the INSROP as a domestic research project. The primary objective of the project was to stimulate the interest of Asian countries in the NSR and Russian Far East, through providing updated information on legal and socio-economic issues, as well as, on the state of preserved natural resources and transport infrastructure in the relevant areas through the JANSROP-GIS on the world wide web.

The possibility of increased use of high latitude oceans could be realized in due course from the development of marine technology allowing safe navigation, more economically viable production activities in ice-infested waters and from advances in the sciences of oceanography, marine geology and earth science as well. These developments, even of an academic nature, should be accompanied by a deep concern for their impacts on the natural and ecological environments of oceans due to accidents, the discharge of waste and other kinds of serious disturbance. Recent trend in jurisdiction over maritime zones will hopefully establish a regal order for the ocean which can preserve marine environments and promote efficient and peaceful uses of the resources and the ocean itself. This has been evident in the case of the Sub-arctic ocean, where the offshore production of oil and gas has made great strides in the past few years.

The Sea of Okhotsk poses as much of a diplomatic challenge as it does an ecological one. Pollution, overfishing, and climate change appear to have negatively affected biodiversity. Currently, meaningful dialogue among stakeholders is limited, and no effective international management system exists among countries that rely on the Sea of Okhotsk for sustenance. We believe that effective conservation of the Sea requires linking international environmental efforts with meaningful international policies that can protect the marine environment as a whole in harmony with industrial expansion and resource custodianship in the sub-arctic. NGOs will then be expected to expand their role and activities in both national and international issues and conflicts.

Through NGOs activities such as the OPRF, equity is increasingly a feature of sustainable development dialogue. That dialogue now embraces not only preservation and protection but also sustainable use encompassing socio-economic as well as environmental dimensions, emphasizing local and global benefits alike.

Environmental requirements therefore imposed upon the JANSROP II, the tasks of devising a marine environmental regime for the Sea of Okhotsk and sustainable development of the NSR and surrounding regions.

The JANSROP II International Forum, “Resource Development in the Northern Seas and Environmental Protection”, held in November, 2003 in Tokyo and the International NSR Conferences, “New Era in Far East Russia & Asia” which was held in Tokyo and comprised the “International Experts Meeting” on June 30th and the “International Symposium for Potential Users”, on July 1st, 2005, greatly enriched this project through invaluable presentations, discussions and encouraging suggestions by Mr. Y. Sasakawa, Chairman of The Nippon Foundation, Mr. A. Losyukov, Russian Ambassador to Japan, and Mr. Å.B. Grutle, Norwegian Ambassador to Japan, which I deeply appreciate. At the International Symposium for Potential Users, Mr. V.

Chlenov, Minister of Transport of Sakha Republic, Russia kindly gave an informative lecture about the present and future development of the Republic of Sakha. Capt. A. Olshevskiy, Head of Shipping Maintenance Dept., Federal Agency of Marine and River Transport of the Russian Federation kindly provided a general view of federal marine operations over the coming decades. I am likewise much obliged to them.

This book, as an integration of the JANSROP II over three years（2002-2004), is a diverse package of information of the Russian Far East and the NSR update and captures the very essence of the project results. With the extensive use of the JANSROP-GIS, governmental and market managers can derive valuable suggestions for their planning and decision makings relevant to the activities and managements in the regions. I hope that this publication further contributes to formulation and implementation of policy proposals for the transition towards a robust market economy in Far East Russia.

I am confident that the book also provides valuable advice regarding measures to be taken and elements to consider for the preservation of the marine environment in the Sea of Okhotsk within the framework of a sustainable development policy.

To the authors of the papers and to the people who were involved in this project, I would like to express my heartfelt appreciation for your collaborative efforts in bringing this book to fruition. I would also like to express my sincere gratitude for the valuable contributions to the JANSROP II from every researcher and research institution involved, particularly to the Central Marine Research & Design Institute of Russia and its Director General V. Peresypkin; the Fridtjof Nansen Institute of Norway; and the Transport Canada/National Research Council Canada. Finally I am deeply indebted to The Nippon Foundation for its warm encouragement and financial support throughout the project.

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First and foremost I am highly honoured by the encouraging and suggestive messages offered in this book by Mr.Y.Sasakawa, Chairman of The Nippon Foundation, Mr.A.Losyukov, Russian Ambassador to Japan, and Mr.Å.B.Grutle, Norwegian Ambassador to Japan.

I would like to express my sincere gratitude to every contributor to this book on the perspectives on Russian Far East and the Northern Sea Route (NSR). My unfeigned praise goes to Prof.W. Østreng of the Centre of Advanced Study in Norway for his continuing interest and eminent services in development of the NSR.

The Russian Far East undoubtedly has tremendous potential for the advancement of global society in the 21st century. Its abundant mineral and energy resources and the remaining large wildness areas on the globe are rapidly increasing in value. At the same time, we should realize that continuing on the present path of resource consumption, pollution, and over-population will not deliver sustainability. Reliable scientific data is crucial for any decision making concerning sustainable development in the literal sense of the words. The primary objective of the JANSROP II was to provide useful data and information of the Russian Far East on the web, namely JANSROP-GIS. I would like to express my sincere appreciation to every Russian scientist and institute for their valuable contributions in gathering materials, information and reviews: D.A.Dodin of Russian Academy; Yu.N.Grigorenko, V.K.Shimansky of VNIGRI; N.A.Isakov, Yu.M.Ivanov, E.G.Logvinovich, A.N. Jakovlev, A.V.Sylin, M.I.Sharov, A.E.Nikulin, T.Maksimova, E.Sorokin, N. Zaporozhets, A.A.Romanenko of CNIIMF; Y.Semenikhin of FEMRI; I.E.Kochergin, A.N.Vrazhkin, S.I.Rybalko, O.V.Sokolov, N.A.Rykov, M.A.Danchenkov, T.P. Patrakova, P.A.Fayman, V.A.Luchin, Yu.N.Volkov of FERHRI/ROSHYDROMET; and Deputy Prime Minister A.A.Nikoloevich and Minister V.Chlenov of Yakutia.

Special thanks also go to K.Kamesaki and Y.Yamauchi of Universal Shipbuilding Co. A.Siraki of JFE SOLDEC Co.; and N.Otsuka of North Japan Port Consultants Co.,Ltd. for providing various data and enthusiastically formulating the GIS.

In particular, I am deeply indebted to A.Olshevskiy of Federal Agency of Marine and River Transport in Moscow; V.I.Persypkin, G.N.Semanov, V.Vasilyev of CNIIMF and the late G.Y.Serebryansky of FERHRI in Vladiovstock for their valuable contributions and friendly collaboration.

Although he appears in a relatively minor part of the table of contents, Dr.Peresypkin played an essential role in cooperative managing the project on the Russian side and without him the JANSROP II could not have been concluded with such success.

In response to the rapid development of energy resources around Sakhalin Island, a marine environmental regime relevant for the Sea of Okhotsk was developed as a proposal based on the principle of sustainable development and I would like to thank A.Moe, P.J.Schei and D.R.Brubaker of FNI; V.M.Santos-Pedro of Transport Canada; R.Frederking of CHC, NRCC; V.Vasilyev, G.N.Semanov, L.G.Tsoy of CNIIMF;

G.E.Rumyantsev of State Marine Academy; V.G.Rumyantseva of Institute of Maritime Law; M.Okada of Tokyo MOU; and K.Izumiyama of NMRI for their valuable comments and constructive advice to the maritime regime concept.

I would also like to express my sincere gratitude to L.Brigham of the U.S.Arctic Research Commission; Y.-S.Ha of Keimyung University in Korea; Y.Ishikawa of Marubeni Co., who provided enlightening perspectives of the NSR, Arctic and sub-Arctic areas.

Further, I would especially like to offer my heartfelt appreciation to all the members of the JANSROP II Committee who worked together to both hammer out a research design and to lead the project to success: Prof.M.Wakatstuchi of Hokkaido University; Prof.H.Yamaguchi of University of Tokyo; N.Otsuka; I.Watanabe and K.Izumiyama of NMRI; K.Kamesaki; K.Kuwahara of Marubeni Corp.; M.Motomura of Japan Oil, Gas and Metals National Corp.; M.Tsugane of Japan Marine Science Inc.; and the late Prof.T.Murakami of Hokkiado University.

Over the course of the project, much to our deep regret, the JANSROP Committee sadly lost two of its key members: Prof. T. Murakmi and Dr. G.Y.Serebryansky both of whom contributed a great deal to the venture and their memory will remain with us all.

My gratitude is likewise extended to the project secretariat of OPRF, in particular H. Tagami and H.Tamama for their relentless enthusiasm and tireless administrative support and particularly to Executive Director E.Kudo for his able and vigorous leadership in the project.

Finally, but by no means least of all, I would like to express my profound indebtedness to the Chairman of The Nippon Foundation, Yohei Sasakawa, for his continuing support and warm encouragement of the JANSROP II.

I would like to add that none of the abovementioned authors or organizations is responsible for any shortcomings in this book. Although the individual author bears responsibility for the content of each paper, the editor alone is answerable for the book as such.

Unless a more recent date has been specified at any particular place in the book, the book is up to date as of December 2005.

Prof. Hiromitsu Kitagawa
Chairman, JANSROP II Committee

Abbreviations

AC	Arctic Council
ACIA	Arctic Climate Impact Assessment
ADCP	acoustic doppler current profiler
AIRSS	Arctic Ice Regime Shipping System
AIS	Automatic Identification System
ALS	Aboriginal Leaders Summit
AMTS	Arctic Marine Transportation System
AO	joint stock company
ARFEZ	Amur River Free Economic Zone
ASPPR	Arctic Shipping Pollution Prevention Regulations
AWPPA	Arctic Waters Pollution Prevention Act
BAM	Baikal-Amur Mainline (Railway)
BAT	Best Available Techniques
bbl	barrel
BEAR	Barents Euro-Arctic Region
BEP	Best Environmental Practice
CAC	Canadian Arctic Class
CAFF	Conservation of Arctic Flora and Fauna program
CBD	Convention on Biological Diversity/Convention on Biodiversity
CCAMLR	Convention on the Conservation of Antarctic Marine Living Resources
CFC	chlorofluorocarbon
CLC	International Convention on Civil Liability for Oil Pollution Damage
CLCS	Commission on the Limits of the Continental Shelf
CNIIMF	Central Marine Research & Design Institute
CPUE	Catch per Unit Effort
DIS	Danish International Ship Register
DMSP	Defense Meteorological Satellite Program
DNV	Det Norske Veritas
DOC	dissolved organic carbon
DSW	dense shelf water
EBRD	European Bank for Reconstruction and Development
ECDIS	electronic chart display and information system
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
ESC	East Sakhalin Current
ESCW	East Sakhalin Current Water
ESI	Environmental Sensitivity Index
FAO	Food and Agriculture Organization

FEMRI	Far-Eastern Marine Research, Design and Technology Institute
FERHRI	Far Eastern Regional Hydrometeorological Research Institute
FESCO	Far Eastern Shipping Company
FNI	Fridtjof Nansen Institute
GATS	General Agreement on Trade in Services
GCM	global climate model
GDP	Gross Domestic Product
GIS	Geographical Information System
GOFREP	The Gulf of Finland Ship's Reporting System
GOSPLAN	the State Planning Committee in the Soviet Union
HELCOM	Helsinki Commission
HU	Hokkaido University
IACS	International Association of Classification Societies
IAIA	International Association for Impact Assessment
IASC	International Arctic Science Committee
IBI	Index of Biological Integrity
IIASA	International Institute for Applied Systems Analysis
ILM	International Legal Materials
ILO	International Labour Organization
IMO	International Maritime Organization
INSROP	International Northern Sea Route Programme
IOPC	International Oil Pollution Compensation
IPCC	Intergovernmental Panel on Climate Change
ISOPE	International Society of Ocean and Polar Engineering
ISPS	International Ship and Port Facility Security Code
IST'95	INSROP Symposium Tokyo '95
JANSROP	Japanese Northern Sea Route Programme
JOGMEC	Japan Oil, Gas and Metals National Corporation
kyr	1,000 years
LOSC	United Nations Convention on the Law of the Sea
MAR	Madeira International Ship Register
MARPOL 73/78	International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto
MEPC	Marine Environmental Policy Committee (IMO)
MERRAC	The Marine Environmental Emergency Preparedness and Response Regional Activity Centre
MODIS	moderate resolution imaging spectroradiometer
MOU	Memorandum of Understandings
MOX	mixed uranium and plutonium oxide
MSC	Maritime Safety Committee
MSCO	Murmansk Shipping Company
MSY	Maximum Sustainable Yield

NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NAV	Sub-Committee on Safety of Navigation (IMO)
NCCOS	National Centers for Coastal Ocean Science
NEPA	National Environmental Policy Act
NF	Northern Forum
NGO	Nongovernmental Organization
NIS	Norwegian International Ship Register
NJPC	North Japan Port Consultants Co.,Ltd.
NMRI	National Maritime Research Institute
NMSP	National Marine Sanctuary Program
NOAA	National Oceanic and Atmospheric Administration
NOAA/AVHRR	National Oceanic and Atmospheric Administration/Advanced Very High Resolution Radiometer
NOWPAP	North West Pacific Action Plan
NOx	nitrogen oxide
NPAFC	North Pacific Anadromous Fish Commission
NPDW	North Pacific Deep Water
NPIW	North Pacific Intermediate Water
NRCC	National Research Council Canada
NRC-CHC	National Research Council of Canada - Canadian Hydraulics Centre
NSR	Northern Sea Route
NSRA	Northern Sea Route Administration
NWP	Northwest Passage
OBO	multipurpose ship that can carry ore, heavy dry bulk goods and oil
ONGC	Oil and Natural Gas Corporation Limited
OPA 1990	United States Oil Pollution Act of 1990
OPRF	Ocean Policy Research Foundation
OSIW	Okhotsk Sea Intermediate Water
OSPAR	Convention for the Protection of the Marine Environment of the Northeast Atlantic
PA	Protcted Area
PAME	Programme for Protection of the Arctic Marine Environment
POAC	International Conference on Port and Ocean Engineering under Arctic Conditions
POC	particulate organic carbon
PSSA	Particutarly Sensitive Sea Area
RF	Russian Federation
ROSHYDROMET	Russian Federal Service for Hydrometeorology and Environmental Monitoring
RS	Russian Maritime Register of Shipping
SA	Special Area
SAA	Satellite Active Archive

SBT	segregated ballast tank
SLB	Siberian Land Bridge
SOF	Ship & Ocean Foundation
SOFIA	The State of World Fisheries and Aquaculture
SOLAS	International Convention for the Safety of Life at Sea
SOx	sulfur oxide
SPMA	Specially Protected Marine Area
Sv	10^6 m^3/s
t.o.e.	tons of oil equivalent
TC	Transport Canada
TcF	trillion cubic feet
TEU	Twenty-foot Equivalent Unit
TKR	Trans-Korean-Railway
TOC	total organic carbon
TOE	tons of energy
TOM	Territorial Organic Matter
TransSib	Trans-Siberian Main Railroad/Trans-Siberian Railway
TSR	Trans-Siberian Main Railroad/Trans-Siberian Railway
UN	United Nations
UN/ECE	United Nations Economic Commission for Europe
UNCLOS	United Nations Convention on the Law of the Sea
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
USARC	United States Arctic Research Commission
USC	Universal Shipbuilding Corporation
USSR	Union of Soviet Socialist Republics
UT	University of Tokyo
VNIGRI	All-Russia Petroleum Research Exploration Institute
WDDB	World Digital Database
WMO	World Meteorological Organization
WSSD	World Summit on Sustainable Development
WTO	World Trade Organization
WWF	World Wildlife Foundation

Contents

NORTHERN SEA ROUTE;
THE PERSPECTIVE

JANSROP Phase II Programme: Primary Objectives and Outcomes

Prof. Hiromitsu Kitagawa
Chairman, JANSROP II Committee
Japan

Background

The Northern Sea Route (NSR) has an indisputable advantage in the traveling distance between Europe and the Far East or the west coast of North America. Via the NSR, the navigational distance between Hamburg and Yokohama, for instance, is only 6,900 miles, while via the conventional southern route it is 11,430 miles, passing through the Suez Canal; the NSR markedly reduces the distance by 40%. In the regions of Siberia and the Russian Far East there are natural resources preserved in copious abundance. These resources are waiting for appropriate and stable means of transport, particularly surface transport development via the NSR. The NSR has a significant commercial potential for stimulating the further development of international shipping and world markets alike.

To examine all the possibilities of the NSR as an international commercial sea lane, the Ship & Ocean Foundation (SOF), aided and encouraged by The Nippon Foundation, conducted the "International Northern Sea Route Programme (INSROP)" between 1993 and 1999 which was an international project, featuring close collaboration between Japan, Norway and Russia. INSROP was able to develop and demonstrate the technical possibility of the NSR as an international commercial sea-lane and it ended successfully with fruitful results in terms of the assessment of the insurance and legal issues of the NSR and practical suggestions for improvements.

In the INSROP diversified feasibility study programme, the Russian Far East was regarded as the type of the region to be investigated in the future, as it is located in the northeastern periphery of the Russian Federation and lacked international markets' interest. In comparison with present development activities in the Barents Sea, development in the Sea of Okhotsk seemed to be advancing much more slowly, but it was steadily proceeding. However, after the INSROP, a drastic transformation took place in the political and socio-economic situation in Russia and with it the NSR has been changing in response to the world markets for natural resources. The rapid development of oil and gas in the region, in particular on the continental shelf of the Sakhalin Island, has highlighted a new feature of the Russian Far East.

It is both the right and a crucial time to implement a programme to establish a socio-scientific rationale for all human activities in Subarctic areas, namely the Sea of Okhotsk.

JANSROP Phase II

The SOF, renamed the Ocean Policy Research Foundation (OPRF) in 2005, then examined the current situation in Russian and the world market trends, and decided to start a new project on the NSR and the related issues from a new perspective in close cooperation with Russia. The new project, "JANSROP Phase II", or briefly "JANSROP II", was determined to be carried out over a three-year period from 2002, with the kind support of The Nippon Foundation once again. JANSROP which will correspond to the Phase I project of JANSROP, had been a domestic project carried out by the SOF in conjunction with the INSROP, and JANSROP II, which characterizes the Japan-funded project, stands for "Development and Operation Programme for Environmental Sustainability in East Eurasia". The project was a continuation of the SOF's long-standing interest and involvement in research on the Northern Sea Route.

In contrast to the INSROP, JANSROP II emphasized the eastern part of the NSR including some regions of Siberia, Far East Russia and the Sea of Okhotsk.

The objectives of the Project are to stimulate Asian countries' interest in the NSR and in the regions of the Russian Far East. This will be accomplished by highlighting the natural resource wealth in those territories and along the eastern half of the NSR by suggesting a plan for their development and by putting forward scenarios of an effective infrastructure for marine operations and for a transport system. An attempt was also made to develop a proposal for a maritime regime in the Subarctic region, based on the principle of environmental sustainability, with a particular emphasis on the Sea of Okhotsk as an archetypal example.

The core concept of the JANSROP II is "Sustainable Development", in harmony with the preservation of the environment in the regions of eastern Eurasia, as clearly indicated clearly in the above-mentioned study contents. This concept, having laid the foundation in the latter half of the 1980s and been declared to the whole world at the Earth Summit in 1992, will take on added significance in the 21st century. The concept is vital to the development of the Arctic and Subarctic regions as they have a major influence on the earth system and are an environmentally vulnerable to pollution.

The Project was carried out according to the following eight sub-programmes in cooperation with Russia, Norway, Canada and other countries, emphasizing the formulation of the JANSROP-GIS on the worldwide web for academic and commercial users with various intentions.

SP-1: Development Scheme for Natural Resources along the Eastern Half of the NSR
SP-2: Upgrading Scenarios of Port and Harbour Infrastructures along the NSR
SP-3: GIS Formulation for the Russian Far East Region
SP-4: Study on Environmental Security in the Arctic and the Subarctic Seas
SP-5: Development and Transportation Scheme for Natural Resources along the NSR
SP-6: Study of International Maritime Regimes
SP-7: Proposal for a Maritime Regime for the Sea of Okhotsk
SP-8: Consideration of a Trial Voyage to Ascertain the Current Security System

Collaboration between the following major universities and institutes has made these project tasks possible: Hokkaido University, Marubeni Corp., National Maritime Research Institute, North Japan Port Consultants Co., Ltd., University of Tokyo, Universal Shipbuilding Co., Ltd., Central Marine Research & Design Institute in Russia, State Marine Academy of Russia, Institute of Maritime Law in Russia, Far Eastern Regional Institute of Russian Federal Service for Hydrometeorology and Environmental Monitoring, All Russia Petroleum Research Exploration Institute, Ministry of Transport of Sakha Republic, The Fridtjof Nansen Institute in Norway, and Transport Canada/NRCC Canadian Hydraulics Centre.

JANSROP II could contribute tremendously to the marine industry, commercial shipping and various markets of natural resources through providing a JANSROP-GIS, the first multidisciplinary geographical information system for the Far East Russian regions, including adjoining areas. In addition to the JANSROP-GIS, development scenarios for the industrial and transportation infrastructures in the regions, which will include the preservation of the environment, could bring wealth to the Far East Russian-Asian countries.

After the successful experimental voyage with the Kandalaksha, the second experimental voyage plan was to materialize only when the project determines its necessity through a substantial assessment of the prospect of the NSR. However, the Project concluded that such a voyage still remained premature in ascertaining the current maritime operating systems.

The Project marked a distinct step to lay the foundation of knowledge and understanding of the target regions that will enable both present decision-makers and future generations to react intelligently to the global changes on earth and to preserve pristine marine environments, emphasizing the interactions between the atmosphere, oceans, cryosphere, solid earth, and biological systems, both in the processes involved and the changes in global state variables. It can still go a long way towards giving a full account of physical and biological interactions, the trans-national character of living resources, the reasons behind the flow of merchant ships, management concepts, legal regimes of the oceans, international agreements and the legislation of international law.

The ocean has long been regarded as the last major frontier on earth for the exploration and development of resources to sustain humankind in the future. World population growth, however, together with the near depletion of vital minerals and fossil energy sources on land, pollution, the careless disposal of nuclear waste and the dumping and discharge of hazardous wastes into rivers and oceans, have all led to compelling interest in the oceans.

The possibility of more uses of the ocean has emerged with advances in the sciences of marine geology and oceanography, marine biology, and the development of marine technology allowing the exploitation of hydrocarbons and minerals in deeper and more hostile regions of the ocean, even in ice-covered regions. These advances should be accompanied by concern for the holistic health of the oceans due to accidents, the discharge of waste, over-fishing of a number of species and conflicts between countries over access to and ownership of maritime areas which may bring about further changes in jurisdiction over maritime zones.

As for the Arctic region, IASC, the International Arctic Science Committee, has played an active and major role in all aspects of Arctic research. The mission of IASC is to encourage, facilitate and promote basic and applied interdisciplinary research of or concerned with the Arctic at a circum-arctic or international level. The activities of IASC have been expanding to adjoining Subarctic areas, but they still remains far from comprehensive.

Sustainability is a term that has gained widespread popularity through a loose or even arbitrary definition. Someone might define this fashionable term as ensuring that our future generations have equal access to the resources that the earth offers. Working out effective solutions to marine environmental problems involves more than simply gathering facts, understanding the scientific issues of a particular problem or strengthening interdisciplinary cooperation in order to understand the relationships between biological and physical sciences. It should also be concerned with our value systems of values and issues of social justice as well as potentially divisive issues of jurisdiction, within a broader and longer-term perspective. We also must be aware of the cultural and historical contexts in which our choices are made and implemented.

The world is in an accelerating spiral of change and uncertainty. To improve our ability to respond and adapt to climate change or to any other environmental disturbances, we must preserve a healthy, resilient environment and create human institutions based on participation and respect. We feel it is our responsibility to bring the resilience and vulnerability of the Subarctic systems to the attention of stakeholders concluding and extending their activities in the Sea of Okhotsk and the Bering Sea to the resilience and vulnerability in the sub-arctic systems. Up until the present time, meaningful dialogue among the stakeholders has been limited, and no effective international management system exists among countries that rely on the Sea of Okhotsk for sustenance. We believe that effective conservation of the Sea of Okhtotsk requires the linking of national and international environmental efforts with effective international policies that seek to protect and preserve the marine environment and its species. The JANSROP II has therefore paid a particular attention to the marine environmental issues in the Sea of Okhotsk. The Project has certainly provided an informed starting point for a sounder understanding of the ocean-resources system involving humans and the marine environment in Subarctic regions.

The Northern Sea Route

The volume of cargo in the transit route between Europe and the Far East has been stagnant since 1991 and several problems still remain for there to be substantial use of the NSR. The vessels should be able to navigate safely and efficiently, competing economically against those on the long-accustomed southern routes. The NSR operations should not cause environmental pollution due to accidents and the customary navigation of ships. These requirements could only be suited to a reliable and transparent study on sustainable development scenarios and market principles and the insurance and legislative issues of shipping regulations acceptable to the international commercial shipping industry.

Both of the current instability in the Middle East and the excited energy market of world demand to ensure the transportation of key materials and strategic goods and to find out an alternative way of transporting them. As the IASC has pointed out, sea ice conditions in the Arctic demonstrate favorable trends for shipping, which implies improved ship accessibility around the marginal areas of the Arctic Basin. The NSR can anticipate a prosperous future.

As the chairman of the JANSROP II Committee, first of all, I would firstly like to thank The Nippon Foundation, whose generous contribution to the Project is vital. Most sincere thanks go to all of the contributors, universities and institutes who have also collaborated. Finally I would like to express my heartfelt appreciations to every member of the Committee and the Secretariat. Without their advice and contributions, the Project could not have been successfully accomplished.

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The Changing Utility Pattern of the High North

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The post-Cold War era has seen significant changes in Arctic politics. Civil societal organizations are slowly but surely gaining access to areas of the High North previously either designated for military purposes only or sealed off from human exploitation by harsh environmental conditions, in particular sea ice. As a consequence, a brand new set of values, interests and priorities are increasingly making their mark on the political agenda setting of the North. The Arctic is getting civilianized, implying that a 'New Age of the Arctic' is in the making.

The purpose of this article is to touch on three interrelated questions addressing the changing utility pattern of the High North: What are the driving forces behind these changes? How may these changes affect the political organization of the Arctic? What is the overall political challenge of the Arctic states in light of civilianization?

1. What are the Driving Forces behind the Transformation of the Arctic Utility Pattern?

Four kinds of interacting dynamic factors are at work here: *Security factors, environmental factors, geographical factors* and *extraterritorial factors.*

1.1 Security Factors

During the Cold War the Arctic became the object of unprecedented large-scale militarization driven by the needs of strategic deterrence. In the course of a few decades, the Arctic was transformed from a *military vacuum* prior to World War II, to a *military flank* in the 1950-70 period and to a *military front* in the 1980s. The gradual inclusion of the High North in Cold War nuclear planning made most governments conceive of arctic security solely in military terms. As a consequence, civil issue areas like resource exploitation, transport, research, rescue operations, native communities, environmental problems etc., were subordinated to military needs and priorities, and were controlled to keep a low profile in regional affairs. As a rule, security considerations gained the upper hand in setting national priorities for the North, and civil issue areas were subordinated to the realm of military priorities. Whenever the military establishment perceived of a conflict between the two types of interests, the civil sector was obliged to yield. Thus, the militarization deprived the region of cooperative a cooperative atmosphere, collaborative institutions and sidetracked the interests of civil society in policy formulation (See Figure 1).

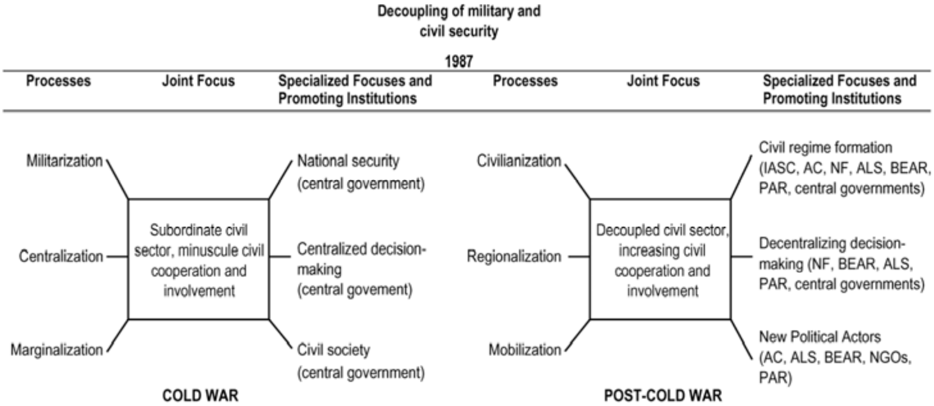
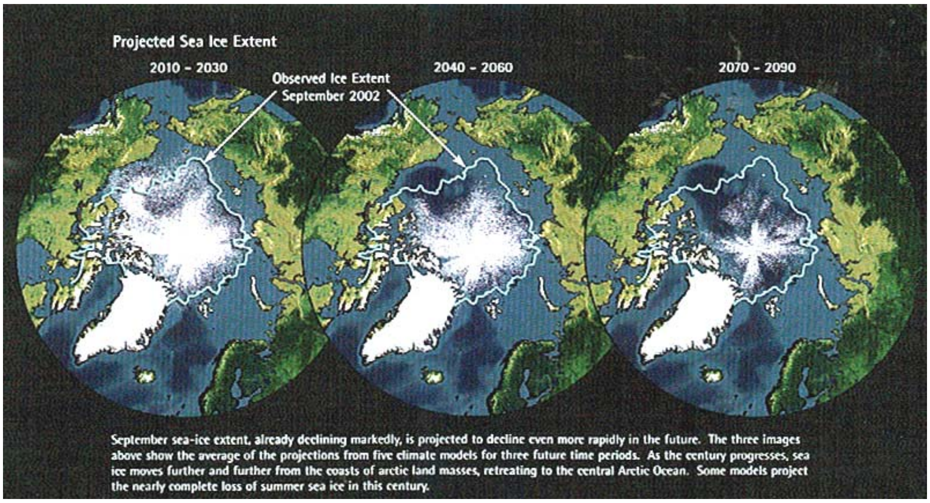


Figure 1 The Rethinking of National Security and Civil Societies in Arctic Politics

This policy was turned around in 1987 when Michael Gorbachev signalled a willingness to initiate international regional cooperation in four civil issue areas: *energy planning*, *environmental protection*, *scientific cooperation* and *sea transportation*. In identifying these areas, Gorbachev introduced a distinction between *military* and *civil security*. Both were regarded as vital for safeguarding national security, but the civil component was from then on given an independent priority in its own right. The purpose was to create *extended security* through international cooperation by a decoupling of military and civil issue areas. This move unleashed a political process between the Arctic Eight that broke the long term military domination of arctic affairs and cleared the way for a change in the regional utility pattern. Thus, a most stage-setting turn in Arctic history and politics was caused by a reconceptualization and rethinking of regional security (See Figure 1).

1.2 Environmental Factors

The warming observed over the land masses of the Arctic over the last few decades is matched by a corresponding reduction in the sea ice extent and thickness. Between the 1976 and the 1990s, sea ice thickness has decreased by about 1.3 m – from 3.1 m to 1.8 m – in most of the deep water portions of the Arctic Ocean, i.e. 42% reduction. Over the last 30 years the sea ice extent has decreased by some 10%, i.e. nearly one million square kilometres (386,100 square miles) – an area larger than all of Norway, Sweden and Denmark combined. The extent of multi-year sea ice has in the same period been reduced by some 8% per decade, and deep pressure ridges are almost vanishing from the Arctic Ocean. New extreme minima of summer ice extent have been established repeatedly since 1980 with a loss of 15-20% of the late-summer ice coverage. The September sea ice extent in the Chuckchi Sea in 2002 was 25 % below the prior minimum value over a 45-year record, and it is projected to decline even more rapidly in the future. Some climate models actually project the nearly complete loss of summer sea ice in this century (See Figure 2).



September sea-ice extent, already declining markedly, is projected to decline even more rapidly in the future. The three images above show the average of the projections from five climate models for three future time periods. As the century progresses, sea ice moves further and further from the coasts of arctic land masses, retreating to the central Arctic Ocean. Some models project the nearly complete loss of summer sea ice in this century.

Source: NASA

Figure 2 Projected Sea Ice Extent

The sea ice edge is migrating northward, the sea ice is getting weaker and the influx of multi-year ice and deep pressure ridges to the coastal areas of the Northern Sea Route (NSR) is decreasing. This means that the huge continental shelf areas north of the Russian mainland – thought to be rich in oil and gas - are gradually being cleared of ice, exposing the continental shelf for further prospecting and exploitation. What is more: These changes may fundamentally influence operations along the Northern Sea Route (NSR), expand regional trade, and stimulate year-round transits in the decades ahead. The 2004 *Arctic Climate Impact Assessment* (ACIA) study concludes: “Regional as well as trans-Arctic Shipping along the NSR is very likely to benefit from a continuing reduction in sea ice and lengthening navigation seasons…. The further north the ice-edge retreats, the further north ships can sail in open water on trans-Arctic voyages, thereby avoiding the shallow shelf waters and narrow straits of the Russian Arctic (ACIA, p. 83).”

If sea ice reductions are due to natural cyclical variations or climate change, scientists cannot say for sure. However, the *Intergovernmental Panel on Climate Change* (IPCC), conclude that new and stronger evidence suggests that most of the warming observed over the last 50 years is attributable to human activities. Individual scientists are more conclusive, indicating that the probability of the observed sea ice trends resulting from natural climatic variability is less than 0.1 percent (Weller, 2000). On this backdrop, there are fairly strong scientific evidence suggesting that the changes in the sea ice regime are long-term and to a large extent anthropogenic.

Combined with geography these environmental changes may further enhance the motivation of civil societal organizations to engage in arctic exploitations.

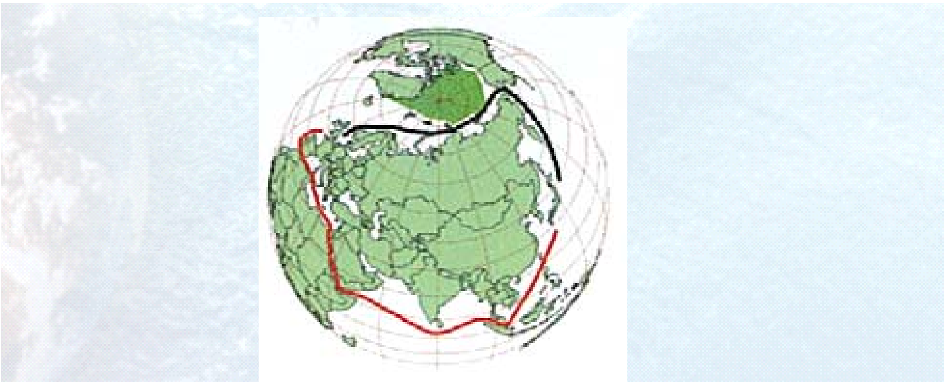
1.3 Geographical Factors

Let us consider some indisputable geographical facts relating to the Arctic:

- the shortest distance between the North American and Eurasian continents passes across the Arctic Ocean;
- none of the major industrial areas in Russia, North America, Europe, Japan and most of China are located more than 3,800 nautical miles from the North Pole.
- Some 80% of world industrial production takes place north of 30 degrees N. latitude;
- some 75% of all metropolitan areas of the world lie north of the Tropic of cancer.

In combining these facts, the Arctic Ocean stand out as a shortcut junction – a 'Mediterranean Sea' – lying in between the world's most advanced and productive regions, and is not as indicated by the Mercator-projection, an outskirt area poorly portrayed as a white, stretch-out location barely visible at the top section of most world maps. On the northern hemisphere, the Arctic Ocean is geographically blessed with centrality rather than marginality (See Figure 3).

In the West, the general tendency has been to play down the geographical aspects of the NSR and emphasize the hydrological and bathymetric challenges of these waters. The lack of regular sailing schedules, limited length of sailing seasons (6 months), cost of icebreaker assistance, high insurance premium, limited sailing speeds and cargo capacity, and the costs involved in building ice-reinforced freighters, where only a few of the numerous factors invoked when declining to use these waters for transportation purposes. Western ship owners have therefore not perceived of the NSR as a viable alternative to the Suez and Panama Canals. This despite the fact that there is an obvious and at times considerable distance and time advantage involved in using



Source: Claes Lykke Ragner (ed.) "The 21st Cenury; turning point for the Northern Sea Route?, Kluwer Academic Publishers, 2000

Figure 3 The Northern Hemisphere and Transport Routes

the NSR between ports in the Pacific and those in the Atlantic as compared to the Suez and Panama Canals.

The state of extraterritorial affairs in providing global energy security may be the single most important factor in changing these attitudes.

1.4 Extraterritorial Factors

Six features of the global energy system make the Arctic an interesting region in extraterritorial affairs:

- The Middle East is the most prominent oil and gas producing region in the world,
- The Suez and Panama Canals are the most used delivery routes of oil and gas to the western world,
- To meet their energy demands, the bulk of western countries depend heavily on oil and gas imports from the Middle East,
- The global energy demands are predicted to rise by 60% in the next 30 years,
- The Arctic is estimated to contain 25% of world undiscovered oil and gas resources,
- Most oil and gas importing countries have policies to reduce their energy dependency of areas of political instability.

Three aspects command interest in this context: First, the Suez Canal has been closed two times for extended periods in the post-World War II period, making fuel prices and transportation costs in general soar to a level seriously hurting the world economy; Second, the five Israel/Arab wars, the Gulf War, the military invasions of Afghanistan and Iraq all relate to the threat scenarios of the 'clashes of civilizations', which in the mind of some analysts, will become the principal course of future international conflicts, in particular between the Western and Islamic cultures. Third, the eight years of war between Iraq and Iran show how 'clashes within civilizations' controlling the bulk of the world oil reserves, may introduce severe uncertainties to the future supply of oil to energy dependent countries.

Fifteen years ago, the world had no viable alternative but to live with political risks associated with the Middle East, both for delivery and transportation of energy resources. Due to a host of practical, legal, security and political reasons, the NSR was not an alternative to existing routes of transportation. The official opening of the NSR to international shipping on July 1, 1991 has to a certain extent changed this situation. Today, the western part of the NSR is already in operation on a year round basis for transportation of oil and gas from Northwest Russia to markets in the west – the USA being one of more important recipients. It is projected that this trading will increase substantionally in the years ahead. The political rapprochement between Russia and the West, due to the cessation of the Cold War, their joint war against terrorism, and the pressing economic needs of Russia to continue improving on its national economy, has provided a regional political stability in the High North that is new to the region and very different from that of the Middle East.

In summing up: the driving forces, the energy vulnerability of oil dependent countries, the receding and thinning of sea ice, the war against terrorism, the political instability of the Middle East, the abundance of discovered and undiscovered arctic energy resources, rapidly increasing international energy demands, the geographical location of the Arctic Ocean, the official opening of the NSR to international shipping, and the all-year usage of the western part of the NSR for oil transportation, provide new and important perspectives as to the future role of the Arctic in extraterritorial affairs.

2. How may the Civilization Process Affect the Political Organization of the Arctic?

The rethinking of regional security lead to a surge of international civil cooperative arrangements in the Arctic. It started out with the formation of the *International Arctic Science Committee* (IASC) in 1990. One year later, three new establishments saw the light of day: the *Northern Forum* (NF), the *Aboriginal Leaders Summit* (ALS), and the *Rovaniemi process*. Then followed the founding of the *Barents Euro-Arctic Region* (BEAR) and the *Parliamentarians of the Arctic* in 1993. Last but not least, the *Arctic Council* (AC) was formed in 1996. These spontaneous and highly uncoordinated establishments have opened up a whole new era of formalised cooperation between the Arctic states gradually doing away with the regional East/West divide. These institutions manifest the fact that civil issue areas have been assigned a role of its own in Arctic developments. For the first time in Arctic history, a pan-arctic cooperative and communicative structure has been established to deal with some of the concerns, values and interests of civil society. *Environmental protection and preservation*, *scientific exploration* and *indigenous peoples and cultures* have been singled out by all these institutions as the most suitable issue areas for promoting multilateral civil cooperation (See Figure 1).

This development makes room for political authority and influence in different forms and at other levels than the state. Non-state polities are increasingly claiming to be points of identification, as well as claiming greater manoeuvring room for their own interests and some even ask for greater political autonomy. The northern policies of the Arctic states are getting more decentralized, inviting local authorities, indigenous peoples and societal organizations to take part in foreign policy formation. This poses the question if the Arctic is in the process to become an *international political region* in which the institutionalization of arctic cooperation and politics will be further elaborated and developed?

An international political region is a spatially delimited area encompassing parts of two or more states marked by three characteristics:

A. the political agendas is being framed and forged in regional terms,
B. the pattern of political interactions and alignments is regional–specific,
C. the evolution of political regimes (AC, BEAR etc) and codes of conduct is defined in regional terms.

These criteria are to a certain extent applicable to the Arctic. Since the existing regimes are both multiple, pan-arctic in application and based on the same code of conduct, the Arctic satisfies the requirements of the third definition criterion. When it comes to the internal pattern of alignments, the *Arctic Eight* stands out as a group different from the rest of *Arctic-interested states*. The Regional Board of IASC and the decision-making bodies of the Arctic Council are reserved exclusively for the Arctic Eight, which have also accepted the obligation to secure that the activities undertaken by the two organizations are in line with the interests of the region. However, the Council of the IASC, ranking above the Regional Board, is open to all extra-territorial states having an interest in the Arctic. The same applies to the Board of Directors of the Northern Forum who has members representing the Republic of Korea, the Heilongjiang province in China and Hokkaido in Japan. Thus, the pattern of political interaction and alignments is a blend of regional-specificity and extraterritoriality, blurring the interaction pattern of the North. Therefore, also the first criterion, requiring political agendas to be shaped by and based in regional conditions and not in global interests, is a mixed bag.

Thus, the present situation indicates that the Arctic has not yet developed into a full-fledged international political region. It has more of the characteristics of a *coordinate political region* in which the coordination of state behaviour takes place through multilateral institutions on issues perceived to be significant. On a continuum depicting the level of regional integration, a coordinate political region is located in between what has been labelled a *minimal political region* and an *integration region*. The interaction pattern of the former is one of unilateral behaviour and bilateral interactions occurring more frequently than multilateral relationships, whereas the latter is a full-fledge international political region based on a community feeling and concerted actions among the regional states in multiple issue areas (See Figure 4). Thus, in the course of the post-Cold War period, the Arctic has moved from being a *minimal political region* in *1990*, to become a *coordinate political region in 2000*, featuring a few characteristics of an *integration region* in 2005. The Arctic is still in a process of political transition.

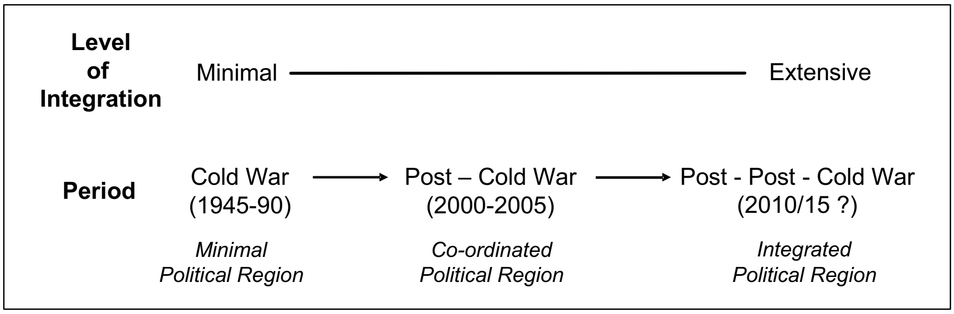


Figure 4 The Arctic as an International Political Region

3. What is the Overall Political Challenge of the Arctic States in Light of Civilianization?

The integration of the Arctic in world affairs is a direct consequence of, and is strongly influence by problems in southern latitudes. For centuries, the region was off the beaten track of international affairs. It was surplus to requirements. The East-West conflict triggered a change in this situation, transforming the region into a theatre of strategic deterrence to keep the Cold War from getting warm. In recent years, the South has added more issues to the list of integration with the North in which long-term energy security are among the more prominent. Because issues of this kind concern the functioning and well-being of nation states, they hold high political priority in the extended security deliberations of governments. Due to their sensitivity, these issues will not, in times of conflicts of interests, be easy objects of political compromise, and the likelihood is for the intensity of conflicts to be rather high.

As of now, the two branches of society – the military establishment and civil societal organizations - are involved in fulfilling their objectives in the Arctic. During the Cold War, the potential of regional conflict between the two was reduced by the policy requiring civil interests to yield to those of the military. In this way, the resolution of conflicts was decided before they even materialized. At present, the fulfilment of civil and military goals are supposed to coexist in parallel, on an equal footing and within the same operational space without any predefined policy declaration requiring the one to yield to the other. This may invite for collisions of interests. What is more: None of the Arctic regimes addresses the question of military security directly. The establishment of the Arctic Council was, for instance, based on the explicit premise that the organization should not involve itself in matters related to military security, which should be the exclusive realm of national governments. In practice, however, the cooperative regimes are building civil security tacitly through international cooperation without being explicit about it. The division of labour between the governments and the Arctic institutions, complicates the endeavours to get a comprehensive grip on arctic affairs. The likelihood of these collisions to happend does not, however, apply equally to all parts of the Arctic.

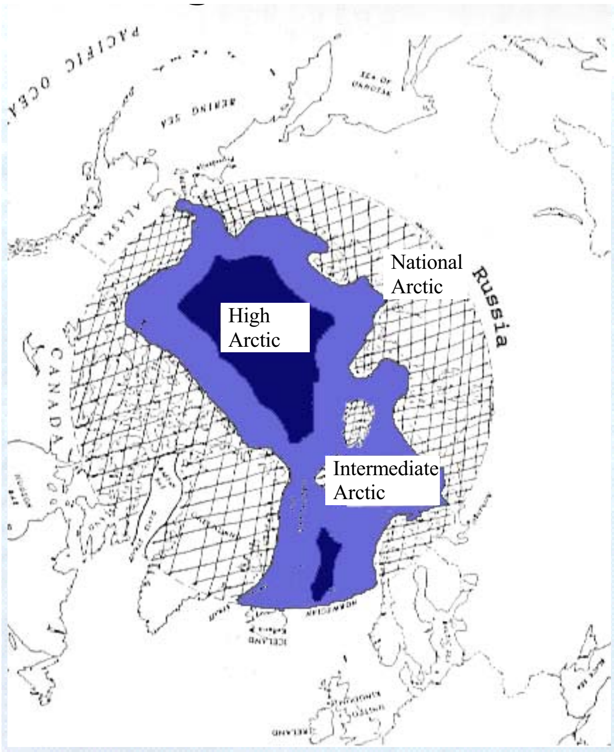
In terms of conflicting interests and jurisdictional responsibilities, the Arctic can be sub-divided into three zones: a *National Arctic*, an *Intermediate Arctic* and a *High Arctic* (See Figure 5). The national Arctic encompasses geographically all land, islands and internal waters north of the polar circumference. This zone is subjected to unrestricted national jurisdiction according to national and international law. Hence, it is the business of individual governments to decide on the types of activity that can be performed within their respective zones and under what preconditions these activities can take place. This is the activity zone of sovereign governments acting on their own national interests.

The intermediate Arctic includes areas where restricted but recognized national rights are in force, viz., the continental shelf, the economic zone and the territorial waters. The intermediate Arctic thus covers the area between the base lines and the shelf margin and/or the outer limits of the 200 miles economic zones. The limited jurisdictional powers awarded the littoral states in these waters implies that the nationalities might operate there if the rules laid down by the holder of sovereignty are complied with and in accordance with the Article 234 of UNCLOS. The Intermediate Arctic contains two types of areas: *areas of interest congestion* and *areas of interest separation*.

The Barents Sea is a good example of an area of interest congestion, i.e. areas of too many interests and too little operational space. The ice free part of the Barents Sea in winter amounts to approximately 524,000 square kilometres. Within this restricted area, the Russian Northern Fleet based at the Kola Peninsula, oil and gas rigs, fisheries, transportation, tourism etc. have operational requirements that are issue-specific and not adjustable to those of the others. To illustrate the point: A single Thyphoon submarine is estimated to need an operational radius in the horizontal plane of up to 34,000 square kilometres of water in order to perform his tasks; Drilling rigs require wide safety zones, sea transportation is in need of navigational corridors, the fisheries occupy fish banks, environmental values are announced by the Norwegian government to be protected by the measures of PSSAs (Particularly Sensitive Sea Areas) (Brubaker, 2005) etc. Thus, in areas of interest congestion, the operational space is a critical but limited good, inviting for space competition between clients of different sectors and nationalities. These areas are conflict-prone and should be regulated both by national and concerted international means. Sub-regional cooperative institutions like BEAR are suitable candidates for dealing with challenges contained in areas of interest congestion.

The Intermediate Arctic also contains areas of interest separation, i.e. areas hosting activities that do not compete for operational space. Parts of the continental shelf north of the Russian mainland is for instance too shallow to allow for submarine operations, whereas the same shallowness is attractive to the oil and gas industry in light of retreating and weakening of sea ice. Here bathymetric features separate activities effectively. This is also the case for transportation along the NSR. Certain areas are off limit even for ships with shallow draughts. These areas can therefore be used for hunting and fishing by aboriginal peoples. Areas of interest separation also occur between the Intermediate Arctic and the High Arctic combined.

The High Arctic comprises the areas outside the national domain, having a definite international status as a high sea. In the Arctic Ocean this area has tacitly been designated a military operational zone, in particular for strategic submarines, due to favourable depths conditions. In this scheme of separation the Intermediate Arctic allows for sea-based economic activity, whereas the High Arctic is a zone of military interests. Again, bathymetric features effectively provide for separation of activities. Plans exists, however, for constructing sub- and surface super tankers intended for operation in the central polar basin, carrying petroleum from production sites in the Arctic to markets in the South. If plans like these materialize, sub-sea freight routes should be channelled into certain regions so as to avoid collision with military interests, transforming the High Arctic into an *area of interest overlap and separation*.



Source: Ben C. Gerwick (ed.) "Arctic Ocean Engineering for the 21st Century

Figure 5 The Sketch of the Proposed Zonal Arrangement in the Arctic

A Zonal Arrangement of this kind is one way of sorting out the hot spots and cold spots of northern conflicts stemming from the civilianization of arctic politics. To do that, the employment of the fresh cooperative regimes would be useful instruments of deliberations. The Arctic Council is certainly a candidate to be involved in mitigating problems relating to multiple activities both to the Intermediate and High Arctic. That in turn, would mean a furthering of regional integration and represent an important step towards making the Arctic an integration region for concerted actions. The challenges of civilianization would benefit from some more political integration of the region.

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Future Marine Access in the Arctic Ocean

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Introduction

Marine access in the Arctic Ocean changed in unprecedented ways during the second half of the 20th Century. The Arctic Climate Impact Assessment (ACIA), approved by the Arctic Council in November 2004, documents substantial observational evidence that the sea ice cover has undergone profound changes in recent decades including: a steady decrease in extent with larger areas of open water during summer; decreasing coverage of multi-year ice in the central Arctic Ocean; and, thinning of sea ice throughout the Arctic Ocean. These changes have implications for a host of marine uses such as shipping, offshore development, fishing, indigenous hunting, tourism, and scientific exploration. In response to these environmental changes and their potential implications for the Arctic Ocean, the Arctic Council ministers also approved a new strategic guide – the Arctic Marine Strategic Plan – that was developed by the working group on Protection of the Arctic Marine Environment (PAME). In addition, the ministers requested that PAME conduct a comprehensive 'Arctic marine shipping assessment' with Canada, Finland, and the United States as lead countries and in collaboration with the Council's other working groups and Permanent Participants. This assessment will be conducted during 2005-2008 and will form the basis for the Arctic Council's future responses to increased marine activity throughout the Arctic Ocean.

Recent Arctic Marine Operations

Icebreaker access to nearly all regions of the Arctic Ocean was attained by the end of the 20th Century. During 1977-2004, 52 transits have been made to the Geographic North Pole by the icebreakers of Russia (42), Sweden (4), Germany (2), USA (2), Canada (1), and Norway (1). Remarkably, eight successful transits by surface ships to the North Pole were conducted during the summer of 2004. Thirteen of the 52 voyages were in support of scientific research and the remaining 39 were devoted to tourist voyages to the North Pole and across the Arctic Ocean. Only a single voyage of the 52 did not occur during summer and that was the nuclear icebreaker *Sibir's* (Russia) celebrated voyage which supported scientific operations during 8 May to 10 June 1987 (reaching the North Pole 25 May 1987). During the decade of the 1990's, five historic trans-Arctic voyages were accomplished: a transit across the central Arctic Ocean by the nuclear icebreaker *Sovetskiy Soyuz* (Russia) with tourists in August 1991; transits by the *Louis S. St. Laurent* (Canada) and the *Polar Sea* (USA) during July and August 1994 from the Bering Strait to the North Pole and to Svalbard – the first scientific transect of the Arctic Ocean conducted by surface ship; and, two crossings by the nuclear icebreaker *Yamal* (Russia) with tourists in 1996. During the late summer of 2004, a small 'armada' consisting of the nuclear icebreaker *Sovetskiy Soyuz*, the icebreaker *Oden* (Sweden) and the icebreaking ship *Vidar Viking* (Norway), out-fitted for drilling, conducted a unique scientific drilling voyage in the most remote reaches of the Arctic Ocean. A review of these pioneering voyages provides substantial confirmation that marine access in summer throughout the Arctic Ocean has been achieved by highly capable icebreaking ships.

A snapshot of summer 2004 Arctic marine operations shows a diversity of ships operating in all regions of the Arctic Ocean. Canadian Coast Guard reports indicate 107 voyages by large vessels in the waters of Canadian Archipelago; only five vessels in 2004 made full transits of the Northwest Passage: two Canadian Coast Guard ships, one foreign tourist ship (a Russian icebreaker) and two foreign yachts. Although there were no reported full transits of the Northern Sea Route (NSR) in 2004, an estimated 165 voyages (by 52 vessels) carried 1.75 million tons of cargo along the western sector of the NSR. At least 27 cruise ships and expedition ships sailed around the coasts of Greenland in summer 2004. In addition to the three icebreakers operating in the central Arctic Ocean while conducting drilling into the seabed, six icebreaking ships carried out scientific operations in other regional Arctic seas. While there is currently no complete record of marine activity in the Barents region, there were hundreds of transits and many marine operations in the Barents Sea and in the waters around Svalbard. Thus, a cursory review illustrates that there were a significant number of ships and transits in all Arctic waters during 2004.

Arctic Climate Impact Assessment

The Arctic Climate Impact Assessment (ACIA) released in November 2004 was called for by the Arctic Council and the International Arctic Science Committee. ACIA found that the Arctic is extremely vulnerable to observed and projected climate change and its impacts. The Arctic is now experiencing some of the most rapid and severe climate change on Earth. During the 21st Century, climate change is expected to accelerate, contributing to major physical, ecological, social, and economic changes, many of which have already begun. Changes in Arctic climate will also affect the rest of the planet through increased global warming and rising sea levels (ACIA 2004).

ACIA documented that declining Arctic sea ice is a key climate change indicator. During the past five decades the observed extent of the Arctic sea ice has declined in all seasons, with the most prominent retreat in summer. Each of the five Global Climate Models (GCMs) used in ACIA project a continuous decline in Arctic sea ice coverage throughout the 21st Century. One of the models projects an ice-free Arctic Ocean in summer by 2005, a projected scenario of great significance for Arctic marine shipping since multi-year ice would essentially disappear in the Arctic Ocean (all the next winter's sea ice would be first-year). GCM projections to 2100 suggest that

Arctic sea ice in summer will retreat further and further away from most Arctic coasts, potentially increasing marine access and extending the season of navigation in nearly all Arctic regional seas.

The work of ACIA also included first-order attempts at regional assessments for the Northwest Passage (NWP) in the Canadian Arctic and the Northern Sea Route (NSR) along the northern Eurasian coast. Two serious constraints limited an adequate ACIA assessment of the NWP: the GCMs could not resolve the complex geography of the Canadian Archipelago; and, the observed sea ice trends analyzed by the Canadian Ice Service, although negative for sea ice extent since the late 1960s (in both the eastern and western regions of the NWP), indicated a very high inter-annual variability of coverage. Sea ice simulations conducted for the NSR (analyzing the region from Kara Gate in the west to Bering Strait) were more successful and these indicated decreasing sea ice coverage and plausible increases in the length of the NSR navigation season throughout the 21st Century. Many of the simulations show retreating ice conditions along the NSR, but with ice consistently present at the northern tip of Severnaya Zemlya; such model results imply, for example, a potential reliance on a transit route through Vilkitskii Strait between the Kara and Laptev seas, rather than a more northerly route in the open Arctic Ocean.

In summary, ACIA confirms that the observed retreat of Arctic sea ice is a real phenomenon. The GCM projections to 2100 show extensive open water areas in summer around the Arctic basin. Thus, it is highly plausible there will be increasing regional marine access in all the Arctic coastal seas. However, the projections show only a modest decrease in winter Arctic sea ice coverage; there will always be an ice covered Arctic Ocean in winter although the ice may be thinner and may contain less multi-year ice. The very high, inter-annual variability of observed sea ice in the NWP and non-applicability of the GCMs to the region, prevent an adequate assessment of this complex region. Although the ACIA projections indicate an increasing length of the navigation season for the NSR, detailed quantification of this changing marine access is testing the limitations of today's GCMs. There is a definite need for improved Arctic regional models to adequately assess these observed changes in sea ice and their considerable implications for the expanded marine uses of the Arctic Ocean.

The suite of plausible, alternative futures of the Arctic sea ice during the ACIA time periods (2010-2030, 2040-2060, and 2070-2090) represent a first-order, strategic guide to future marine access in the Arctic Ocean. These sea ice analyses have provided the foundation for an initial attempt at construction of an 'Arctic Sea Ice Atlas of the Future.' Climatological sea ice atlases of the Arctic Ocean and regional seas have been developed by several Arctic nations during the 20th Century. Unlike these earlier atlases based on the observed record, this new atlas under development will be based primarily on GCM projections of Arctic sea ice conditions for the remainder of the 21st Century. Illustrated will be the 5-model median Arctic sea ice simulations for the ACIA time slices and simulations for single models over a complete annual cycle. Although some uncertainty remains in the projections, the intent of the atlas will be to provide a strategic, long range view of plausible futures of sea ice and potential marine access throughout the Arctic basin. The atlas will be designed as a strategic planning tool and potentially can be a vehicle to provoke wide-ranging discussions about the future of the Arctic Ocean.

Arctic Marine Strategic Plan

The Arctic Council's vision for the Arctic marine environment is designed to foster 'a healthy and productive Arctic Ocean and coasts that support environmental, economic and socio-cultural values for current and future generations.' During 2003 to 2004, PAME, with Canada and Iceland as lead countries, developed a strategic guide – the Arctic Marine Strategic Plan. The Plan addresses emerging issues, such as oil, gas and shipping activities, employing a risk assessment approach. It takes into account the special needs and requirements of indigenous communities while maintaining an objective of sustainable development of the Arctic marine environment. The Plan aims to improve how the Arctic coastal and marine environment is managed, particularly given the accelerated changes occurring in the North due to climate change and increasing economic activity. The goals of the Plan are to:

- Reduce and prevent pollution in the Arctic marine environment
- Conserve Arctic marine biodiversity and ecosystem functions
- Promote the health and prosperity of all Arctic inhabitants
- Advance sustainable Arctic marine resource use.

The Plan relies on the existing structures and mechanisms of the Arctic Council and other bodies for its implementation. Some examples of key strategic actions include:

- Conduct a comprehensive assessment of Arctic marine shipping at current and projected levels.
- Improve capabilities for responding to marine emergency situations, including those resulting from climate variability.
- Promote World Summit on Sustainable Development (WSSD) actions related to the marine and coastal environment, including the application of an ecosystem approach and establishment of marine protected areas, including representative networks.

- Identify networks that can serve as key environmental and socio-economic indications of the state of the Arctic marine ecosystems and thus guide effective decision-making.

- Foster partnerships among governments, indigenous peoples' organizations, communities, industry, international bodies, non-governmental organizations and academia to advance the goals of this Plan, employing such mechanisms as partnership conferences and workshops.

- Promote oceans education through appropriate instructions and organizations such as the University of the Arctic; encouraging training related to best operating practices.

- Promote a marine and coastal component in the International Polar Year program.

The Arctic Marine Strategic Plan was approved by the Arctic ministers in November 2004. The Plan addresses both short-term and long term challenges and opportunities, and recognizes the success of its implementation rests on institutional support and effective engagement of a wide range of Arctic and non-Arctic stakeholders.

Arctic Marine Shipping Assessment

The Arctic Council's working group, PAME, is to lead a comprehensive assessment of Arctic marine shipping during 2005 to 2008. This initiative is a natural follow-on to ACIA and the Arctic Marine Strategic Plan. There will be two components to the assessment:

- A snapshot of the current Arctic marine shipping situation (will initially include all possible ship activities and types: tankers, cruise ships, fishing vessels, drilling ships, offshore supply vessels, scientific ships, and others),

- Future projections of Arctic marine activity (will be based partially on ACIA environmental projections of climate and sea ice to 2050, and economic projections to 2020).

The PAME-led assessment will be inclusive and will encourage participation by the Member States, Permanent Participants, and working groups of the Arctic Council; industry; the International Maritime Organization; ship classification societies; research organizations; and, non-Arctic stakeholders such as Japan. The assessment will yield a host of useful recommendations for the Member States of the Arctic Council and for the global maritime community.

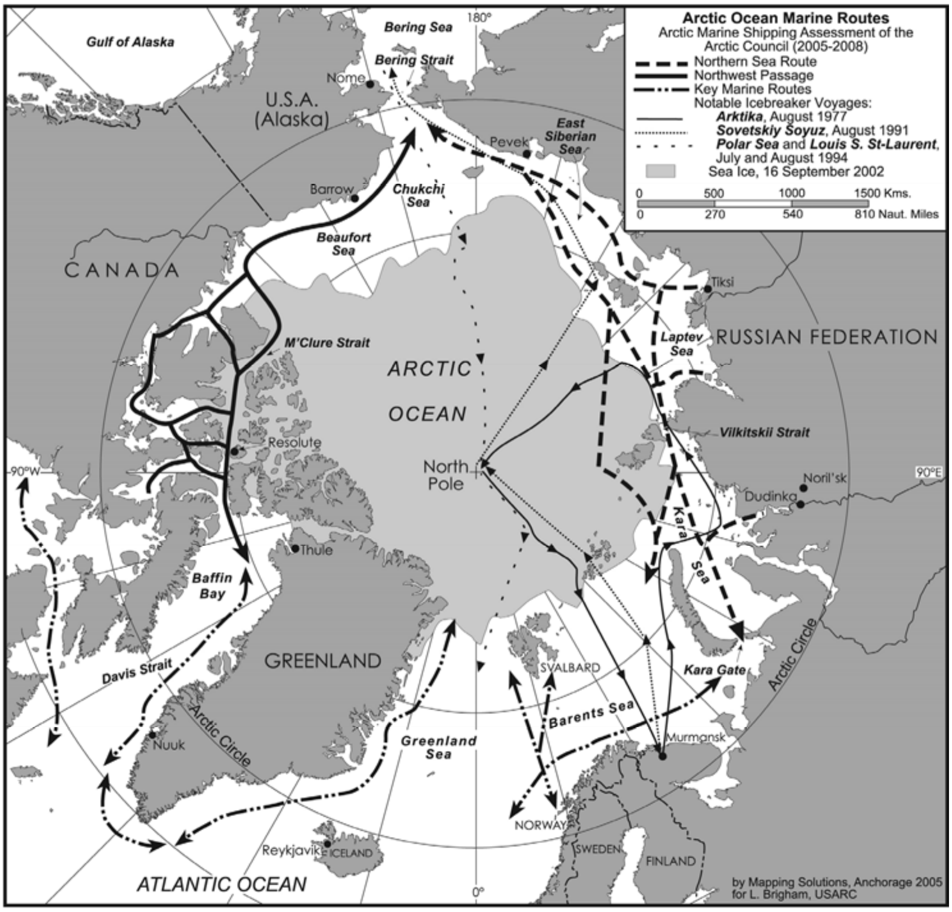

Figure 1 This map indicates the key marine routes in the Arctic Ocean that will be reviewed as part of the Arctic Council's 'Arctic Marine Shipping Assessment, 2005-2008.': Three historic polar voyages in the central Arctic Ocean are illustrated: the first surface ship voyage to the North Pole by the Soviet nuclear icebreaker *Arktika* in August 1977; the tourist voyage of the Soviet nuclear icebreaker *Sovetskiy Soyuz* across the Arctic Ocean in August 1991; and the historic Arctic scientific transect by the polar icebreakers *Polar Sea* (USA) and *Louis S. St-Laurent* (Canada) during July and August 1994. These voyages confirm that in summer at the end of the 20th century the entire Arctic Ocean was accessible by icebreaker. Also shown is the minimum extent of Arctic sea ice on 16 September 2002 derived from satellite passive microwave observations. Prominent on this date are ice-free areas across each of the Russian Arctic coastal seas, an historic retreat of the ice edge in the Beaufort Sea, and an ice edge position north of Svalbard.

Summary

Three key Arctic initiatives – the *Arctic Climate Impact Assessment*, the *Arctic Marine Strategic Plan*, and the ongoing *Arctic Marine Shipping Assessment* – will influence the future directions and policies of the Arctic nations regarding Arctic marine transport. The Arctic Council, by supporting these unique Arctic efforts, has evolved as a proactive forum responding to the realities of Arctic environmental change and increased economic activity in the region. Hopefully, this international Arctic collaboration will promote enhanced research, monitoring, assessment and technical cooperation among all Arctic and non-Arctic stakeholders who envision greater marine use of the Arctic Ocean.

Further Development of the NSR in the Coming Decades

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The famous Russian naval commander, Admiral Makarov, who designed the first icebreaker in the world, compared Russia to a building facing the Arctic Ocean.[1] Indeed, more than 20% of the territory of Russia is situated above the Polar circle and the Russian Arctic Sea Shelf occupies a third of the Arctic Ocean. Not less than 30% of the world's reserves of oil and gas are concentrated in the Russian Arctic zone. In its far-northern regions, Russia produces 95% of its gas, 75% of its oil, mines the major part of its nickel, tin, platinum and gold and extracts the bulk of its diamonds.

The efficient development of the resources in the Arctic is a long-standing priority in Russia's economic strategy.

The development of these resources requires an adequate transportation service. Russian shipowners, first and foremost, the Murmansk, Far Eastern and Northern Shipping Companies, have accumulated a great deal of know-how in operating fleets in arctic conditions.

A major part of the still-developing infrastructure of the economic complex of the extreme north of Russia is the Northern Sea Route (NSR).

The policies of the Russian Federation in the field of Arctic shipping development is predicated on the fact that the NSR is a historically-established national united transport communication line in the Arctic.

Year after year, the traffic of goods through the NSR has been consistently increasing and the Arctic Marine Transportation System (AMTS) has developed accordingly. Since 1978, transportation of cargo for the Norilsk mining and smelting integrated works has been carried out on a year-round basis on the line between the port of Murmansk and the port of Dudinka.

By the mid-80s, the total volume of traffic passing through the NSR amounted to 6.6 million tons annually.[2]

Russia has unique experience in carrying out sea ice operations in the Arctic. A large number of highly skilled ice masters, icebreaking fleet operators, polar hydrographers, ice scouts and hydrometeorologists (forecasters) have been trained.

Elaborating on the peaceful initiatives in the Arctic, Russia adopted non-discriminatory policies for ships from all states based on "Regulations for Navigation on the Seaways of the NSR", 1991; "Guide for Navigation through the

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1 Makarov S.O. "Yermak in the ice". St. Petersburg, 1901.
2 Peresypkin V.I., Tsoy L.G. Arctic icebreakers, state and prospects of development.//Proceedings of ICETECH'2000.

NSR", 1995; and "Requirements for Design, Equipment and Supply of Vessels Navigating the NSR", 1995. In these normative documents, priority is given to prevailing international legal standards and appropriate rights of the coastal states to ensuremaritime safety and to take measures for preventing the pollution of the marine environment by ships. Navigational safety is secured through the use of modern navigational equipment, maps and manuals in both Russian and English.[3]

The transition to a market-oriented economy has resulted in disruptions to previously established regional transportation relations and the weakening of the administrative and economic mechanisms of the NSR. Traffic volume has decreased during the last decade by three to four-fold.

Despite the losses sustained from the fall in traffic volume through the NSR, in the ice going transport fleet composition, in the Arctic infrastructure, the created sea transport system keeps on smoothly meeting all the demands of the country in the Arctic traffic. Cargo turnover in the Arctic has been growing in recent years.

All in all, there are eight areas exhibiting progressive economic growth in Russia's Arctic zone. Six areas are situated in the Euro-Asian and West-Siberian parts of the Arctic, with Nizhne-Yeneseysky, Yamal and Timan-Pechorsky the localities of pioneering development (Fig. 1).

Today, Russia is engaged in mutually beneficial dialogue with the global energy community. The provision of deliveries of Russian energy exports to the world market in a northerly direction is the key to making these discussions effective, in due consideration of the limitations of traditional seaborne routes (Straits of the Black and Baltic Seas).

For a long time, there has been a stable system of transport logistics in the Russian part of the Arctic and the NSR, Russia's major latitude highway for ships, is its basis.

According to calculations, maritime exports of Arctic hydrocarbons along the NSR have great advantages over pipeline traffic. When used, capital expenses are on average reduced by 1.5, free choice of ultimate consumer becomes available and the risk of environmental pollution is reduced.

Exports of oil from the Arctic by sea began in 2000. The volume of cartage is increasing each year and burgeoning investments are aimed at the development of the Arctic Transport System.

In 2004, more than 6 million tons of oil was transported from the Karsk, Barents and White Sea terminals and from the port of Murmansk.

Rapid growth in the transportation of exports by sea in the Arctic region is expected in the near future, firstly in connection with the development of coastal and shelf deposits of hydrocarbon raw materials.

Around 40-50 vessels are continuously operating in the seaways of the NSR and this fleet is expanding all the time.

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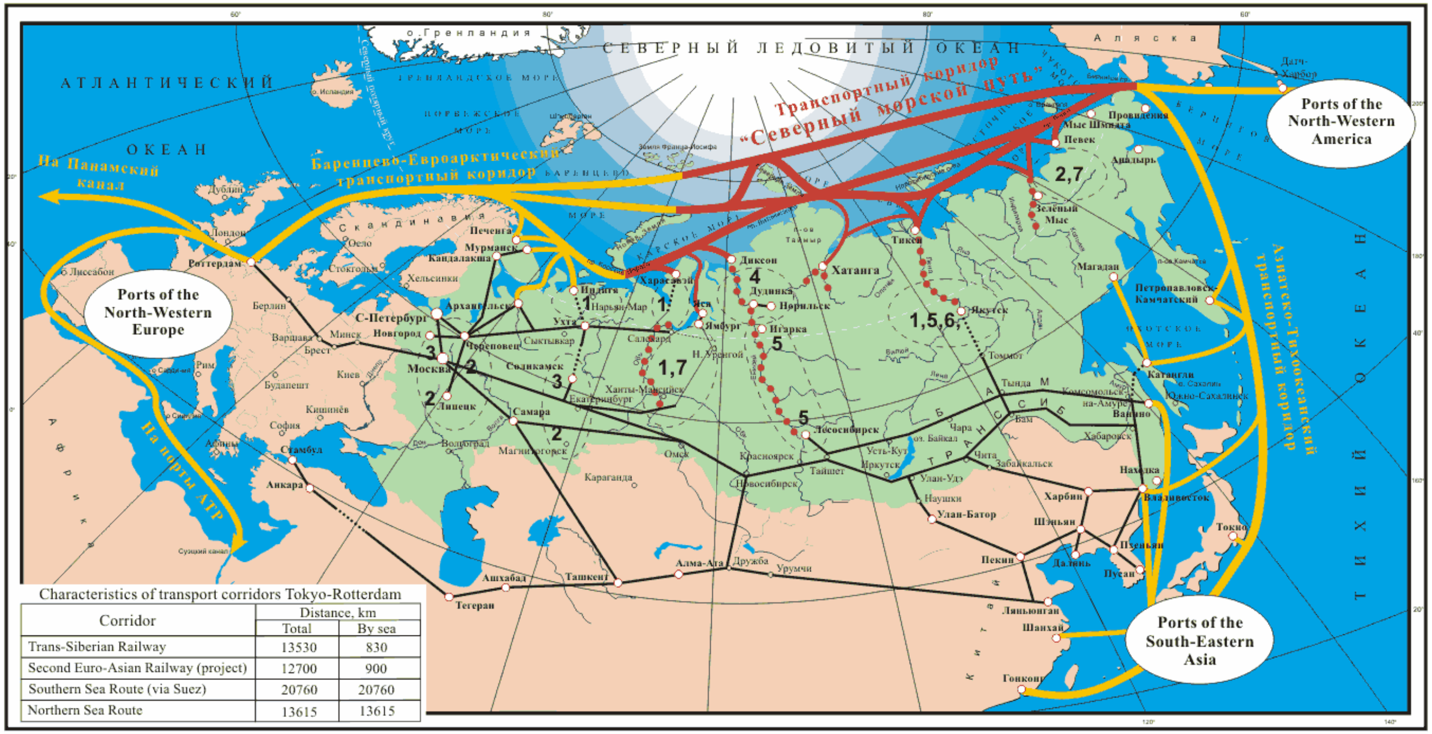
3 Peresypkin V.I., Tsoy L.G. Northern Sea Route Navigation. Risk Assessment. Presentation on Joint EU-Russia-Canada-US Workshop, "A Common Approach to Collaborative Technological Research for Arctic Development". Brussels, October 2001.



Characteristics of transport corridors Tokyo-Rotterdam

Corridor	Distance, km	
	Total	By sea
Trans-Siberian Railway	13530	830
Second Euro-Asian Railway (project)	12700	900
Southern Sea Route (via Suez)	20760	20760
Northern Sea Route	13615	13615

Export: 1 - hydrocarbons, 2 - ferrous metals, 3 - mineral fertilizers, 4 - non-ferrous metals, 5 - timber, 6 - coal.

Import: 7 - food stuffs.

Symbols:

- Sea transport corridors.
- Railways.
- Railways to be constructed.
- River shipping lines.
- Areas of the formation of cargo sources for the Northern Sea Route.

CNIIMF

Figure 1 Northern Sea Route and Transport Corridors "East-West-East"

Thus, LUKOIL Company, which currently operates 10 ice-class Handymax tankers, is planning to arrange a tender for the construction of four more ice-class Panamax/Aframaxes to operate out of the Varandey deep-sea terminal in the Timan-Pechorskoye oilfields.

GAZPROM is planning to order two ice-class (LU-6) tankers of 70,000 tons (deadweight) each, to carry oil from the Prirazlomnaya platform in the Pechora Sea. ROSNEFT plans to order four of five ice-class (LU-7) tankers of 120,000 tons (deadweight) each to carry oil from the Dikson terminal.

NORILSKIY NIKEL has started to build a fleet of its own to operate in ice conditions.

For this purpose, they are placing an order in Finland for the construction of four ice-class (LU-7) multipurpose ships of 14,500 tons (deadweight).

Ice-class tankers are also being built for such large shipping companies as Sovkomflot (eight tankers), Primorsk and Novoship (Fig. 2).

In 2006, GAZPROM will establish a permanent offshore platform in the Prirazlomnoye shelf oilfield in the Pechora Sea with an annual shipment volume of 7 million tons. Support in ice conditions will be carried out by a nuclear-powered icebreaker and two diesel–powered icebreakers.

ROSNEFT is likewise carrying out research and development work for the construction of a deep-sea oil terminal in the vicinity of the port of Dickson to ship oil from the Vankorsk group of Nezhne-Yeniseyskoye oilfields by 2009, with an expected shipment volume of 18 million tons per year. Support will be carried out by

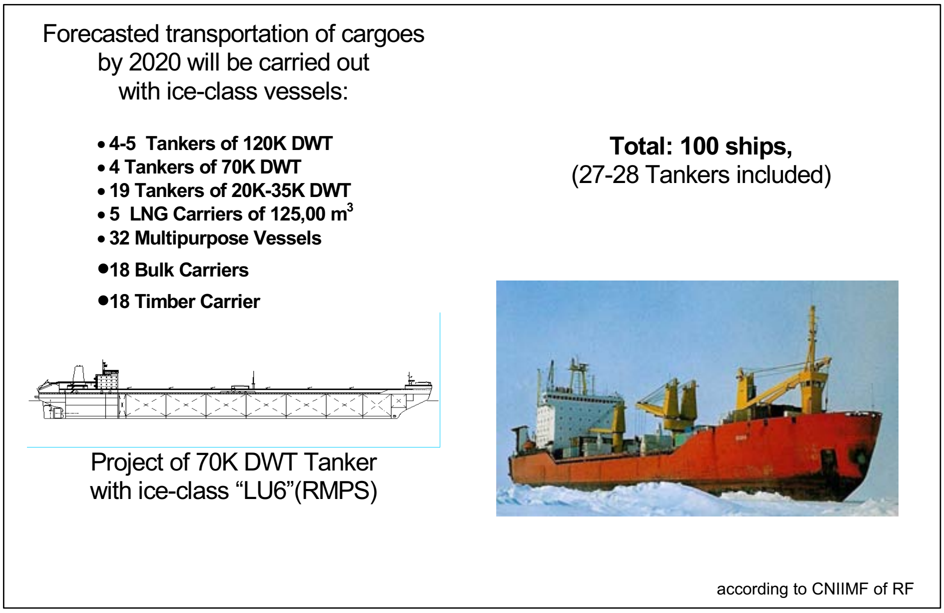


Figure 2 Structure of Transport Fleet for the Period till 2020

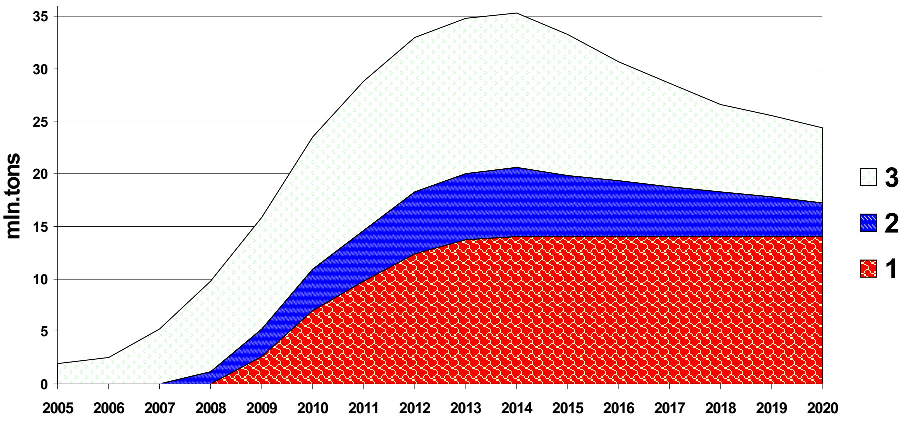


TABLE OF SYMBOLS:	MAXIMUM OF OIL TRANSPORTATION, mln.tons/year
1 – VANKORSKOYE	14
2 - PRIRAZLOMNOYE	7
3 – TRANSPORTATION VIA VARANDAY TERMINAL	15

according to CNIIMF of RF

Figure 3 Dynamics of Oil Export from Nizyne-Yeniseyskoye (Vankorskoye), Prirazlomnoye and Timano-Pechorskoye (Varandeyskoe) Oilfields up to 2020

three or four nuclear-powered icebreakers. The government has been charged by the President of the Russian Federation[4] to promote the realization of investment projects concerning the development of the Vankorskoye oil and gas deposits (Fig. 3).

In 2007, LUKOIL Company will deepen its Varandey roads deep-sea oil terminal in the Timan-Pechorskoye oilfields from 12 to 17 metres. The volume of oil shipments from the terminal will amount to 15 million tons annually. Pilotage will be carried out by two line diesel icebreakers.

TRANSNEFT is planning to establish a pipeline system in Indiga in Western Siberia and to construct a deep-sea shipment terminal in Chesha Bay to dispatch 25 million tons of oil to the USA and European customers using tankers of up to 250,000 tons (deadweight).

I would like to stress that the transportation patterns and schemes of the Arctic transport system are constantly improving. Oil export logistics of the Nizhne-Yeniseyskoye, Prirazlomnoye and Timan-Pechorskoye oilfields are the most advanced in terms of development. In particular, a shuttle service of ice-class tankers, transporting oil to offshore trans-shipment terminals in the port of Murmansk is being tested. Oil is then transferred to storage tankers where it is pumped into ocean-going tankers of 150,000-300,000 tons (deadweight) to be exported to the ports of Europe

[4] Decree #412 by the President of the Russian Federation, April 12, 2005.

and the United States. The early road trans-shipment terminals in the port of Murmansk are already in operation, including the 350,000-ton (deadweight) tanker, “Belokamenka” (Fig. 4).

Year-round cargo delivery for the NORILSKY NIKEL Company through the port of Dudinka is being maintained at a level of 1.2-1.3 million tons. Pilotage of bulkers along the Dudinka line will be carried out by two or three universal nuclear-powered twin-draft icebreakers.

Timber exports from the ports of Archangel, Kandalaksha, Igarka and Tixi will be resumed and will approach 1.1 million tons. 15-20 timber carriers are required to export this volume.

1.8 million tons of cargo to be used for the development of the Yamal gas deposits and up to 2 million tons of metallurgical and chemical export products from Krasnoyarsky krai will be transported by sea and sea-river vessels from the Yenisey Shipping Company.

Production from the Republic of Sakha (Yakutia) and the Chukchi Autonomous okrug (oil, coal, tin concentrate and timber) will be shipped by vessels from the Murmansk and Far East Shipping Companies and also by river-sea vessels from the Lena Shipping Company. The volume of vitally important cargo to be transported to the Arctic region (so-called Northern Delivery) with the use of sea and sea-river vessels is expected to amount to 1-3 million tons. On the whole, pilotage in the eastern part of the NSR will be carried out by two linear diesel icebreakers.

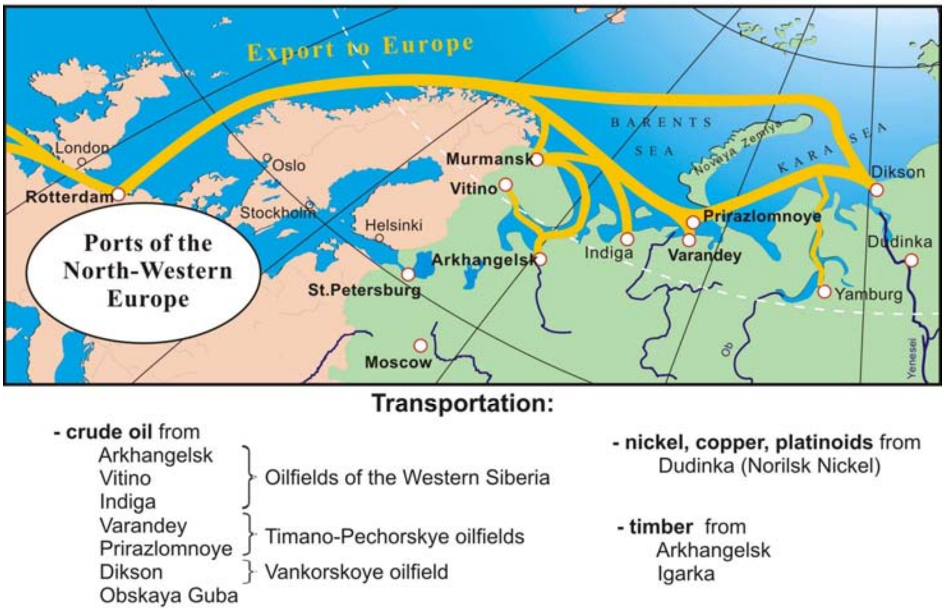


Figure 4 Transport Routes for Exporting Natural Resources from the Western Region of the Russian Arctic

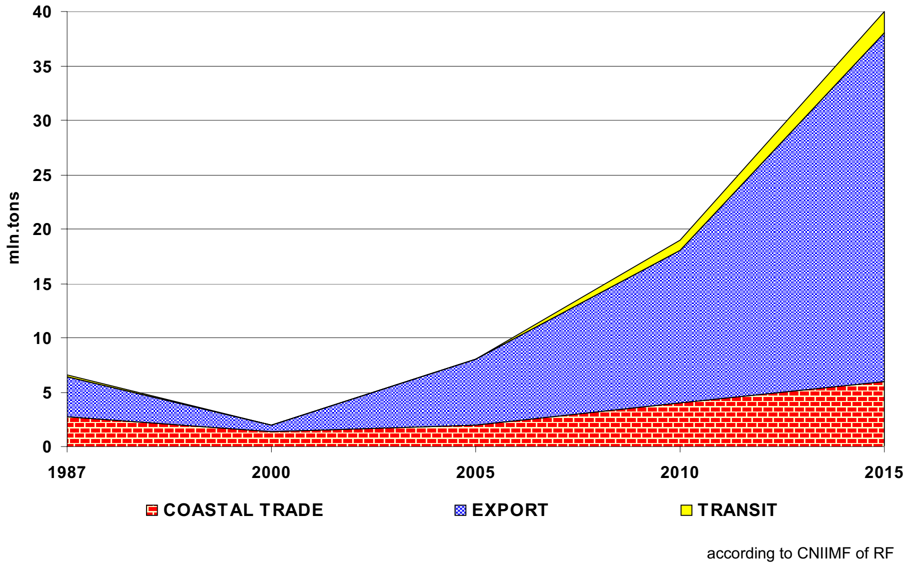


Figure 5 Development of Carriages along the Nothern Sea Route up to 2015

The volume of transit along the NSR will not exceed 500,000 tons. In the past, up to 20 transit passages were carried out annually (in 1993, 22 passages and 226,000 tons of transit cargo was shipped), but during the last few years only one vessel has passed in transit through the NSR (in 2001). (Fig. 5)

According to current forecasts, the volume of carriage along the NSR in 2015 will be at 40 million tons a year. Oil and gas exports will dominate the type of cargo being carried accounting for 70%, bulk cargo will constitute 10%, general and container cargo 8%, the export of nonferrous metals will amount to 5%, ferrous metals 3% and timber cargo will be approximately 4% (Fig. 6).

Conceptually, the new approach of the NSR development under market conditions is based on the following principles:[5]

The state supports the priority sectors of the economy of the North (oil and gas, mining, metallurgical, timber) and is developing the NSR as a federal transport infrastructure (icebreakers, navigational, hydrographical, hydrometeorological, communications, search and rescue facilities).

Commercial enterprises, utilizing the natural resources of the Arctic, are building diesel-electric icebreakers of the multipurpose supply icebreaker variety and in cooperation with the shipping companies, are developing the Arctic transport fleet and oil and gas trans-shipment terminals using their own or borrowed funds. Minimum

[5] Peresypkin V.I., Yakovlev A.N. The Northern Sea Route – current state and perspective development, CNIIMF Proceedings, “Perspective means of transportation for the Arctic”. St. Petersburg, 2003, pp. 3-17.

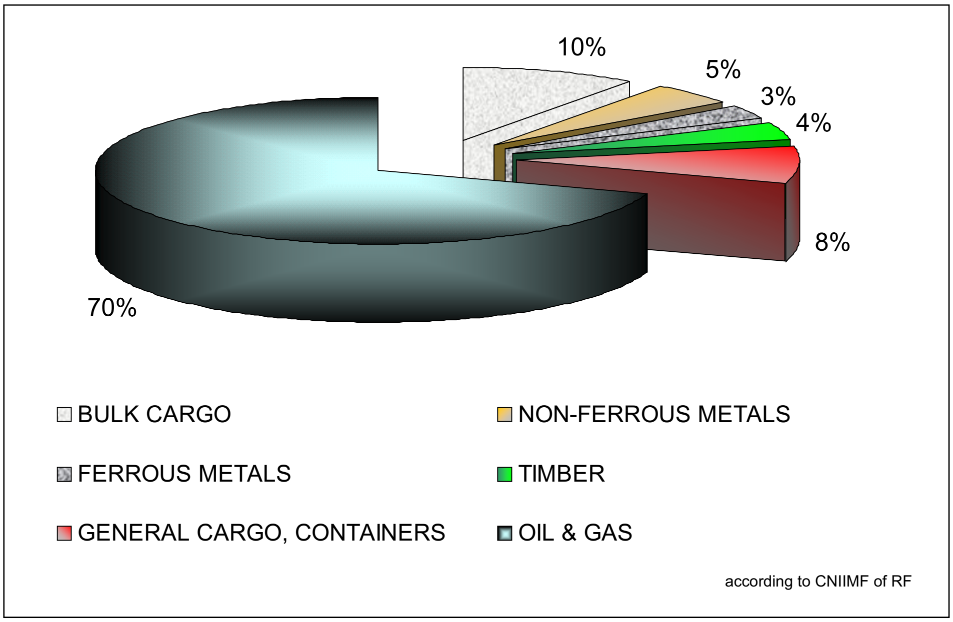


Figure 6 Structure of Carriages along the Northen Sea Route in 2015

state support is directed to subsidizing a portion of the interest rate for credit from Russian Banks when the ships are built at Russian shipyards.

Development of the harbour industry is affected by subjects of the Russian Federation, by shipping companies and by other commercial enterprises.

Harbour icebreakers are replaced by the owners of the sea ports and by the federal unitary enterprise ROSMORPORT.

The basis of AMTS is the icebreaking fleet with nuclear icebreakers as the main effective power (Figs. 7, 8, 9).[6]

Existing Russian icebreakers, mainly built in the 70th - 80th , are now aging and being written-off. Due to such physical and moral obsolescence, it is necessary to recommence icebreaker construction and to create a next-generation fleet.

The Ministry of Transport has developed programs - which are being implemented - for extending the service lives of steam-generating plants and nuclear and linear diesel icebreakers by 8 to 15 years. The total cost of the work to extend the lifetimes of the nuclear and Arctic diesel icebreakers is approximately US$150 million.

[6] Marine Doctrine of the Russian Federation for the period up to 2020. Approved in Decree #1357 by the President of the Russian Federation, 27 May 2001.

Figure 7 Nuclear Icebreaker *Rossiya* Towing Tanker *Uikku*

Figure 8 Diesel-electric Icebreaker *Yermak* in the Eastern Arctic

Figure 9 Shallow-draught Icebreaker *Kapitan Sorokin* in Yenisei Gulf

The existing Arctic linear icebreaking fleet is federal property. Operator functions are carried out by two stockholding shipping companies - the Murmansk and Far Eastern Shipping Companies. The Murmansk Shipping Company operates eight nuclear and two linear diesel-electric icebreakers, while the Far Eastern Shipping Company operates three linear diesel-electric icebreakers and an auxiliary diesel icebreaker.[7]

Two nuclear-powered icebreakers (Lenin and Sibir) have been decommissioned due to physical deterioration. The icebreaker “50 Let Pobedy”, which closes a series of Arctic class nuclear icebreakers, is in the final stages of construction at the Baltic shipyard and is to be ready in 2006.

The composition of the Arctic fleet currently in operation and the distribution of icebreakers among shipping companies is shown in Table 1.

Table 1 Russian Arctic Icebreaker Fleet as of the Beginning of 2005

Name	Year of construction	Shaft power, kW	Builder	Operator
Nuclear icebreakers				
Arktika	1974	49000	USSR	MSCO
Rossia	1985	49000	USSR	MSCO
Sovetskiy Soyuz	1989	49000	USSR	MSCO
Yamal	1992	49000	USSR	MSCO
Taimyr	1989	32500	Finland, USSR	MSCO
Vaigach	1990	32500	Finland, USSR	MSCO
Diesel-electric icebreakers				
Admiral Makarov	1975	26500	Finland	FESCO
Krasin	1976	26500	Finland	FESCO
Kapitan Nikolaev	1978	16200	Finland	MSCO
Kapitan Dranitsyn	1980	16200	Finland	MSCO
Kapitan Khlebnikov	1981	16200	Finland	FESCO

Provision is being made for the further development of the icebreaking fleet. Primary emphasis will be placed upon icebreakers powered by nuclear energy which have superior icebreaking capabilities and unlimited endurance. State-of-the-art science and technology makes it possible to reduce the size differences between the next-generation icebreakers through both the building of double-draft 60-megawatt nuclear icebreakers capable of operating in waters other than the main waterways of the NSR, such as in the coastal areas of Arctic seas and the estuaries of the Siberian rivers, and through the construction of powerful 25-megawatt sea-going diesel

[7] Icebreaker support of fleet operation in freezing seas of Russia (Reference information). Ministry of Transport of the Russian Federation. Moscow, 2001.

icebreakers with a restriction on the draft that will enable the combination of functions of icebreakers from two classes into one vessel.[8]

The nuclear and diesel linear icebreakers are to be built using federal funds. Additional sources are to be found through investment promotion.

It will take around ten years to prepare feasibility reports, carry out research work and to design and build a pilot next-generation icebreaker (LK-60N), including the establishment of a new power reactor facility.

It is expected that the icebreaker will be put into service by 2015. Table 2 shows the timeframe over which the existing nuclear icebreaking fleet will be decommissioned.

Table 2 Nuclear Icebreakers Decommissioning

Name	Year of built	Termination of the rated period, year	Termination of extended period, year
Arktika	1974	1990	2008
Sibir	1976	2009	2020
Rossiya	1984	2006	2017
Taimyr	1988	2004	2011
Sovetskiy Soyuz	1989	2008	2018
Vaigach	1989	2005	2012
Yamal	1991	2009	2019

Eight nuclear-powered icebreakers shall operate along the NSR seaways to provide the abovementioned cargo transportation by 2020, including seven next-generation icebreakers (LK-60N). Table 3 shows the dynamics of decommissioning nuclear-powered icebreakers and replacing them with next-generation vessels (LK-60N).

8 Tsoy L.G. et. al. Design Requirements for Future NSR Ships. INSROP Working paper #160, 1999.

Table 3 Dynamics of the Decommissioning of Existing Nuclear Icebreakers and their Replacement with Next-generation Vessels of the LK-60 Type to Ensure Cargo Transportation of RAO "Norilsky Nickel" and the Amounts of Oil Planned by the "Gazprom and Rosneft" Oil Company from the Prirazlomnoye and Vankorskoye Deposits to 2021

Year	Putting into operation/out of operation of icebreakers	Number of icebreakers in operation	Number of icebreakers needed		
			for "Norilsky Nickel"	for "Gazprom and Rosneft"	
				Prirazlomnoye	Vankorskoye
2005	Putting into operation of n/i *Rossiya* after repair and works for the extension of life time	6	4-5	1	-
2006	Putting into operation of n/i *50 let Pobedy* and putting out of operation for the extension of life time of n/i *Sovyetsky Soyuz*	6	4-5	1	-
2007	Putting into operation after the extension of life time of n/i *Sovyetsky Soyuz* and putting out of operation of n/i *Arktika*	6	4-5	1	-
2008	Putting into operation of n/i *Sibir* after reconstruction	7	4-5	1	1
2009	Putting out of operation for the extension of life time of n/i *Yamal*	6	4-5	1	2
2010	Putting into operation of n/i *Yamal* after the extension of life time	7	4-5	1	2
2011	All icebreakers are in operation	7	4-5	1	3
2012	Putting out of operation of n/i *Taimyr*	6	4-5[i)]	1	3
2013	Putting into operation of *Vaigach*	5	4-5[i)]	1	3-4[ii)]
2014	All icebreakers are in operation	5	4-5[i)]	1	3-4
2015	Putting into operation of an icebreaker of the next-generation *LK*-60 type	6	3-4[i)]	1	3-4
2016	Putting out of operation of n/i *Rossiya* and putting into operation of an icebreaker of the next-generation *LK*-60 type	6	2-3	1	3-4
2017	Putting out of operation of n/i *Sovyetsky Soyuz* and putting into operation of an icebreaker of the next-generation *IB*-60*N* type	6	2-3	1	3-4
2018	Putting out of operation of n/i *Yamal* and putting into operation of an icebreaker of the next-generation *LK*-60 type	6	2-3	1	3-4
2019	Putting out of operation of n/i *Sibir* and putting into operation of an icebreaker of the next- generation *LK*-60 type	6	2-3	1	3-4
2020	Putting into operation of an icebreaker of the next-generation *LK*-60 type	7	2-3	1	3-4
2021	Putting into operation of an icebreaker of the next-generation *LK*-60 type	8	2-3	1	3-4

Notes:

(i) After disposing of the shallow draft nuclear icebreakers Taimyr and Vaigach for the period before the putting into operation of the next-generation nuclear icebreakers (2012-2014), 1-2 operating diesel-electric icebreakers of the Kapitan Sorokin type should be used to support navigation on the Yenisei river in winter.

(ii) Three icebreakers are needed to transport oil from the Vancor group of deposits at the maximum annual volume according to version A (15 million t) and four icebreakers according to version B (18 million t).

Diesel-electric Icebreakers

The current state of domestic diesel icebreakers, which carry out pilotage in ice conditions in the Arctic and in Far East waters, and the times when the icebreakers were decommissioned are shown in Table 4.

Table 4 Decommissioning of Diesel Icebreakers Operating in the Arctic, White Sea and Far-Eastern Basin.

Name	Shaft power, kW	Year of construc-tion	Areas of operation	Termination of the rated period, year	Termination of extended period, year
Linear icebreakers					
Admiral Makarov	26500	1975	Arctic, Far-Eastern Basin, Finnish Gulf	1999	2015
Krasin	26500	1976	Arctic, Far-Eastern Basin	2000	2017
Kapitan Nikolaev	16200	1978	Shallow water areas of Arctic, White Sea	2002	2017
Kapitan Dranitsin	16200	1980		2004	2019
Kapitan Khlebnikov	16200	1981	Arctic, Far-Eastern Basin	2005	2017
Auxiliary and port icebreakers					
Magadan	7000	1983	Far-Eastern ports	2007	2017
Dikson	7000	1983	Archangelsk	2007	2022
Kapitan Kosolapov	2500	1976	Archangelsk	2000	2017
Fyodor Litke	3450	1970	Vanino, De-Kastri	1994	2012

Linear Diesel Electric Icebreakers

Two diesel-electric next-generation icebreakers of the LK-25D type with shaft power of about 25 megawatts are required to provide summer season cargo deliveries from the East to the eastern region of the Arctic. These icebreakers shall supersede the *Krasin* and *Admiral Makarov* icebreakers which are to be written off in 2015-2017.

In winter, these icebreakers shall provide pilotage in the Magadan direction and in the Tartar Strait, where exports of oil from Sakhalin by heavy-tonnage tankers will start in 2006-2007.

Diesel-electric icebreakers of the LK-25D type are capable of moving in up to two meters of ice and can be used to export oil from the Timan-Pechora fields in the Varandey area. Two icebreakers of this type are to be built by 2009-2010 to meet the requirements of oil exports from the area.

In future, when the problem of constructing a new oil terminal in Indiga is solved, it will be reasonable to continue the building of icebreakers of the LK-25D type, with coming up to 5 icebreakers in the series.

Auxiliary and Harbour Icebreakers

To provide year-round servicing of both vessels at the berths of the port of Dudinka and tankers at the offshore terminals of Dikson and Varandey, at least five next-generation icebreakers of the LK-7D type with 7-megawatt shaft power shall be built (one icebreaker for Dudinka and two icebreakers for the ports of Dikson and Varandey).

The expected characteristics of nuclear-powered and diesel next-generation icebreakers are shown in Table 5 and in the Illustrations (Figs. 10, 11, 12).

Table 5 Characteristics of Next-generation Icebreakers

Characteristics	LK-60	LK-25	LK-7
Length, m			
overall	176.0	139.6	92.0
on design WL	164.0	129.6	85.8
Breadth, m			
overall	34.0	30.0	23.0
on design WL	32.2	28.0	22.0
Depth, m	15.8	13.2	9.8
Draft, m			
on design WL	10.5	8.5	6.0
design minimum	8.5	-	-
Displacement on design WL, t	32400	19500	6000
Type of power plant	nuclear	diesel-electric	diesel-electric
Shaft power, MW	60	24	7
Number of propellers	3	3	2
Open water speed, knots	22.3	19.2	17.0
Icebreaking capability, m	2.9	2.0	1.1
Fuel endurance, days	unlimited	35	25

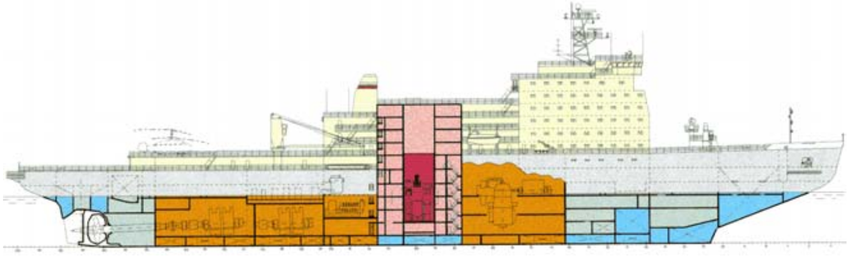


Figure 10 Universal Double-draft Nuclear Icebreaker of LK-60 Type

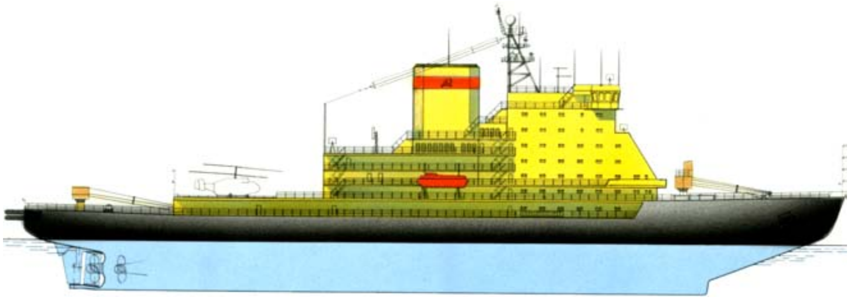


Figure 11 Linear Diesel-electric Icebreaker of LK-25 Type

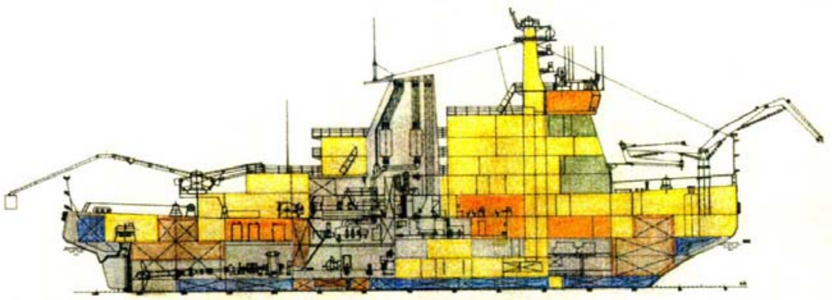


Figure 12 Auxiliary Diesel-electric Icebreaker of LK-7 Type

Conclusion

The document "Transport Strategy of the Russian Federation for the period to 2020", approved by the supreme organs of the government of the Russian Federation points out that the role of the state in the formation of the Arctic transport system is to provide favorable conditions for the reliable functioning of the NSR.

The purposes of NSR development are: to preserve the NSR as a main national waterway in the Arctic, to strengthen national security in the Arctic region, to provide transport services for the development of Arctic deposits, to develop exports and coastal shipping and to form a self-sustaining and profitable Arctic marine transport system.

The reforms are based on the principle of preserving the NSR infrastructure as government property, since the infrastructure is considered to be a principal part of the Russian transport system in the Arctic region.

Administrative reforms are being carried out in Russia and in order to continue the development and improvement of NSR operation within the framework of these revisions, a set of measures is planned to be undertaken, including the following:

To create a new state organization for the supervision of sea operations in the Arctic. The organization shall act as an operator of the state icebreaking fleet and exercise control over the functioning of the NSR infrastructure;

To improve the normative and legal basis, that is, to complete the elaboration and adoption of the new “Regulations for navigation on the Seaways of the NSR” by the government of the Russian Federation;

To correct and republish the “Guide for Navigating through the NSR” and “Requirements for Design, Equipment and Supply of Vessels Navigating the NSR”;

To continue large-scale hydrographic studies of Arctic seas to the level of modern requirements;

To create a database of electronic navigational charts for waterways of the NSR (meeting the requirements of the Standards of the International Hydrographic Organization) to create a corrective system and electronic mapping service;

To develop an electronic sea cartographic navigational information system;

To develop a network of navigational aids, including coastal differential stations of global navigational satellite systems;

To develop a system of ice and hydrometeorological information;

To develop a system of maritime communication;

To develop salvage and lifesaving support, etc.

The tariffs for icebreaker services will be reduced as traffic volume in the NSR increases.

When developing the Arctic, it is important to remember that this is a unique region with the least destroyed and a largely untouched natural ecological system.

High ecological standards are required of the companies involved in the development of mineral resources in the Arctic.

In welcoming and encouraging the expansion of international commercial shipping through the NSR, Russia is preserving high standards of navigational safety and ensuring the protection of the environment. The Arctic is a very sensitive region and accidents of any sort can have serious consequences. Therefore, the navigation of all vessels through the seaways of the NSR is to be conducted under reliable state control and with icebreaker assistance.

We must leave a pristine Arctic to future generations.

Russia actively participates in international organizations and projects: Arctic Council, Council of the Barents/Euroarctic region, Northern Measurement, International Arctic Scientific Committee, Northern forum and in many international Arctic programs.

We support the idea of cooperation among the northern territories, the pooling of economic, scientific, intellectual and raw material resources in the interests of the harmonious development of nations, the improvement of the quality of life of all people and the settlement of critical environmental problems. The transport systems that are created shall respond to the interests of the entire world community.

The Republic of Sakha; The Country's Development and the Northern Sea Route

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Ocean Policy Research Foundation, Japan

Introduction

Under the former social system, a long term political strategy was pursued for developing the Russian North via the Northern Sea Route (NSR) complexes, connecting river-ways such as the Yenisey, the Ob and the Lena. In the Republic of Sakha, considerable efforts were made to develop the river-way transportation of particularly the Lena River and expectations were placed on the port of Tiksi in the Lena delta to perform a gateway function for the whole of Russia via the NSR.

Losing strong, strategic subsidiary support of the federal government for the northern areas, the transformation of the former social system in Russia resulted in substantial contractions in the economies and industrial production of the regions. On the other hand, towards the reestablishment and further development of the societies affected by the transition, Russia is increasing its dependence on energy and mineral resources in the North as those in the southern regions have been fully exploited. The large deposits of fossil fuels, minerals, precious metals, rare earth elements and timbers in the northern regions appear to be one of the driving forces for a recovery in the economies and social welfare of Russian, as well as the development of the Russian North and the NSR.

In particular, the Republic of Sakha, or Yakutia, is blessed with abundant natural resources. However, natural resources have mainly been discovered and exploited in isolated regions or areas barely approachable due to the severe natural conditions. Yakutia is a case in point. In order to fully reap the country's wealth, Yakutia has had to confront typical socio-technological issues typical of high latitude areas and overcome a geographical handicap in the transportation of goods and materials to outside markets.

Yakutia thus readily acknowledges the importance of the NSR for the mass transportation of natural resources via the Lena, Indigirka, Yana, Anabar and Kolyma rivers, and then via the NSR. This waterway should be an attractive prospect for foreign investment. Otherwise, Yakutia's natural resources will fail to meet the demand for international markets. Precious metals and some products of wood industry should take full advantage of motorways and railways directly connected to deposit sites and ports for export.

In any event, the establishment of transport infrastructure is crucial for the development of Yakutia in the coming decades.

Essential Features of Yakutia

Yakutia covers a vast territorial area, accounting for almost one-fourth of the territory of the Russian Federation. Yakutia stretches to the far north, to 77°N, facing the Laptev and the Eastern Siberian Seas, and almost forty percent of it lies within the Arctic Circle, where permafrost is commonly found.

In Yakutsk, capital of Yakutia, the temperature reaches 39℃ in summer, in a marked contrast to the lowest of -70℃ in the town of Verkhoyansk in winter. Arctic tundra grows around the coast, while sub-arctic tundra is a feature of the northern regions of Yakutia. Lichen and moss cover the ground providing favorable pastures for reindeer, while boreal forests can be found in the southern regions.

Yakutia is a typical mountainous country, where the Verkhoyansk and Chersky mountain ranges and highlands cover about seventy percent of the Republic. The highest mountain range, the Verkhoyansk and the Momskiy lie along the east of the Lena and Kolyma rivers from the area relatively close to the Sea of Okhotsk to the Arctic Ocean, and has a significant effects on the climate and the vegetation.

The main rivers are the Lena, the Anabar, the Olenyok, the Yana, the Indigirka, and the Kolyma. The Lena River watershed, providing the most important waterway to the region, begins in the steep and timbered mountains close to the western bank of Lake Baikal. It then meanders northeast through forests and fields and joined by the Vitim River, follows the Olyokma, Aldan, Amga, and Vilyui rivers, before flowing through a widely spreading delta into the Arctic Ocean. The Lena spreads in Yakutia with its tributaries, forming the great river network which supports the typical ecology of this region. The Lena River is over 4,000km long, and the entire basin covers 2.5 million sq. km.

Yakutia has complex and diverse geological structures with immense mineral wealth. Its western region is a source of major interest for geologists as the area is one of the most ancient of the earth's crust. Yakutia is now expected throughout the world to be one of the major providers of mineral resources to international markets in the next few decades.

The population of Yaktia in 2004 is 949.5 thousand people and the population density is 0.3 persons/sq.km. Yakutia is the traditional homeland of the Yakut people and they constitute about one-third of the population today. Other indigenous peoples who live in Yakutia include Evens, Evenks, Dolgans, Chukchi, and Yukagirs. The Yakut traditional way of life centers around reindeer herding, cattle and horse breeding, hunting, and fishing, but most Yakut people today are urban dwellers and live much like other Russian. Yakutsk, Neryungri and Mirny are the key cities of Yakutia. Yakutsk is the capital and industrial centre. Neryungri, the second largest city and the centre of coal mining with a large thermal power plant, is located in the south. Mirny, the third largest city, is the centre of diamond industry. Smaller-sized, but important cities are Aldan and Lensk, the former gold mining region and the latter a

Figure 1 Republic of Sakha (Yakutia)

major river port.

Unfortunately, except for the cities in Yakutia, social infrastructure, particularly transport infrastructure, still remains considerably poor, partly due to apathy of the federal government concerning the transport development after the social reforms in Russia. The natural wealth of the region should lead to development of infrastructure, thereby attracting foreign capital.

Mineral Resources in Yakutia

The region’s immense mineral resources have the potential to bring great benefits to Yakutia and indeed to the world in the 21st century. In Yakutia, there are more than 1,500 deposits of various mineral resources, including 150 kimberlite pipes, around 600 gold-bearing, 44 tin-bearing and the same number of coal-bearing deposits, 34 oil-gas fields, 26 mica deposits and 7 iron ore deposits, along with a number of antimony, zeolite, apatite and many other deposits. The total amount of confirmed mineral reserves is approximately US$1.3 trillion and accounts for about 1.5 per cent of the world reserves. The amount of the potential reserves is estimated at US$5.4 trillion. The main mineral resources are gold, platinum, oil, gas, diamonds, tin, coal, titanium, silver, poly-metals, mica, rare earth elements and iron ores. Many deposits

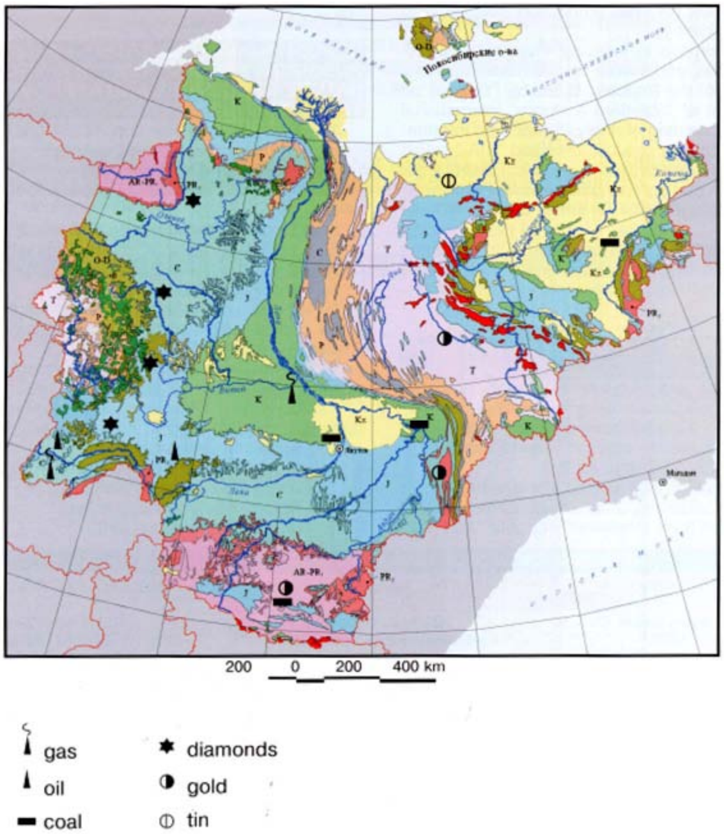

Figure 2 Mineral Resources in Yakutia

have already been developed, but many remain undeveloped or unexplored. In addition, Yakutia is also rich in forestry resources.

With support of large federal subsidies, Yakutia is the biggest provider in Russia of antimony (100%), rough diamonds (98%), cut diamonds (24%), tin (40%), and gold (15%).

Diamonds

The total explored reserves of diamonds are able to supply the diamond industry in the region for about 30 years. The Republic's five-year development plan for the diamond industry was designed to construct and put into operation the four underground sites at Udachny, Alykhal, Mir and Internatsionalniy. In 2003, Nyurbinsky ore mine began operation.

The predominant producer of diamonds is the state-owned monopoly Almazy Rossi-Sakha, known as ALROSA. Besides this organization, diamonds are also produced by ALROSA-Nyurba JSC, Nizhne-Lenskoye JSC, Almazi-Anabara Ltd., CDM-Olenyok Ltd. Balanced profit of them increased to a total of 25.3 billion rubles between Janurary and November, 2004

The Republic also attaches high priority to developing the diamond polishing/faceting industry by modernizing the means and processes of production, leasing, dealings on credit, scientific research on enhancing and developing grading and jewelry technology, and the organizations of diamond exchange. In 2004, Yakutia adopted the Republic law, "Concerning State Regulation of Regulations within the Diamond Lapidary Industry", which has achieved favorable conditions for lapidary enterprises' activities in Yakutia. The largest companies are ALROSA JSC, Tuymaada-Diamond Ltd., ComDragMet SUE (State Unitary Enterprise), EPL-Diamond Ltd., and Choron-Diamond Ltd.

The diamond faceting enterprises face complicated issues regarding the promotion of sales of brilliants (diamonds) and direct capital turnover within the existing framework of restriction on and the licensing of sales to international markets. The more stringent policies in diamond faceting industry in the Republic will hopefully resolve these issues through modernizing the industry, improving the level of craftsmanship and assisting in the development of novel ornament techniques.

Figure 3 Opencast Diamond Mining : A Typical Spot for Tourism

Gold

Gold mining is another major industry, but loss of federal subsidies, instability in energy supplies and high transportation costs presented obstaclesupon for the gold industry in the 1990s. Supported by positive trends in the world gold market, however, in 2004 gold mining output increased by 10.7% and its share of industrial output amounted to 6.3%. The largest companies are AldanZoloto JSC, AldGold Ltd., Zolotinka Industrial Complex, Zapadbaya Artel, Seligdar Artel, Nirungan Ltd., Nerungri Metallic Ltd., Novaya Artel, and Drazhbic Artel.

Gold output has been boosted in accordance with the development program for gold mining and non-ferrous deposits. The program has encouraged the exploitations of small- and medium-scale deposits and vitalized production at the larger gold deposits.

The Republic has a plan for developing the ornamental gold fields, which will not only yield financial benefits, but promote craftsmanship as well.

Jewelry

The Republic has long enjoyed its wealth in jewelry and the resource has mainly been provided from the Mariika, Taloye, Ogonnor and Nadezhda deposits. Modernization in the production and implementation of new gem grading technologies increased output and in 2004, the production of jewelry amounted to 580 million rubles, with exports running to 234.3 million rubles. The largest companies in the jewelry industry are Zoloto Yakutii JSC, Sakha Yuvelir Ltd. and Aldan Zoloto JSC. Trading activities in jewelry have been expanded via special trade enterprise Dragotsennosti Yakutii Ltd., and by trading offices in Yakutia, Moskow, Khabarovsk, and St. Petersburg.

Other Mineral Resources

For silver, the Verkhneye Menketche and Prognoz deposits will be the targets for the investment and development with the former deposit now ready for development.

Tin, in term of both amount of reserves and production, is the most abundant mineral resource in Russia.

The amount of antimony reserves in the Republic is more than 90% of the Russian total. The Sarilakhskiy deposit is the most active, while the Sentatchanskiy deposit is dormant. There are relatively small tin deposits in the Maltanskiy, Kimovskiy and Tanskiy and establishing a smelting factory for advanced antimony products is still in the planning stage.

Niobium, yttrium and rare-earth elements can be found in the northwest of Yakutia. The Tomtorskiy deposit is well known in Russia and the amount of its reserves is capable of supplying Russia’s total needs well into the future. Those reserves are presently attracting the attention of the world’s electronics industry.

With regard to titanium, surveying work has been completed in the Torginsky deposit in the Murunsky field.

The Tcharo-Tokkinsky iron ore deposit, the largest in the region, is located in the same area. Besides this deposit, a number of iron deposits, such as the Taejny, Desovskoy, Tarinnakhsky, Gorkitsky and Imalakhsky desposits are ready for production. The construction of a steelworks or at least an ironworks close to the deposit sites is a key factor in the long-term prospects of the iron ore industry.

Energy Resouces in Yakutia

Oil and Gas

The main reserves of hydrocarbon resources are concentrated in the Vilyuysk, Nepsko-Botuobunsk, and Predpatomsk oil- and gas-bearing regions. The five largest natural gas deposits are the Srednevlyuysk, Srednebotuobinsk, Srednetyungsk, Verkhnevilyutchansk and Tchayandinsk fields.

The following measures have been taken for oil production and processing;

- realization of the East Siberian oil delivery project for export, including the Talakan oil deposit,
- exploitation of the Chayandinskoye oil and gas condensate field,
- establishment of oil processing facilities in Western Yakutia,
- continuation of gasification for settlements.

The third line from the Sredne Vilyuiskoye OGF through Mastakh, Berge, Yakutsk to the main pipeline is under construction. Liquidized gas and motor fuel are provided for the Vilyui regions and customers in the central regions in the Federal and the Republic budgets. The construction of a gas processing factory in Yakutsk has been completed.

ALROSA is the main customer for oil in the Republic, consuming almost half of total oil production.

Coal

The geological reserves of coal in the Republic are the most plentiful in the Russian Federation, equivalent to more than 40% of the total. There are a number of coal deposits, such as the South Yakutian, Ziryansk, Lensk and Tungussky deposits and other isolated coal mines. Currently only 44 deposits are accounted for the state balance.

One of the most perspective coal reserves will be the Elga deposit of high quality coking coal with the amount of coal production at 11,044,000 tons in 2004. The YakutUgol JSC occupies leading role in the coal industry and is one of the major suppliers of coal products to the Republic and also export to Asian Pacific countries. Approximately 8,283,500 tons of coal was shipped outside of the Republic, of which 5,286,400 tons were exported. The YakutUgol JSC carried out a project to increase coal production at the huge opencast mine in the south to 10 million tons per year.

Power Industry

The power industry is one of the region's secondary industries. Yakutia's power supply system consists of 106 power stations with the Vilyuiskaya (hydroelectric), Yakutskaya (gas-fired), and Neryungri (coal-fired) power stations supplying most of the electricity. The power stations are located in the major mining centres and there are four independent power districts in the Republic;

- Central, which forms a power network for the capital's industrial centre and a number of central regions in the Republic, some of which are located along the Lena River. The main power source is the Yakutsk HPS,
- Western, which unites the Aykhal-Udatchninsk, Mirny, and Lensk industrial regions and a number of Vilyui agricultural regions. The main power source is the Vilyuisk HPS.
- Southern, which constitutes a power network for the fuel industrial complex in the southern Yakutia, Neryungri and Aldan industrial and agricultural zones. The main power sources are the Neryungri HPS and Tchulmansk TPP.
- Northern, which provides electricity for the northern regions, together with the autonomous DPSs.

The YakutskEnergo JSC is a power supplier in a framework of FOREM (Federal Gross Market of Power and Capacity). The Republic now has a surplus power capacity and the possibility exists for a transfer of power within the FOREM framework to 1,800-2,000 million kWhr per year.

Timber

The Republic contains over 44 percent of the Russian Far East's total timber stock. Due to a lack of forest roads, however, most logging occurs near the main transportation routes, settlements and along the Lena River. A shortage of advanced machinery such as feller bunchers, yarders and feller skidders, together with weaknesses in commercial efforts of enterprises has resulted in the under-achievement of the timber industry.

Although the Republic has charted a new development program for the timber industry, it consists of the establishment of a highly productive sawing industry with minimum waste and the construction of forest roads for logging throughout the year (Tommot-Uchur).

In response to the potential demand of international timber markets, particularly in China, the Republic is strengthening its capabilities in market research and the trading of value-added timber and wood products.

Agriculture

Due to the severe natural conditions, agriculture in the Republic has definite competitive handicap compared to regions with milder climates. Abundant energy stock may overcome this to some degree, by allowing vegetables to be grown in greenhouses. Livestock farming is in progress, including horse herding and breeding with the state support, which is a symbol of the Republic.

Both agriculture and livestock farming would be blessed by the effective use of agricultural fodder places, the development of deserted arable land, low cost technologies for maintenance and the renewal of meadows, and a higher level of productivity in hay-making.

Tourism

In the short space of a decade there has been tremendous growth in the eco-tourism industry in the world. Visitors are able to see rare and/or spectacular wildlife and enjoy magnificent scenery, while local governments and organizations derive advantages from the expense of their visits, and in turn, provide funds to protect the environment, animals and their habitats.

The Republic of Sakha is undoubtedly rich in biodiversity, enchanting scenery and wildlife, but for the moment, tourism activities in the region, though gradually increasing, remain very limited in number and scope.

Transportation

The vast and sparsely populated Yakutia has been confronted with great difficulties in the development of an effective transportation infrastructure, not least of which is the serious hindrance presented by permafrost to the construction and maintenance of roads and railways.

The volume of cargo and passenger transportation is expected to increase in the coming decades.

Roads

The length of roads in Yakutia total about 25,000 km, including 19,800 km for general traffic and 5,200 km for special purposes. Federal roads are 2,100 km long and regional roads are 17,700 km long. Three percent of the roads for general traffic are paved, while 36 percent of them are hard-surfaceds.

Railways

The total length of the railway in the Republic amounts to 165km for the time being. Compared to the huge size of the country, the railway system is significantly undeveloped, particularly for an establishment of mass transportation through the year.

The Berkakit-Tommot-Yakutsk railway is nearing completion and stepped forward in the construction between Tommot and Kerdem (375km) in 2005. Yakutia's railway will attain a total length of 735km in 2010. This railway will help form a reliable transportation network in northeastern Russia, substantially lower cargo delivery costs.

Waterways

The total length of navigable waters is 16,108km. The waterways of the Republic rely on the large rivers of the Lena, Vilyuy, Aldan, Kolima, Indigirka and Yana. Traffic on the Republic waterways is accommodated by the six river ports, namely the ports of Yakutsk, Nijneyansk, Belogorsk, Lensk, Olekminsk, Khandiga, and two sea ports, the ports of Tiksi at the mouth of the Lena and Zelenomysk, which link to inland waterways to the Northern Sea Route.

Permafrost and low precipitation around the Lena basin has caused problems such

Figure 4 Cargo Handling Facilities on the Lena River

as rapid run-off in spring and a low water level in summer. The Lena is shallow downstream, due to deltas and rivermouth bars and as a result has often impeded navigation of loaded river-sea vessels. The guaranteed water depth of the Lena for navigation is around 1.7-3.0 meters. Bank erosion is another serious problem in clearing passages for river ships and naturally ice is another pressing concern with the Lena and other rivers in the region freezing to a depth of 2.5-3.0 meters. River ice grows to bottoms of smaller rivers. The navigation season for the Lena is not long enough, standing at around 90 days on average.

Development of an efficient river fleet would be largely dependent upon proper maintenance of the passages and renewal of river port facilities.

Northern Sea Route (NSR)

Shipping via the NSR has been dormant since the transformation of the Russian social system. Oil and gas development is considerably vitalizing the western part of the NSR, while cargo movement based on the ports of Tiksi and Pevek has not yet recovered from its lowest levels. In the eastern part of the NSR in particular, international shipping markets hold little promise for the NSR for the time being.

The activities on the NSR are still based on existing expertise, equipment and infrastructure, with the present Russian Arctic fleet expected to play an important role in the short term. Unfortunately most of the Russian Arctic icebreakers and ice-strengthened cargo vessels have been superannuated. From time to time, federal programs are announced for the replacement of the Arctic fleet, however, such announcements have not moved the world shipping market.

It should be noted that there would be no incentives to shipping through the Arctic Ocean without clear commercial benefits.

Airways

The Republic has 33 airports, two of which Yakutsk and Tiksi are under the federal air system. The annual volume of passengers is 600,000 peoples. The air traffic control system has been modernized and most of the airports are able to accept any type of aircraft.

In expectation of an increase in airborne traffic in the next few decades, the government approved a state program in 2002, "Development of Air Transport in the Republic of Sakha (Yakutia) for the period 2002-2006". The establishment of the leading airline, "Yakutia", will be effective in preserving the aviation servicing market, strengthening the competitiveness of regional airlines and improving the quality of transportation services and flight regularity.

Pipelines

The trunk pipelines are 1,818km (December, 2001) long in total. For the period between January and December 2002, more than 1,247,400 tons of gas and more than 295,600 tons of oil was transported by pipelines. In response to a growing demand for energy resources, the construction of new pipelines is expected.

Concluding Remarks

From a long-term perspective, the sustained development of Yakutia's economy will be a crucial issue. The establishment of a robust domestic market would overcome environmental handicaps and create an affluent social framework for the Republic, through substantial increases in trade revenues.

This indicates that the prompt establishment of transportation infrastructure is vital for the modernization of industry and the creation of new business ventures which could yield considerable benefits to the Republic and result in stable employment for its people.

In fact, the basic aim of structural reorganization of the Republic's economy, consistently supported by the State Government, is to overcome the raw material orientation of industry of the Republic and to promote the development of processing industry which could produce value-added products. For instance, the advancement of gold mining should be continued within a framework of developing the jewelry industry in the Republic. However, there are significant problems associated with such expansion to world markets. Jewelry processing equipment is insufficient to produce products in response to the varying and changeable tastes of world customers. What the State development program is basically aiming at is to improve the international competitiveness of the jewelry industry.

On the other hand, the State Government is keenly aware of the disproportionate socio-economic development between the industrial and agricultural districts in the Republic, in particular in the Arctic districts. Further development of the NSR would greatly improve their present economic situation.

The creation of a healthy economy in Yakutia in the long term is undoubtedly dependent upon the establishment of infrastructure for mass and large-scale transportation. The primary measure is to establish a highly effective combinatory transportation system of roads, railways and waterways via the NSR. Naturally the key is to lure foreign partners to join in investment and production activities. In order to activate the NSR and attract the world shipping market, the principle of marginal pricing should be adopted instead of the current policy of total cost recovery, because the NSR is part of the Russian infrastructure. This would lead to much lower costs for foreign users, but would require a long-term understanding of Russian economics. It is clear that federal subsidies are vital in developing the NSR as a competitive international shipping route, at least in the medium term. Large federal grants and subsidies should be allocated to a number of enterprises in the North. While market relationships evolve, costs for foreign users of the NSR should be supervised by the federal government, which should effectively administer responsibility for stabilizing the economy of the NSR and the surrounding areas. This would afford a more reliable environment for foreign investment and international cooperation in the region. It stands to reason that international activity in the NSR must be in accordance with a strong Russian regional policy.

The Arctic Council has said that the current Arctic sea ice trend implies improved ship accessibility around the margins of the Arctic Basin. As insurance and capital costs depend on how many days per year these costs should be distributed over, the NSR can anticipate a prosperous future and the Republic of Sakha. However, global warming is likely initiating a number of changes in the biosphere, threatening ecological systems and living things. The Republic will do its best to achieve proper harmony between the environment and the way our citizens live and work in developing the region.

What is absolutely essential for the Far East Russian-Asian region is to increase awareness of the importance of regional energy and resources cooperation and to make a conscientious effort to put that awareness into practice.

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DEVELOPMENT OF FAR EAST RUSSIA & JANSROP-GIS

Oil-Gas Resources in the East of Russia

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About a quarter of Russia's total hydrocarbon resources are concentrated in its eastern regions. Three distinct groups of petro-geological elements characterized by almost equal hydrocarbon potential are presented in Fig. 1.

They are:

1) the intra-continental basins in the east and south of the East Siberian platform within the Republic of Sakha, Irkutsk oblast, and the Baikit-Katanga area of the Evenk Autonomous Okrug;

2) the Far Eastern oil-gas basins in the active West-Pacific margin from Sakhalin to the Chukot Peninsula.

3) the basins of the Eurasian passives margin in the Laptev, East Siberian, and Chukchi Seas[4].

The share of explored hydrocarbon reserves of the confirmed total hydrocarbon resources is not great. On the East Siberian platform, it amounts only 7% and in the Far East about 10%. A share of problematic forecast category D_2 hydrocarbon resources is high (from 35 to 100%) (Fig. 2). However, data on already discovered fields allow us to say with confidence that existing resource estimations are conservative 143 oil and gas fields, including 5 unique and 11 large gas fields and also 10 large oil fields have been discovered in the east of Russia. Such resources are capable to satisfy just as the internal demand of the Russia eastern oblasts, so to provide the considerable export supplies of hydrocarbon raw materials to the countries of the Asia-Pacific region and the United States[9].

The first group includes eight oil-gas regions, the most important for organizing considerable oil and gas production in the fields of Eastern Siberia. These regions include the Nepa-Botuoba, Katanga, Angara-Lena, Baikit and other regions in the Lena-Tunguska oil-gas province and also a gas-bearing district in the south of the Khatanga-Vilyui oil-gas province.

The Lena-Tunguska province, which is the largest in the terms of area resources, and discovered oil and gas reserves, as well as comprising the majority of regions, is characterized by the extreme variability in the thickness of its Riphean basal deposits and a thick Vendian-Mesosoic sedimentary cover. A hydrocarbon-bearing interval encompasses Riphean and Vendian-Lower Cambrian carbonate and terrigene deposits with the density of hydrocarbon resources of from 55,000 to 100,000 t/ km^2.

The discovered fields are characterized by differences in hydrocarbon phase composition and a high content of helium in their gas pools. A large number of hydrocarbon fields are considered to be large and unique, such as the

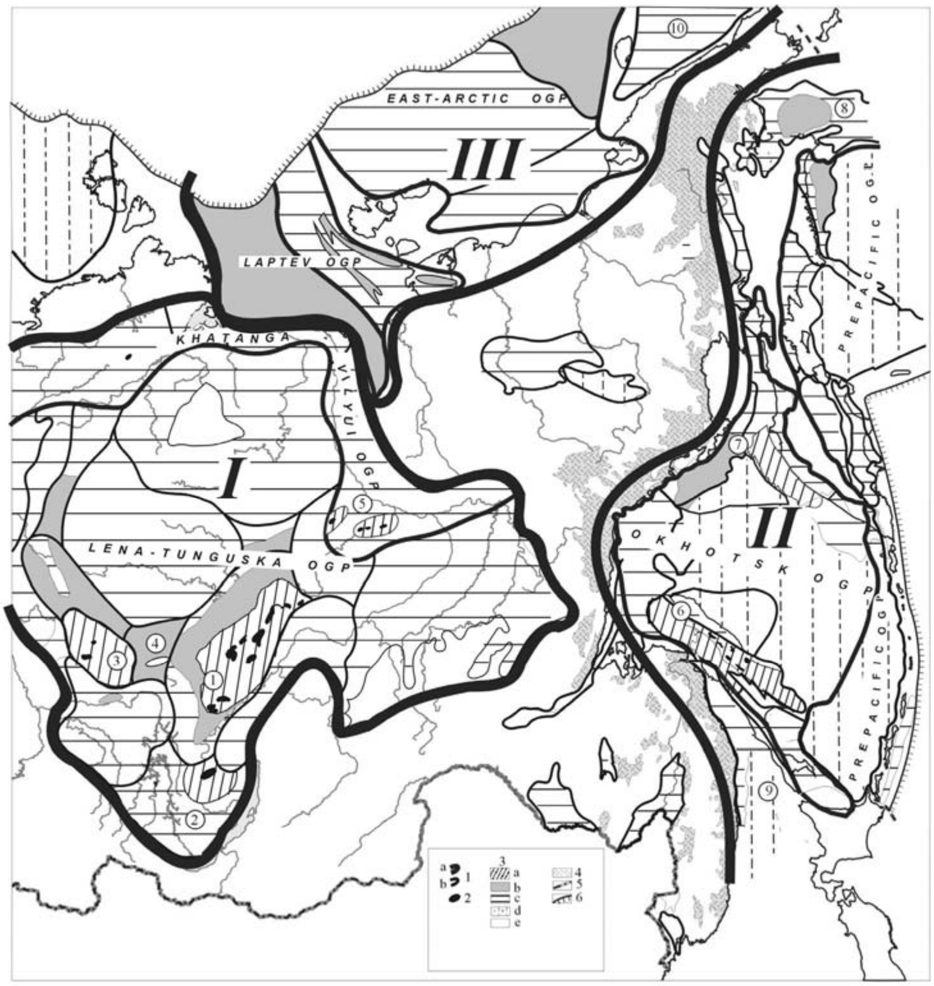


Figure 1 Oil-Gas Provinces and Basins of the East of Russia

1 - oil-geological elements and their boundaries: 1- provinces (a), basins and separate depressions (b); 2 - hydrocarbon fields; 3 - density of initial total hydrocarbon resources in place, (thousand t/sq. km) o.e. in oil-gas provinces and basins: a - 51-300, b - 31-50, c - <30, d - areas with qualitative estimation, e - non-prospective areas; 4 - East-Asian volcanic belt; 5 - state boundary of RF; 6 - boundary of shelf.

Oil-gas provinces (OGP) and basins (OGB): *I - group of intracontinental oli-geological elements:* **Lena-Tunguska OGP:** 1 - Nepa-Botuoba OGB, 2 - Angara-Lena OGB, 3 - Baikit OGB, 4 - Katanga OGB; **Khatanga-Vilyui OGP:** 5 - Lena-Vilyui OGB; *II group of oil-geological elements of active West-Pacific margin:* **Okhotsk OGP**: 6 - Okhotsk-North-Sakhalin OGB, 7 - Magadan - West-Kamchatka OGB; **Prepacific OGP:** 8 - Anadyr-Navarin OGB, 9 - West-Sakhalin OGB; *III - group of oil-geological elements of passive margin:* **Laptev and East-Arctic OGP:** 10 - South-Chukot OGB.

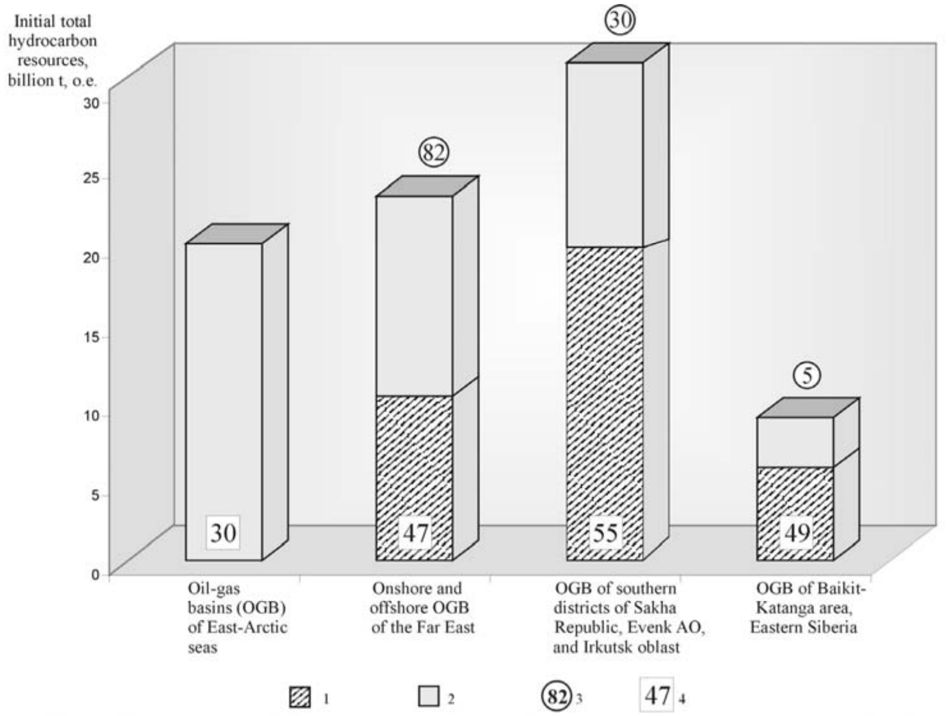


Figure 2 Size and Structure of Oil-Gas Resources in the Districts of the Most Resource Concentration, the East of Russia

Structure of hydrocarbon resouces: *1 - effective resources of* $C_3 + D_1$ *cat., 2 - problematic resources of* D_2 *cat.; 3- number of discovered fields; 4 - average density of resources, thousand t/sq. km.*

Yurubcheno-Tokhomskoye and Chayandinskoye oil-gas-condensate fields and also the Kovyktinskoye gas-condensate field. Together with the detailed exploration of already discovered fields, no less than 20 new areas are expected to be discovered by 2020. Additions to oil reserves must comprise no less than 1.1 billion tons and to gas reserves more than 1.0 trillion m^3. Major exploratory works are planned for the Nepa-Botuoba, Baikit and Katanga oil-gas regions[3].

Mention should be made of the promising Evenk syneclise where searches for oil and gas have not yet been carried out. The majority of researchers consider this structure to be the largest source of hydrocarbon generation.

The less studied Khatanga-Vilyui province is characterized by considerably fewer resources and also by the fundamentally different structure of its oil-geological elements. This province includes the promising areas of the foredeeps bordering the East Siberian platform to the north and east. A sedimentary cover in these troughs is characterized mainly by gas potential.

In the south-western part of the Lena-Vilyui region, gas-condensate fields have been discovered in the Permian, Triassic, and Cretaceous deposits. The Jurassic and

Cretaceous deposits are productive in the northern regions.

The second group of the most important oil-geological elements in the east of Russia is represented by the numerous basins of the active West-Pacific margin. The distinctive feature of these basins is the dominant role of offshore areas (Fig. 3); their oil and gas resources comprise 83% of the total resources of the Far Eastern region[6]. The main part of the promising areas is concentrated in the Okhotsk and Prepacific provinces and in two independent oil-gas regions – Anadyr-Navarin and West-Sakhalin (Fig. 4).

The Okhotsk province occupies a considerable area in a back part of the island-arched margin and is confined to a megadepression of the same name. The area of this megadepression is comparable with the area of platform syneclises. The main basins of this province are the Okhotsk-North-Sakhalin and Magadan-West-Kamchatka (Fig. 5). They contain a major share of the Okhotsk province's oil and gas resources. 73 hydrocarbon fields have been discovered in the province: 69 fields in the Okhotsk-North-Sakhalin basin and four in the Magadan-West-Kamchatka basin. Most of these fields are multilayer fields of Oligocene-Miocene terrigene reservoir rocks with a complex phase pool composition. By resource characteristics, these basins are similar to the large basins of the West-Pacific oil-gas belt such as East-Kalimantan, West-Palawan, North-Yava, and others[7] .

61 fields have been discovered in the onshore of the Okhotsk-North-Sakhalin basin; a share of produced explored reserves comes to a critical value. The main perspectives of this basin are connected with shelf areas where eight fields have been discovered and oil is produced. Five mainly oil-gas-condensate fields are of a substantial size. The Oligocene-Middle Miocene clayey and clayey-siliceous strata with organic matter content of between 1-5 % are the main generators of oil and gas in this basin.

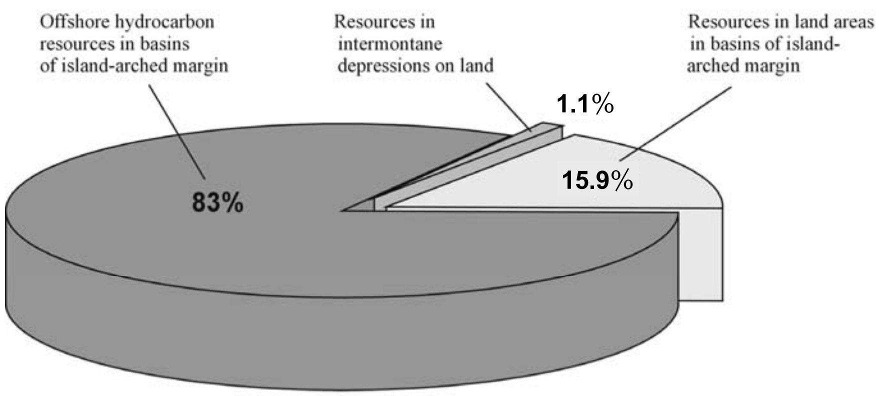


Figure 3 Onshore and Offshore Hydrocarbon Resources of the Far-Eastern Basins, Russia

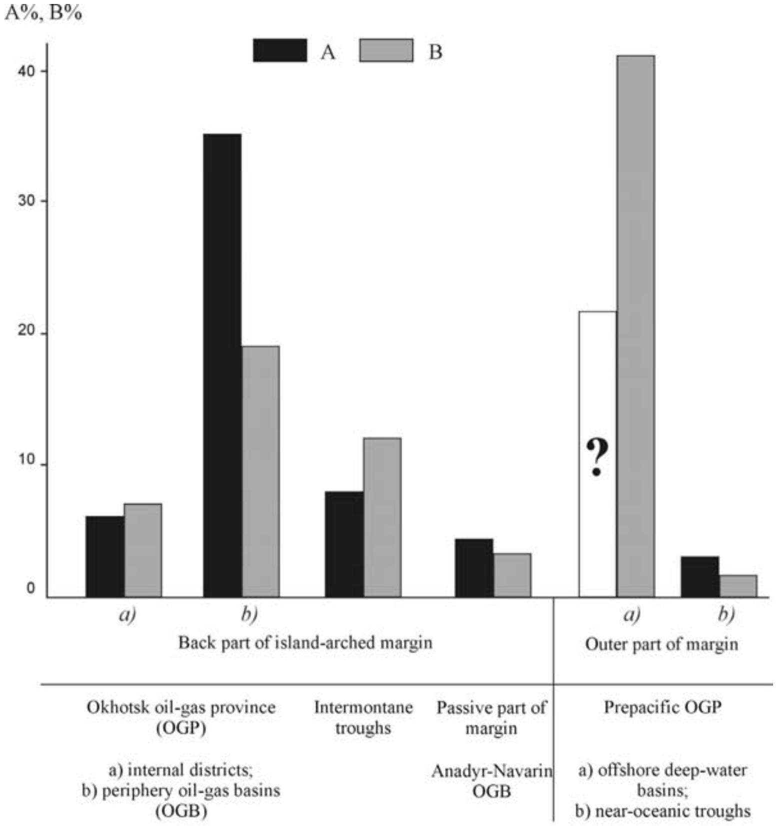


Figure 4 Main Oil-geological Elements of the West-Pacific Island-arched Margin (Russian sector)

A - Intial total hydrocarbon resources of total resources in region, %, o.e.
B - Deposit volume of total deposit volume in region, %

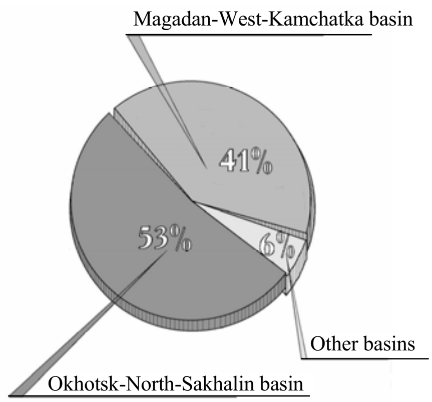


Figure 5 Resource Ratio by Oil-Gas Basins of the Okhotsk Province

Oil and gas accumulations are confined to the alternating strata of sandstone, siltstone and clay. In recent years, the role of reservoirs composed of clayey-siliceous fractured rocks, and even of decompacted serpentinite of basement, has grown. The parameters of 28 established oil-gas-accumulation zones correspond to the optimum characteristics of hydrocarbon accumulations in the oil-gas basins of island-arched margins. The hydrocarbon resources of the largest zones exceed 1 billion tons, their density exceeds 2 million t/km^2 with the almost equal relationship of liquid and gaseous hydrocarbons.

In the offshore part of this basin, the share of explored reserves of confirmed total oil resources is 21% and 19% for gas resources. Taking exploration efficiency into consideration, six or seven large oil fields and about 10 gas fields may be discovered there. The Kirinsk area ("Sakhalin-3" project) with petroleum forecasting potential for Middle Miocene deposits, the Katanga-Vasyukan area ("Sakhalin-5" project) with forecasting potential for pools in Upper-Miocene-Pliocene deposits and the Pogranichny area ("Sakhalin-6" project) with forecasting potential for fields in fractured silicite are of practical importance.

In this basin, by the year 2020, additions to reserves are estimated to be 350 million tons of oil and no less than 600 billion m^3 of gas.

The West-Kamchatka shelf and three near-shore districts of Kamchatka (Kolpakov, Ichinsk, and Severo-Tigil) are the main components of the Magadan-West-Kamchatka megabasin. The main features of its structure and resource characteristics are similar to those of the Okhotsk-North-Sakhalin basin (Fig. 6).

More than 50 local structures and 15 probable zones of oil-gas accumulation have been established on the shelf. The area of these zones ranges from 500 to 1,500 km^2; their resources amount to 200 million tons o.e.; density of the resources varies from 20 to 500 t/sq km. The similarity to the Okhotsk-North-Sakhalin, Thailand and also Taranaki basins and the results of

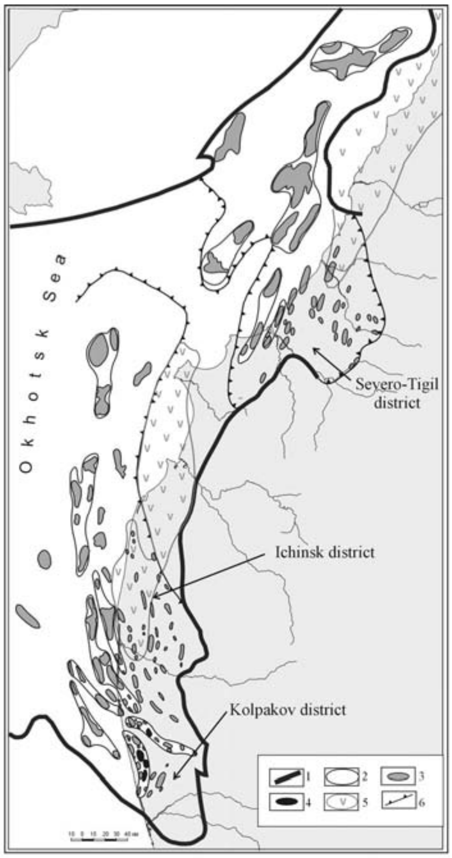


Figure 6 Magadan-West-Kamchatka Basin

I - basin boundary; 2 - zones of oil and gas accumulation; 3 - local structures; 4 - hydrocarbon fields; 5 - areas of Early-Cenozoic volcanic rocks; 6 - boundaries of troughs modeling allow the confirmation of the discovery of some large oil and gas fields with total hydrocarbon resources in the order of 1.5 billion tons[2,6].

Undoubtedly, the Magadan shelf in the north-western part of this basin is promising for oil and gas also. However, the negative results of drilling three offshore wells, the problems of searching for reservoir rocks in a marine sequence and the necessity of discovering only very large hydrocarbon fields should be remembered as the difficulties and complicated conditions of development.

The Prepacific province (Fig. 1) includes troughs, deep-water basins, and separating them uplifts in the outer part of the island-arched margin. In the troughs and basins, a thick sedimentary cover has been insufficiently explored.

The oil-gas resources of the province are estimated to be 10 times less than in the Okhotsk province. In the majority of cases the density of hydrocarbon resources is 15,000-17,000 t/km^2 there. The hydrocarbon resources of deepwater depressions have not been estimated.

The Sredinno-Kuril trough is of particular interest as a promising intraarched structure. It is a narrow linear depression between the Kuril island ridge with a cover thickness of up to 6.0 km. Its hydrocarbon resources are estimated to be 80 million tons, at oil/gas relationship of 3 to 5 and a density of 10 thousand t/km^2. The oil reserves of the largest field, which is forecasted to be most likely discovered in the Oligocene-Lower Miocene complex, are estimated at 15 million tons[1].

In general, the estimations for the Prepacific province's hydrocarbon resources will be specified as the regional exploration of the onshore and offshore would be continued, particularly deep drilling.

The Anadyr-Navarin oil-gas region is the only oil-geological element with proven petroleum potential in the passive Bering area of the active West-Pacific margin. Three fields of paraffin oil and one gas field have been discovered in the Anadyr depression. Major prospects are associated with the offshore, however unsuccessful drilling in the Navarin trough, on the shelf and on the shore of the Anadyr Bay are indicative of the extreme difficulty of searches for oil and gas in the Bering Sea.

The third group includes the insufficiently explored oil-geological elements of the northern passive margin of Eurasia: the Laptev and East-Arctic provinces and the South-Chukot region (Fig. 1). Estimations of their hydrocarbon resources have only been performed using the least reliable D_2 category though they may be improved by further explorations for oil and gas. The predominance of resources of an oil component over a gas component even at the present time, however, is of fundamental importance.

A detailed characteristic of provinces of the East-Arctic offshore with minimum forecasted resources at almost 20 billion tons is premature because of the sufficiently distant term of their development.

The spatially uneven distribution of oil-gas resources and natural groups of hydrocarbon fields determine the optimum way of developing a region's hydrocarbon potential through the establishment of centers of oil and gas production. Global experience testifies to the fact that creating such centers is the most effective way of developing the Fuel-Energy Complexes of these regions. At the present time, the first North Sakhalin center of federal significance is being built in the east of Russia. Maximum oil production will reach to 22 million t/year, gas 30 billion m^3. The formation of several other centers (Nepa-Botuoba, Yurubcheno-Tokhomsky, and Kovyktinsky in Eastern Siberia and also Magadan-West-Kamchatka in the Far East) is proposed to begin in the near future (Fig. 7).

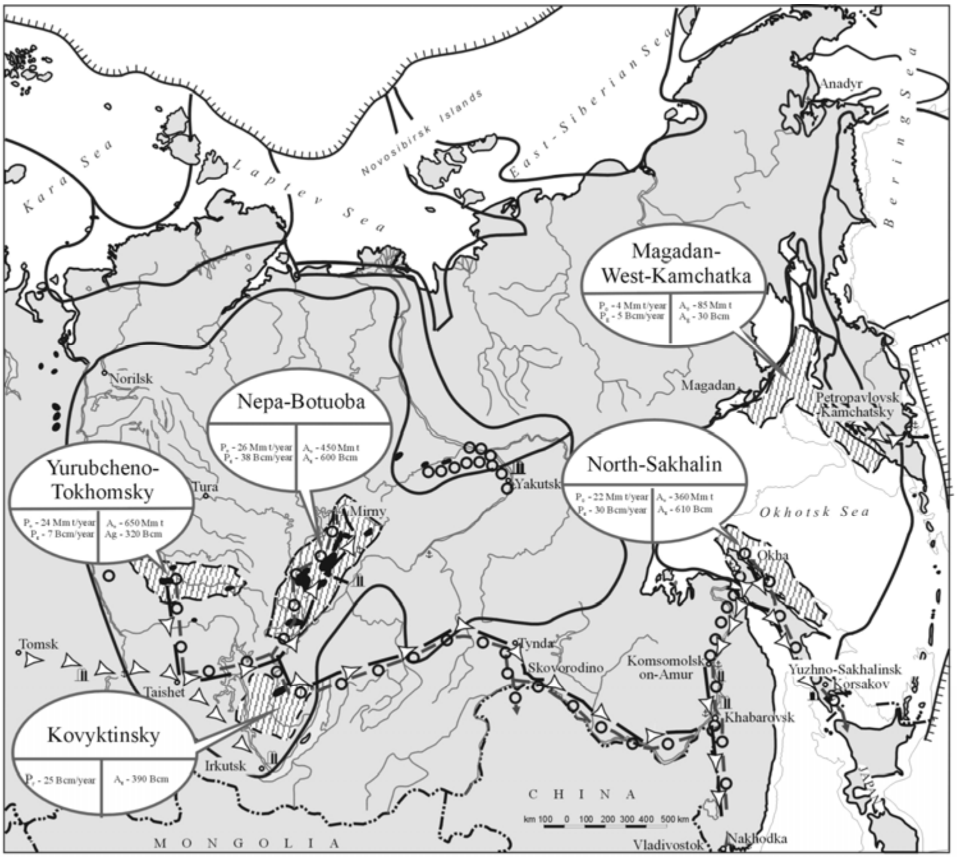
By the year 2020, total oil production in these eastern centers must amount to 50 million t/year and gas production approximately 100 billion m^3/year. In 2030, 75 million tons of oil and 140 billion m^3 of gas are expected to be produced. To achieve such levels of production and the stable functioning of these centers, it is necessary to perform considerable exploration. By the year 2020 in the east of Russia, additions to reserves of liquid hydrocarbons must be no less than 1.5 billion tons, and to gas roughly 2.0 trillion m^3. In preparing such reserves, it is necessary to drill about 2.0 million linear meters or about 700 wells[3].

There is also a need to provide these centers with transport-industrial infrastructure on time. According to estimations, about 7,000 kilometers of oil pipeline and more than 9,000 kilometers of gas pipeline must be constructed in Eastern Siberia and in the Far East[8]. Oil pipeline - Taishet-Skovorodino-Perevoznaya Bay on the Japan Sea shore - will be one of the most important transport routes (Fig. 7). The construction of this 4,188 kilometers, $16 billion oil pipeline is expected to be completed by the year 2008; it is proposed to increase its capacity by stages: 10, 50, and 80 million t/year.

Currently, the routes of future gas pipelines are being discussed. It is obvious that the immediate transportation of gas from the largest Kovyktinskoye and Chayandinskoye fields is extremely necessary. Apparently combining major oil and gas pipelines in one corridor is advisable as it retrenches the expenditure by 10-15% and reduces the terms of project recoupment. In this connection the laying of one of the first gas pipelines in an united transport corridor with the constructing oil pipeline Taishet-Perevoznaya Bay with branch to China near Skovorodino is the most expedient.

Realizing gas production is also envisaged also through the production of liquid natural gas. The first gas liquefaction plant with a capacity of 9.6 million t/year of liquefied natural gas is constructed in the south of Sakhalin Island.

The amount of investments in the development of the discovered fields in this region will need investments in approximately $42 billion: about $30 billion for Eastern Siberia and no less than $12 billion for the North-Sakhalin center. One of the main reasons for such large investments in developing the hydrocarbon fields is the huge cost of creating transport infrastructure (30-32% of total investments). It is probably the case that the construction of long-distance pipelines will only be viable, if a considerable portion of oil and gas production is exported. In such a situation, in the 2020s, oil exports from the eastern districts of Russia must amount to 70-75 million t/year and gas exports 80-85 billion m^3/ year.



Production in 2020:

P_o – oil, million t/year (Mm t/year)

P_g – gas, billion cu m/year (Bcm/year)

Additions to reserves by 2020:

A_o – oil, million t (Mm t)

A_g – gas, billion cu m (Bcm)

Magadan-West-Kamchatka: P_o=4, P_g=5, A_o=85, A_g=30

North-Sakhalin: P_o=22, P_g=30, A_o=360, A_g=610

Nepa-Botuoba: P_o=26, P_g=38, A_o=450, A_g=600

Yurubucheno-Tokhomsky: P_o=24, P_g=7, A_o=650, A_g=320

Kovyktinsky: P_g=25, A_g=390

1 - fields; 2 - boundaries of oil-gas provinces (a) and separate regions (b); 3-4 - pipelines: 3 - functioning: a - oil, b - gas, 4 - projecting: a - oil, b - gas; 5 - oil and gas refinery plants; 6 - natural gas liquefaction plants; 7- ports; 8 - large forming COGP and COGP promising for oil and gas: 9 - boundary of shelf; 10 - state boundary

Figure 7 Centers of Oil and Gas Production (COGP) in the East of Russia

The data presented above on hydrocarbon production and exports, and also concerning the construction of centers and pipeline system will give reasonable grounds for development of the oil-gas resources of the Russian East offshore and onshore oil-gas basins.

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Transport Infrastructure in the Russian Far East

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1. Introduction

It is widely known that there are enormous energy and mineral resources in the Russian Far East, while the forest belt from the Ural Mountains to the Pacific Coast comprises about 40% of the Russian Federation's total forested area. Furthermore, the Sea of Okhotsk contains one of the world's major fishing grounds.

The Russian Far East is conventionally divided into northeastern and southeastern Siberia along the line of the Stanovoy Mountains. The northeastern region, where natural resources are concentrated, is divided into east and west by the Verkhoyanskiy and Cherskiy Mountains. In the eastern area, the Kolyma Lowland fans out from the Kolyma Highland toward the Arctic Ocean, containing the Indigirca and Kolyma Rivers. In the western part, the Yakut Lowland ranges toward the north containing the Lena River. Most of these areas are desolate wilderness covered by permafrost. The southeastern part of the Far East borders northeastern China and the Amur River runs along the border and turns toward the northeast around Khabarovsk, finally flowing into the Sea of Okhotsk.

Cities and settlements are scattered across the uninhabited vast wilderness with very limited means of transportation. The thawing of the permafrost in summer presents great difficulty for the development of transport infrastructure in this region, while the large streams prevent a connection between areas of each riverfront. Only about ten cities, including Vladivostok, Khabarovsk, Yakutsk, Mirny, Magadan, Yuzhno-Sakhalinsk, Okha and Petropavblovsk-Kamchatsky have regular commercial air connections in the region. Meanwhile, the railway network only connects a limited number of cities in the southern part of the territory. In the northern part, there are few commercial flight routes and only a limited number of intercity roads with no railway network at all. Some of the settlements have no land transportation except for the river (used as an inland waterway in summer or a winter road) and the Northern Sea Route (NSR).

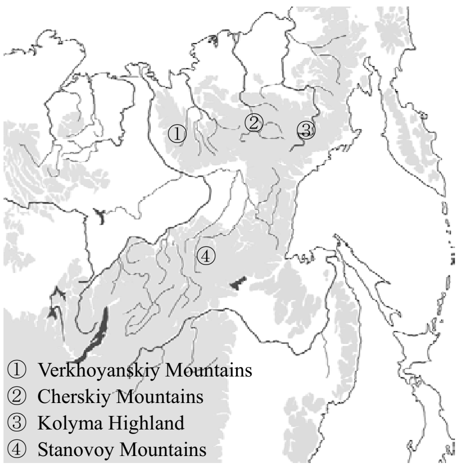


Figure 1 Geographical Features

It is clear that the key factor in the

development of natural resources in the Russian Far East is the transportation system. One response to this problem is to use the rivers and the NSR.[1]

2. Road Network in the Russian Far East

As the backbone of the road network that connects Europe and the Russian Far East, the world's longest national highway from Moscow reaches the primary ports of Primorsky Krai such as Vostochney, Nakhodka and Vladivostok via Chita and Tychet, running parallel to the Trans-Siberian Railroad or the "TransSib". This national highway has almost been completed except for a section in Amurskaya Oblast.

Meanwhile, it is reported that the total length of roads in the Russian Far East run to about 78,000 km. In this area, there are three federal highways, the "Ussuri", "Kolyma" and "Amur" Highways. However, most of the roads are unpaved such as clay, gravel or dirt, especially outside of the cities. It is said that nearly 80% of paved

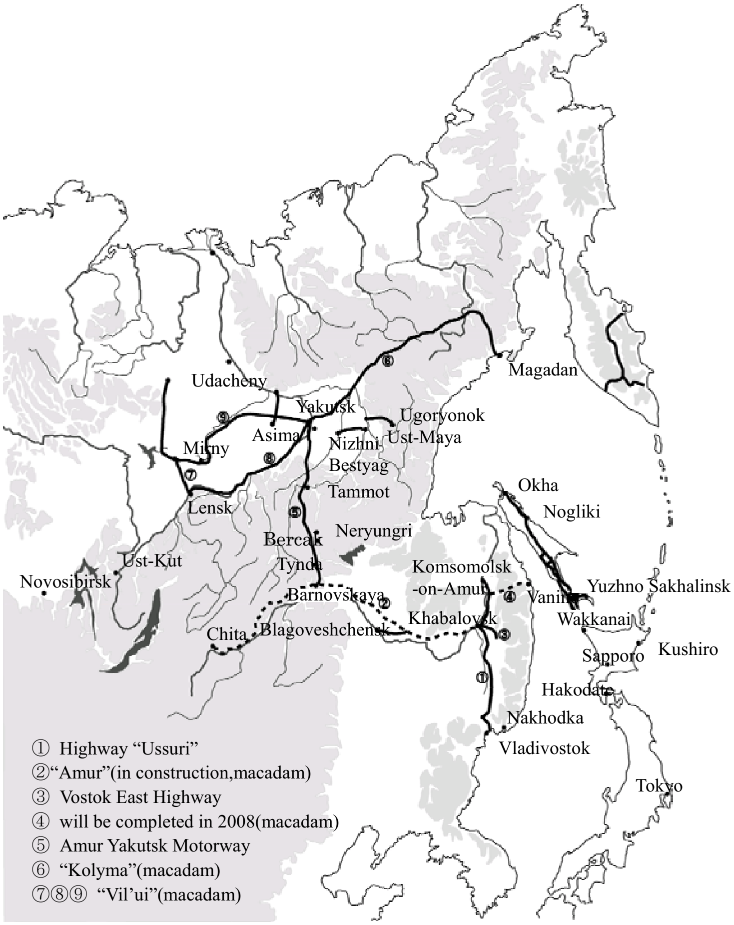


Figure 2 Road Network of the Russian Far East

roads are in the south and on Sakhalin Island.[2] Furthermore, in the northern territories, a harsh environment and expanding permafrost makes it difficult to construct roads. Thus, the undeveloped road network system has been one of the dominant bottlenecks in the Russian Far East. Consequently, the completion of the Chita-Khabarovsk Highway, the construction of Yakutsk-Vilyui-Mirny-Irkutsk Oblast boundary, and other highways and access roads in the Kolyma and Lena regions, is cited in the Russian federal transport strategy.[3]

2.1 Road Network in the Southern Part of the Russian Far East

The "Ussuri" federal highway, which was constructed in 1935, connects the south and north between Vladivostok and Khavarovsk via Ussuriisk over a length of 800 km. The condition of this highway was once poor, but it was reconstructed in recent years. The entire highway is bitumen, however there are sometimes potholes and repair work is also often being conducted. Parallel to it, the construction of the 700 km Vostok East Highway is currently underway to the east.[4] The section between Khabarovsk and the Bikin River has already been completed.

In the past, there was no road connection between east and west Siberia. Foreign travellers called this the 'Zilov Gap'. The "Amur" highway, which connects Amurskaya Oblast and Khabarovsk Krai, will complete the Trans-Siberian highway to a length of about 2,000 km and bridge this gap. In 2000, the construction of the Chita-Khabarovsk section began and some smaller sections have now been completed. However, for the most part it is still under construction and the remaining sections are no more than temporary roads with thin layers of gravel pavement or dirt.

From Khabarovsk to the east, there is a highway to Komsomolsk-on-Amur. Located approximately in the middle of this highway, a branch road starts from Lidoga to Vanino facing the Tatar Strait in the northernmost part of the Japan Sea. The 330 km Lidoga-Vanino section is currently undergoing paving work which will be completed in 2008 and when finished, will provide direct access to the port of Vanino, which is the third largest seaport in the Russian Far East.

2.2 Road Network in the Northern Part of the Russian Far East

In the Republic of Sakha, which constitutes 18% of the area of Russia, cities are scattered over the vast territory. Most of the road network is limited to the outskirts of each settlement and there are only a few intercity roads. This is because most of the land is covered by permafrost which makes construction extremely difficult. Additionally, cities are large distances apart and there lies a great number of rivers to build a bridge. Finally, as the land is divided into north and south along the line of the Stanovoy Mountains and east and west by the Verkhoyanskiy Mountains, the intercity road network is required to pass over steep mountains. All of these factors amount to significant construction costs. The means of transportation between cities without intercity roads are "winter roads" and river transport, and in a few cases by aircraft. The land of the Republic of Sakha is divided into east and west by the Rena River and a few bridges have been constructed over the upper reaches. So the river ship is used for cross-straits transportation by ordinary.

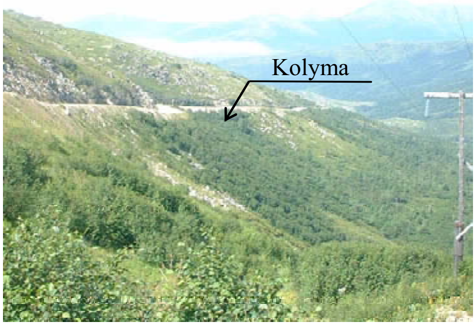


Figure 3 Intercity Road in the Russian Far East

The baseline road networks can be found between Yakutsk, the capital city of the Republic of Sakha, and Tinda via Neringri, which connects Yakutsk and BAM station. The city of Mirny, which is located about 1,900 km west of Yakutsk, is the largest diamond production center in Russia. From Mirny City as a center, macadam roads run to the north and south to Udacheny and Lensk, respectively. These roads connect the diamond mines and Mirny, as well as Mirny and the river port of Lensk.

There are only two towns, Magadan and Susuman, in the Magadan Oblast and all commodities are delivered by road transport as there is no railway. The "Kolyma" federal highway, which is paved with macadam, connects Yakutsk and Magadan via Khandinga and Susuman, traversing the Stanovoy Mountains and the Kolima Highland. Along the main road, some branch roads have been constructed for gold mining. However, the passes are steep and slippery slopes make driving difficult. Details of road conditions are not well understood, especially concerning the branch roads.[5]

3. Railroad Network in the Russian Far East

3.1 TransSib and BAM

The driving force of freight transport in the Russian Far East is the "TransSib", the Trans Siberian Main Railroad, and its branch line "BAM", the Baikal-Amur Mainline. The TransSib is the longest railroad network system in Russia, stretching 9,297 km from Moscow and east to Vladivostok and Nakhodka which face the Japan Sea. The electrification plan for the TransSib, which began in 1929, was completed in 2002. Furthermore, the track-doubling work on the bridge across the Amur River in Khabarovsk is also finished and the whole line is now a double-track railroad. However, the problem about coexisting alternate current section and direct current section in the same railroad track is not solved yet. The main cargo is petroleum products, coal, timber, iron and steel, nonferrous metals and fishery products. Containerized cargo form Korea and Japan is also plentiful. It is reported that the TransSib is capable of 100 million TEU transport, however only 50-70% of its capacity, including bulk cargo, has been achieved in recent years.

The BAM, which runs through areas of the taiga 200-500 km north of the TransSib line, starts from the Port of Vanino (facing the Tatar Strait) to Tychet, which is the junction of the TransSib and the BAM, via Komsomolsk-on-Amur (near the lower waters of the Amur River), Tinda, Angarsk (near by the Lake Bikal) and Ust-kut (near the upper waters of the Lena River), over a length of 4,300 km. It shortens the route from the northern part of the Far East to the Pacific coast compared to the TransSib route. The BAM began operation in 1989, but was only fully opened to traffic in December 2003 with the completion of 15 km of tunnel. There are branch lines that connect the BAM and the TransSib at Tinda and Komsomolsk-on-Amur. The section between Vanino and Lena-Vostocheny is a single-track line and has not yet been electrified. The 720 km section between Lena-Vostocheny and Taychet is double-track and electrified, but there are some steep slope sections and sharp bends which might constitute limiting factors for mass transit in the future. At present, this line is not used a great deal, though it could play an important role for the future development of natural resources in the northern part of the Russian Far East.

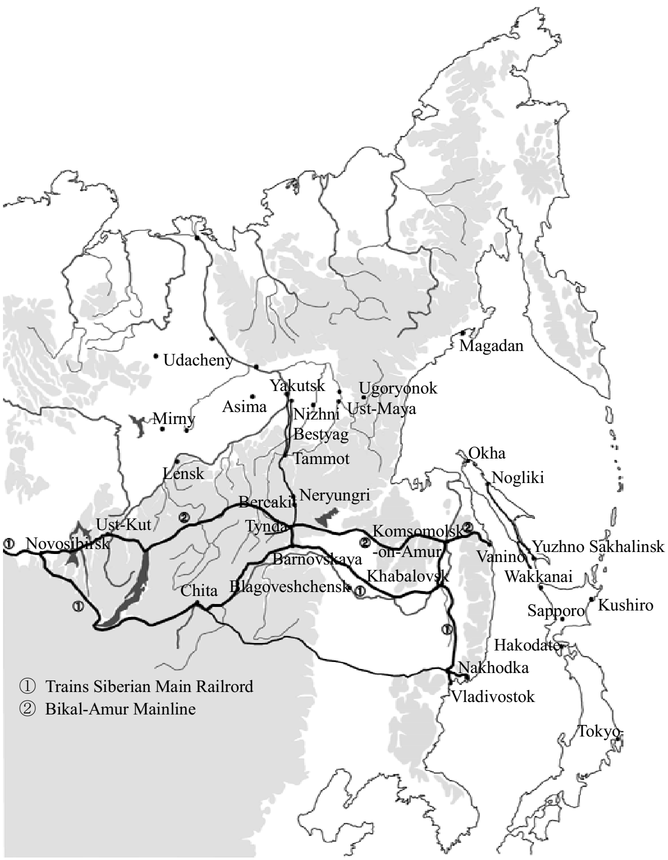


Figure 4 Railroad Network in the Russian Far East

3.2 Railroad Network in the Republic of Sakha

Except for the southernmost part of the Republic of Sakha, there is no railway network at all in the northern regions of the Russian Far East. The BAM runs through the southern border of the Republic of Sakha and branch lines stretch north from Tinda to Tammot via Berkakit and Neryungri. The BAM station Tinda and the TransSib station Bamovskaya, are connected by a branch line. In August 2004, the first train from Tommot in the Republic of Sakha to Moscow was dispatched.[6] There are 14 passenger stations and two freight terminals at Aldan and Tommot, which were opened for universal containers, coal and oil products. This branch line is expected to transport between 5 - 7 million tons of freight annually, and will also haul cargo to Khabarovsk via the TransSib. Thus, the coal and coke produced from the deposits in the southern part of the Sakha Republic such as at Elga and Neryungri, will be transported to the BAM and TransSib. Furthermore, the competitiveness of enterprises in Sakha is expected to be enhanced by improving transportability and reducing transportation costs. The construction of the final 444.6km section between Tommot and Yakutsk is expected to be completed in 2010.

Table 1[7] Railroad Network in the Republic of Sakha

Route	Length (km)	Note
Bamovakaya (TransSib) - Tinda (BAM)	180.5	Existing railway line connecting the BAM and TransSib
Tinda - Berkakit	221	Existing railway line branching from the BAM toward the Republic of Sakha
Berkakit - Tommot	360	Construction completed in 2004.
Tommot – Nizhni Betsyag (Yakutsk)	444.6	Under construction and expected to be completed in 2010

4. Sea and River Transport in the Russian Far East [8]

4.1 Overview

In spite of its extensive area of land, the gateway for freight transport in the Russian Far East is very limited. The TransSib will be the only land route to Europe until the completion of the "Amur" highway, meaning that sea transport from ports in the Pacific coast and NSR[9] plays an important role in the Far East's economy. In the northern regions such as Magadan, Kamchatska, Sakhalin Oblast and the northern areas of the Republic of Sakha and Khabarovsky Krai, sea transport is practically the only means of cargo haulage. There are 22 commercial ports and about 10 fishing ports, small wharfs and anchorages in the Far East. Among them, the following ports can be used year round and play a very important role in the region: Zarubino, Posyet, Vladivostok, Nakhodka, Vostochny, Vanino, Magadan, Petropavlovsk-Kamchatski and Korsakov and Kholmsk on Sakhalin Island. These year-round operational ports, which are concentrated in Primorye, Khabarovsky Krai and Sakhalin Oblast, are the gateway to the Pacific Ocean and to East Asia, North America and other places.

On the contrary, most of the river ports such as the ports in the Lena and Amur Rivers are unable to be used in winter and spring because of freeze up and snowbreak of river. In the Arctic Ocean and the Sea of Okhotsk, most of the ports can be used for a limited amount of time when sea routes can be navigated in the summer season. The ports of Tiksi and Pevek which face the Arctic Ocean are the only practical means of cargo transportation for the northernmost part of the Far East. The NSR navigation route which makes a call at these ports, connects the northernmost part of the Far East, Europe and the Pacific coast.

After the collapse of the Russian economy in the 1990s, cargo handling was at one time reduced to a third to a tenth in most of the ports in the Far East. Recently, however, shipping cargo has shown a tendency to stabilise and increase at most ports although the period of stagnation did leave port facilities rundown and out of date in terms of functional capacity.

Vladivostok, Nakhodka, Vostochny and Vanino facing the Japan Sea are the major ports in the Russian Far East by being the intermediary points between the TransSib and the BAM. These ports are also the gateway of Russian cargo flow to the Pacific area. From the port of Vanino, shipping services, including ferries to Kholmsk, Magadan, Petropablovsk, Otaru (Japan) via Sakhalin Island and Pusan (Korea) via Korsakov (container), are in operation.

4.2 Sea Ports

In the port of Magadan, cargo handling, which amounted to 3 million tons in 1991, fell to 700,000 tons in 2002, but has stabilised in recent years. The depth and total length of the wharves are about 8m and 1,400m, respectively. There are 15 cargo cranes on the wharf, but their capabilities are diminishing due to age. Tidal change is approximately 5 m (maximum) and the sea surface usually freezes over from January to May at a thickness of about 50-60 cm. During this time, an icebreaker is used to break the sea ice surrounding the wharves. The broken ice is taken out of the bay by predominately northwesterly winds, and the wharves are therefore clear of ice. In March and April, ships which cruise within 300 miles of the coastline require an ice breaker escort according to federal regulations.

In the port of Petropavlovsk-Kamchatsky, cargo handling, which peaked at 3 million tons, is at present roughly 750,000 tons. Among them, container cargos make up about 70% of the total volume and commodities are dominant. The main shipping line starts in Vladivosok via the Tsugaru Strait, while ferry services to Sakhalin Island via the Kuril Islands are also operated. For sightseeing, about 20 passenger

Figure 5 The Port of Magadan

ships arrive from the United States and other countries annually. There are 12 berths whose depth and length are about 10 m and 150 m, respectively. The port is used all year round as there is no ice floe in winter.

4.3 River Ports

While road and railway infrastructure is not well developed, especially in the northern part of the Far East, some regions have enagaged in river transport development over an extended period. Navigable rivers are as follows: Amur (Khabarovsky Krai, Jewish Autonomous Oblast and Amurskaya Oblast), Ussuri, Amgun, Maya, Tunguska (Khabarovsky Krai), Zeya, Selemdzha, Bureya (Amurskaya Oblast), Lena, Viluy, Kirenga, Vitim, Olekma, Aldan, Indigirka (Republic of Sakha), Kolyma (Magadanskaya Oblast, Sakha) and Anadyr (Magadanskaya Oblast). Among them, river transportation is commonly used in Khabarovsky Krai, the Republic of Sakha and Magadanskaya Oblast.

4.3.1 River Transport in the Southern Part of the Russian Far East

In the southern part of the Russian Far East, the Amur River and its tributaries are used as inland waterways. The total length of navigable fairways in this region reaches

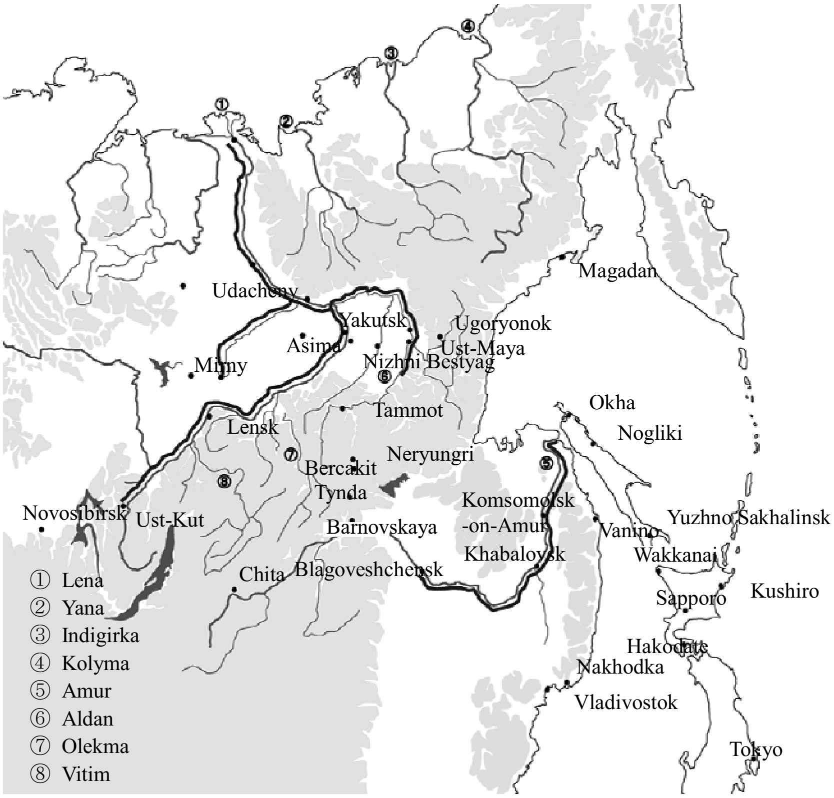


Figure 6 River Transportation Network

about 6,000 km. The main ports are Blagoveshchensk, Khabarovsk and Komsomolsk-on-Amur. Cargoes are delivered not only to neighboring areas, but also to Sakhalin Island, Primorye and Magadanskaya Oblast voyaging out to the sea via the river mouth.

In the port of Khabarovsk, which is located in the middle section of the Amur River about 900 km from the Sea of Okhotsk, there is a berth of approximately 300 m in length and about 4-6 m in depth. At this port, some 2.4-3.0 million tons of cargo is handled annually. The main cargo is river sand for construction materials and timber. Export cargoes travel to Chinese ports located upstream on the Amur River from Khabarovsk, and to Korea and Japan via Komsomorsk-on-Amur downstream. There are port facilities on a scale similar to Khabarovsk in the Akha River. The Amur River is also important for passenger traffic, not only between settlements along the river, but also between Russia and China.

Port operation is halted from October to May due to freezing and snowbreak of the river. Usually, dredging is not necessary to keep a sufficient draught in the shipping channel and it is navigable by 3,000-ton self-propelled ships. However, in the summer of 2001, the water level of the river fell to an unprecedented low level so that passenger and cargo shipping operations were limited and even suspended in certain sections.

4.3.2 River Transport in the Republic of Sakha [10,11,12]

The land area of the Republic of Sakha is divided into east and west by the Lena River which runs to a length of 4,400 km to the Arctic Ocean in the north. The entire river is navigable within Sakha together with some of its tributaries such as the Viluy, Aldan, Olekma and Vitim rivers. Cargo and passengers are carried between river ports and the wharves of riverside cities and settlements such as Osetrovo (Ust-Kut), Kirensk, Lensk, Yakutsk, Sangar, Viluysk (Viluy River) and Ust-Maya (Ardan River). There is also the Arctic port of Tiksi, which is one of the calling ports of the NSR on the east side of the Lena River's estuary.

In the Russian Arctic region, the melting of snow begins in the southern part of the rivers which means that it travels downstream from the upstream area. As a result, snow-fed streams are dammed by the frozen area downstream and sometimes, the broken ice forms an ice jam. This causes the water level of the river to rise so much that in spring, it occasionally leads to flooding of the cities along the river. With the rise in the water level, the elevation of the wharf is about 5 m higher than normal at Yakutsk and up to 14 m at upstream ports.

Figure 7 Lena River Port

The Lena River Port in Yakutsk, the capital city of the Republic of Sakha, is located on the left bank in the middle section of the Lena River. The wharves and sites are constructed on swampland by using landfill along the riverbank. There is one container crane and 15 cargo cranes on the wharf. The depth of the berth is about 3.8 m and the shipping channel is about 2.5 m deep between Yakutsk and Tiksi. The depth of this channel was 3.0 m in the past, but the halting of dredging work by a lack of funding and a decline in shipping traffic allowed the channel to become shallower. The volume of maintenance dredging is about 0.9 million to 10 million m^3 per year and some of the dredged sand is used for construction materials.

Cargo turnover is about 1.6 million tons annually, which is down by about a tenth compared to the 1990s. The main cargoes are coal and oil products, timber, lumber and containers. Passenger traffic between cities and settlements along the river is also important to this region. The operational season is from June to November. There is a 5,000-ton cargo ship which can cruise on the Indigirka and Kolyma Rivers via Tiksi and the Arctic Ocean. It takes a week to make the round trip from Yakutsk to Tiksi.

The port of Lensk plays an important role as a logistical center for the diamond mining industry in the Mirny area. A lot of the equipment, materials and commodities are transported from the port of Osetrovo (Ust-Kut), which is located about 900 km upstream from Lensk, and it takes four days to navigate. Cargo is reloaded onto trucks and taken to Mirny and other complexes. The port of Osetrovo is located on the city of Ust-Kut in Irkutsk Oblast and is a junction point for Lena Station on the BAM. In this region, the depth of the river tends to be shallower and sometimes it obstructs navigation.

The Port Tiksi, which is located in east of the estuary of the Rena River, is the gateway of water transport from the Republic to the NSR. In late the 1980s, cargo turnover reached 1.1 million tons.

5. The Transportation Network on Sakhalin Island [13,14]

5.1 Port and Sea Transport

There are 11 ports on Sakhalin Island and the following eight are commercial ports: Kholmsk, Korsakov, Aleksandrovsk-Sakhalinskiy, Boshnyakovo, Krasnogorsk, Poronaysk, Shakhtersk and Uglegorsk. The main ports are Kholmsk and Korsakov and they can be used year round. The rest of the ports are used for fishing and intrastate transport.

There are two ports in Kholmsk. The Kholmsk Commercial Port is located on the southwestern coast of the island facing the Japan Sea. During the Soviet era, 5-6 million tons of cargo was handled annually which drastically decreased in the 1990s. The main cargo is handled by ferry which accounts for 85%, while brown coal from the northern region accounts for 15% of total turnover. In 2002, 2.2 million tons of cargo was handled and the number of passengers reached about 60,000. There is a ferry service between Kholmsk, Otaru and Vanino. The Kholmsk Commercial Port has jurisdiction over quarantine and customs inspections, including cargo that passes through the Kholmsk Western Sea Port.

The Kholmsk Western Sea Port is located in the north of the Kholmsk Commercial Port. This port was a fishing port before the Sakhalin-Shelf–Service Co. took it over in 2001 and renovated its rundown facilities. In 2003, the “Sakhalin

Energy Investment Co." bought an interest in the port and the port made a fresh start as the "Kholmsk Western Sea Port". Today, the port has become a major sea port for supplying equipment and materials in conjunction with the development of the Sakhalin II Oil and Natural Gas Project.

The Port of Korsakov is located in the Aniva Bay on the southernmost coast of the island, which faces the Sea of Okhotsk and Japan's Hokkaido Island. The port has north and south wharves and a fishing area. The port has been open to foreign countries since 1991 and Japanese passenger boats started to visit annually in 1993. A liner service also runs between Korsakov and Wakkanai. In the past five years, 450,000 - 680,000 tons of cargo, mainly consisting of coal, oil products and containers, have been handled.

Port infrastructure on Sakhalin Island will be further developed by among other things, the renewal plan of Korsakov and Kholmsk in accordance with offshore oil and natural gas development. There are also plans to upgrade smaller ports for coal and oil development in the northern part of the island. Furthermore, the construction of Material Offloading Facilities for the LNG and Oil terminal has begun in the coast of Cape Aniva (Prigorodonoye) by the Sakhalin Energy Investment Co.

Figure 8 Transportation Network on Sakhalin Island

5.2 Roads and Railroads

The road and railroad network begins at Yuzhno-Sakhalinsk and connects the major cities and settlements. Kholmsk, Yuzhno and Korsakov, which are principal cities and located in the southern part of the island, are connected by paved roads and railway. The road between Korsakov and Prigorodonoye is also paved and well developed due to the Sakhalin II Project. The longest road runs north-south from Yuzhno to Okha via Nogliki. It used to be narrow, unpaved and hazardous, especially in the section between Nogliki and Okha. However, asphalt paving and upgrading work on the entire section began a few years ago. During the first stage of this project, preparation work for paving between Yuzhno and Nogliki over a length of 500 km was completed and about 160km of it has already been paved. Paving work from Yuzhno to Nogliki will be completed in 3 - 4 years' time.

The two ports in Kholmsk and the Port of Korsakov are connected to Yuzhno by railway. Thus, the railway network on Sakhalin Island is connected to the TransSib via a ferry service between Vanino and Kholmsk, while the arterial railroad between the northern and southern regions connects Yuzhno and Nogliki. There are also spur lines from Kholmsk to the north and a connecting line from east to west between Ilinskiy and Arsent' evka. These railways are of a narrow-gauged width of 1,067 mm, unlike the standard Russian broad gauge of 1,520 mm. The gauge difference is one of the major obstacles to cargo transportation between the mainland and Sakhalin Island and accordingly, work to unify the gauges commenced in 2003.

There is a narrow-gauge branch line, chiefly 750 mm in width, between Nogliki and Okha, and another between Okha and Katangli located 12 km to the southwest, run by the "Rosneft-Sakhalinmorneftegas" company.

5.3 Transport Infrastructure to be Developed

In recent years on Sakhalin Island, it has been necessary to expand and develop transport infrastructure in line with the large-scale development of oil and gas fields off its northeastern coast. Some of the principal structures had already been renovated such as roads, ports and also an airport. The construction of a railway and roads between Yuzhno and Nogliki are currently underway and the expanding of port facilities is also being examined as future projects.

In 2000, oil production began in the northeastern offshore field under the "Sakhalin II Project" and another oil field commenced production in October 2005, under the "Sakhalin I Project". Related to the latter project, the building of a marine oil terminal in De-Kastri (Chikhacheva Bay, Khabarovsky Krai) is currently underway for future transport by oil tankers.

6. Scenario for Development of Natural Resources in the Russian Far East

6.1 Development of Natural Resources in the Russian Far East

Gold, which is produced in the mines of Magadanskaya Oblast and the Republic of Sakha, is transported to Magadan along the road "Kolyma" which runs though the Kolyma highland. Timber, which is logged in Khabarovsk Krai and Primorsky Krai, is transported by ship along the Amur River and the TransSib. Most of the coal fields are located along the BAM or the TransSib and products are transported by the railway network. Thus, it requires a long-distance transportation system across vast lands to exploit the natural resources of the Russian Far East, meaning that in some instances, the resources, which are distributed in Russia's extreme northern areas far away from the transportation network, are left completely untouched, even though they are promising.

As a matter of course, the Russian Far East has served as a contact between Russia and East Asia geographically. And today, progress in international specialization and economic globalization has accelerated and broadened the interrelationship between the two regions both socially and economically. It is widely known that oil and natural gas development off the coast of Sakhalin Island provides a wide range of multiplier effects in these areas. And in this way, the globalized face of the economy and industry will play an important role in the sustainable development of the Russian Far East and East Asia for many years to come. And the abundant natural resources in extreme north area of Russian Far East will draw a attention of international market.

The "INSROP" project,[15] which was conducted in the 1990s, examined the NSR as a major transportation link between the Sea of Okhotsk and the Barents Sea via the Russian Arctic region. Concomitantly, public attention has been moving away from the development of energy resources in the North and Barents Seas to the Sea of Okhotsk, so the NSR is expected to be a major link in the transportation system for the development of natural resources in the extreme north of the Russian Far East.

6.2 Transportation Scenario for Natural Resource Development [16]

It is absolutely necessary for the Russian Far East to develop a means of transport in order to realize the export of natural resources from its extreme northern areas. In these areas, inland river waterways and roads are the only means of ground transport. Tremendous amounts of money are required for the construction and maintenance of roads on frozen ground and transport capacity is limited. In the case of road transport, hauling distances become so long that the quite high cost will be required for transportatin and its capacity is limited. Therefore, the road network should be constructed in such a way as to connect with production sites and the transfer points of other transport networks such as ports and railway stations.

The operation of river transport is limited to the ice-free season in summer. However, river transport could be utilized for long-distance carriage combining with roads or railways between ground bases and river ports. And only the river transportation can provides direct connection to the sea transport, NSR. Furthermore, in the extreme north, the completion time of port facilities and their costs could be reduced to levels below that of road construction. Sea transport along the NSR is also limited to the ice-free season in the Arctic Ocean, although possibilities exist to enable the export of large quantities of products to Asian countries by combining the lower-cost river transport system in favor of using roads and railroads.

As a result, the most viable transportation scenario for developing natural resources in the extreme northern region is a combined system of river transport and the NSR. The basic concepts are as follows:

a) The Lena River and the NSR

There are plentiful amounts of timber resources in the drainage areas of the mid and upper sections of the Lena River. There are also reasonable coal and nonferrous metal deposits in the area along the Aldan River which is a tributary of the Lena River. The scenario involves consolidating these products and linking them with Lensk and Yakutsk where river ports exist, transporting them by river boats and barges to Tiksi that face the Arctic Ocean, and finally exporting them via the NSR to the Pacific coast and Europe. This is an existing transportation route which is used mainly for domestic cargo today, but also often used for lumber exports to Europe.

b) The Kolyma River and the NSR

Many kinds of nonferrous metal deposits are located in the drainage area of the mid and upper sections of the Kolyma River. The scenario involves constructing loading facilities beside the river and access roads to production sites, and transporting the products by river boat to a shipment base at an estuary, where they would then be exported along the NSR.

There is a small settlement in the estuary area, but its port facilities are so small and old that the shipment base would have to be newly built according to special criteria. This scenario could also be applied to the drainage area of the Indigirka and Yana Rivers.

c) The Kolyma highway

The Kolyma highway runs through the area where the upper stream of the Kolyma River reaches the Port of Magadan and thus, natural products could be transported to Magadan via this highway. The road surface is, however, paved with macadam, not asphalt, and the passes comprise steep and slippery slopes that make driving difficult. Large-scale rebuilding would be needed in this scenario.

6.3 Transportation by River and the Arctic Ocean [17]

In this scenario, natural resource products are consolidated at a river base in the upper section of the Indigirka River and transported to a shipment base in the estuary. The river and marine transportation route is shown in Fig. 9, with the scenario for navigation as follows:

a) Development of Natural Resources : 20,000 tons of nonferrous metals

b) Operational Period : 90 days from July to September

c) River transportation for 324 nm (=600 km)

Depth of water channel	: 2.5 m - 3.0 m
River boat	: Hookupping two 1,000t barge (cargo capacity; 1,000 + 1,000 = 2,000 t), and pusher boat
Average speed	: 5 kn
Navigation	: 324 nm × 2/5kn = 11 days for round trip plus 4 days for loading and unloading

d) Marine Transportation for 3,900 nm (=7,223 km)

Route	: Estuary of Indigirka ~ NSR - Bering Straight - Yokohama
Cargo Ship	: SA-15 Type ULA class Cargo Ship
Average speed [18]	: 11 kn
Navigation	: 3,900 nm ×2/11 kn = 709 hr =30 days, plus 10 days for loading and unloading

Two journeys from the Arctic sea port to Japan via a NSR cargo ship would therefore enable the transport of 20,000 tons of nonferrous metal ore.

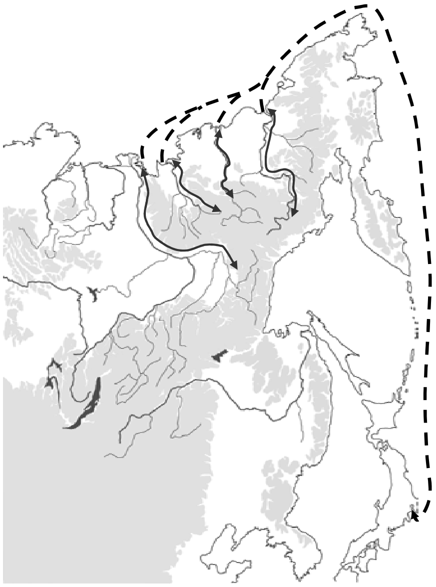
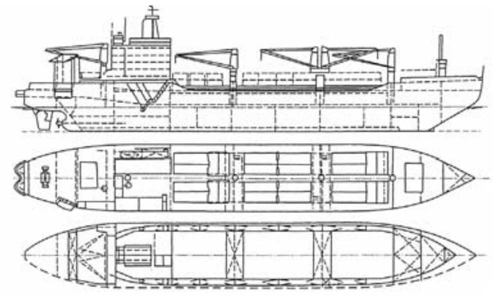


Figure 9 Transportation Scenario



- Classification: RR, Ice Class: ULA
- Loa: 174m, Width: 24m, Draft: 9.0 m(NSR), 10.5m(in open water)
- Gross tonnage : 16,500 tones
  Displacement tonnage: 25,900 tones
  Dead Weight tonnage : 14,700 tones
- Speed: 18.1kn (in open water),
  11kn (in NSR)

Figure 10 SA-15 Arctic Bulk Carrier

6.4 Shipment Base and River Base

In the estuary, river channels fork intricately and change their shape and depth every year so it is vital to the location of the shipment base that the water channel and its depth are as stable as possible. Furthermore, the water depth should be enough for a NSR cargo ship (about 10 m) and the structure impervious to ocean waves.

To build the shipment base in the Arctic Ocean, there are other challenging conditions which are unique to the area. Firstly, structures must be able to bear extremely low temperatures, lower than -40°C. Structures around water surfaces and facilities that are submerged in seawater would also be subjected to ice loads and ice-related interference. During operation and maintenance, special considerations for ice management would therefore be required. Furthermore, the melting of snow usually causes the water level to rise and results in floods in spring or early summer, so the facilities and structures must be able to withstand this.

The construction of a shipping base on the coast of the Arctic Ocean is also a challenging task. The period for field operation is very limited, to around 90 days. The ground is swampy and permafrost also exists. River channels of fan delta hinder the supply of equipment and materials from land. It is considered that the only way to overcome these problems is to use a massive floating structure to reduce field construction work and to shorten work periods as much as possible.

The shipping base is required to be equipped with a quay side to moor and handle cargo, and to be able to house a loading facility, cargo storage yard and an accommodation space. The minimal dimension of the base is set to 250 m by 100 m in order to moor the SA-15 ULA class cargo ship and to store 20,000 tons of mineral ore. The floating body is moored by chains to the sea bed. To build the shipping base, the floating body is divided into two units and fabricated at a shipyard in the Pacific Coast. These units are then towed to the Arctic Coast site and combined into one consolidated unit[19,20].

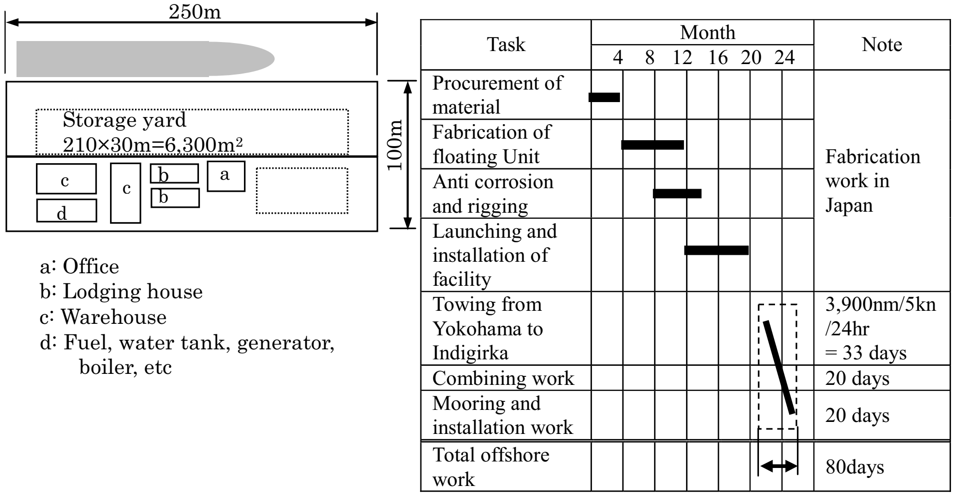


Figure 11 Building the Shipping Base Using a Floating Structure

7. Conclusion

Since the INSROP Project of the 1990s, the interrelationship between the Russian Far East and East Asia has improved dramatically. Today, the oil and natural gas development project off the northeastern coast of Sakhalin Island is flourishing and providing multifarious effects to the regional and international economy. Due to the demand for energy and natural resources, the northern region of the Far East will also begin to attract attention in the not so distant future. The key to the development of the resources in this region is transport infrastructure, but there are many obstacles to be overcome. In this paper, the current status of transport infrastructure in the Russian Far East has been detailed and a transportation scenario for the development of natural resources in the northern region of the Russian Far East utilizing river transport and the NSR has been proposed.

This paper was written with the support of the members of the JANSROP II working group and we hope that a new era in the Arctic region, supported by sustainable development and the rich natural environment, will begin in the near future.

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Prospects of Russian Far East Marine Transport System Development

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In relation to Russia's integration into the international transport system, the transportation of foreign trade cargo is a significant issue. In 2004 the volume of Russian foreign trade cargoes exceeded the one in the former social system by 45 – 65% and it is approximately by 1.5 times. The dynamic of transportation is as follows (CNIIMF, Ministry of Transport data):

USSR: 1986 year – 292.5 million tons
1990 year – 254.2 million tons
Russia: 1991 year – 173.3 million tons
1998 year – 204 million tons
2003 year – 378 million tons
2004 year – 450 million tons

With regard to the analysis of port capability development in the different regions of Russia, the division of transportation volumes of all kinds (including Russian cargoes through foreign ports and from the Administration of Marine Ports) between basins is important.

Table 1

Cargo name	North-West basin	South basin	Far-Eastern basin	Totally
Totally, mln.t.	143.2	142.4	70.3	355.9
Dry cargos, mln.t.	65.6	36.3	55.4	157.3
Liquid cargo, mln.t.	77.6	106.1	14.9	198.6

One further important fact is that despite the reduction of GDP growth, foreign trade turnover in Russia increased 34.9% during January-April 2005, compared with the same period in 2004.

Development of the current Russian marine transport system needs viable projects connected with increasing Russian port capabilities, the promotion of foreign trade and also the development of transport integration processes.

The most important projects of this type in the Russian European side are:

In the Black Sea:

- Caspian Olya port development within the framework of the transport corridor in "North-South" development

- Makhachkala port development, including ferry services
- Reconstruction of terminal for grain cargoes and some berths in Novorossiisk, increasing cargo handling capability up to 4 million tons
- Ammonia terminal near Zhelezni Rog with capacity of 2 million tons

On the Baltic sea:

- Car ferry terminal in Kaliningrad
- Ust Luga coal terminals
- New oil terminal in Primorsk (up to 18 million tons), etc.

In the development of the ports in the European side, it is very important that the marine transport system of the western sector (Black and Baltic Seas) filfills the potential of its development capabilities. There are serious ecological limits on the Baltic Sea, while limits on the capacity of the Bosfor strait exist in the Black Sea.

Against these factors, the development of Far Eastern ports is very desirable, but it still does not go far enough, as the following points indicate:

- Far Eastern ports handle only about 16% of Russia's foreign trade cargoes or about 20% of the volume that passes through Russian ports, while roughly 77% of all sea transportation from the Far Eastern basin passes through the ports of Primorye.
- The role of Far Eastern basin transportations constantly decreases, but the volume of cargo for transportation increases in Primorye, Far Eastern basin and in Russia.

There are three main aspects to the development of the Far Eastern basin cargo base;

- Oil, oil-products, gas;
- Coal;
- Containers.

On the basis of potential cargo of oil and coal and the sign of economic growth, the government has adopted a development project for transport system in the Far East basin. The building of processing plants for raw materials will provide future economic growth in the region.

Current projects of ports development include:

- new oil export facilities (including oil and gas products) - in the Prigorodnoe port (near Korsakov and Sakhalin), in the De-Kastry port (Khabarovsky Kray);
- preparations for the construction of a port in Perevoznay Bay have begun for the Taishet-Perevoznay pipeline project (Primorsky Kray);
- coal processing capacity development:
  - continuing construction of a new coal terminal in Vanino (Muchke Bay, Khabarovsky Kray);
  - preparation of the third coal line building is underway in the Vostochy port;
  - Shahtersk port is planning a new coal terminal (Sakhalin);
  - there are some more regions that are being examined for the possibility of new coal ports (Zarubino, Suhodol, Posiet, Primorsky Kray);

- a new coal terminal project in the Shahtersk port (Sakhalin)

There is a lack of good examples of the development of container-handling capacity, except for the FESCO project relating to the new container terminal in Vladivostok. The existing volume of container handling in ports in the Far East is limted by the TransSib capabilities, port-railway stations facilities, imperfections in ports infrastructure, the absence of substantial transport system and many other factors. Predictions of foreign trade containers traffic through the Vostochny port (container terminals) are shown below, in TEU.

Table 2

Transportation	Fact in 2000	Fact in 2004
Transit	42,731	117,892
Export	10,123	52,033
Import	19,751	102,436
Total	72,605	272,361
	100%	375%

Expert judgment of market niches in the sea transportation in the Far East, taking into consideration potential points of growth, include: depending on substantial development in the transport system, the real potential of goods turnover today in Primorye is between 120 to 300 million tons, which is many times greater than can be handled by the present facilities. Potential for growth also exists in Primorsky region and in Far-eastern basin.

Table 3 Distribution of Export Cargoes between the Ports of Far East (%)

Region	Fact in 2004	Prediction in 2010
Ports of Primorye	82.9%	57.1%
Ports of Priamurie	12.6%	26.4%
Ports of Sakhalin	4.2%	16.3%

For a long-term perspectives there are three models of Russian Far East Transport System Development:

First model: provision of inland traffic + long-term fuel strategy - raw materials export.

Second model: First model + active participation in international transport corridors.

Third model: Second model + creation of own international and regional transport nodes and transport - business centers.

As to the First model, joining of marine transport in the Far East into the international transport network will be done through export cargoes from the ports of Primorye, Priamurie and Sakhalin.

The key element of Far East transport system development in the second and third models is the expansion of transit cargoes.

Unfortunately, on this point we are only at the beginning and while existing transit traffic has considerable growth tendencies in the near future, but it is still small and cannot become the base for integration into the international transport system.

Table 4 The Growth of Transit Transportations through the Ports of Primorye (thousand t.)

Fact in 2000	Fact in 2004	Prediction in 2010
327.6	727.9	1,720.0
100%	222%	525%

The greatest possibility of integration into the international transport network as a transport node is in the south of Primorye.

The transport function of Primorye lies not only in servicing domestic demands, but also in servicing the international market, primarily in transit operations.

Transit operations can be offered on different levels:

- participating in transit from time to time
- participating in transport corridor creation
- functioning as an international transport node, which is needed for international transport corridors and the international transport system.

A Russian transport node could become a great partner of the Japanese, South Korea, Chinese transport networks, but we should conclude that our participation in transit route is not insufficient. The development of the Primorsky transport system greatly depends not only on Russian transport strategy but also the initiatives of North East Asian countries.

Talking about ports development of Primorie, their perspectives will form on the base of local transport nodes development, such as the Vladivostok, Khasan, Bolshoikamen and East- Hakhodka transport nodes.

Khasan node includes the port of Posiet, Troitsa (Zarubino) Bay and berths in Slavyansky Bay. In 2003, this node processed about 1.5million tons of cargoes, but its real potential is much higher.

Vladivostok node includes the Vladivostok commercial port, Vladivostok fishing port, Vladivostok petroleum storage depot and other berths of different commercial structures. In 2003, this node processed about 11million tons of cargoes and real growth and restructuring potential exists.

Bolshoikamen node does not presently exist, but there are prospects for its establishment. While cargo operations are going on the berth of shipbuilding plan “Zvezda”. It is possible to build a berth of up to 13 m deep here. Railway lines also exist. It is possible to operate ships of up to 45,000 deadweight tons.

East- Hakhodka node includes the Nakhodka commercial port, Nakhodka oil port, Vostochny port, Maliy port, Nakhodka fishing port and other berths of different commercial structures. In 2003, this node processed about 30 million tons of cargoes and real growth and restructuring potential exist.

Besides these nodes belonging to the southern ports of Primorie, it is worth mentioning the port of the North, including Plastun, Olga, Svetlaya, Rudnaya pristan, etc.

Concerning Russia's transport strategy, the fulfillment of transit potential should not simply be a major branch of the transport system, but also an independent stimulator of economic growth.

In this strategy, the key tasks of Russian Far East transport development are:

- The completion of the Baikal-Amurkaya and Amuro-Yakutskaya railways and supplementary lines providing mobility within the railway network;
- The creation of a supporting road network (completion of the Chita-Khabarovsk-Nakhodka and Lidoga-Vanino roads, reconstruction of the roads along the Baikal-Amurkaya and Amuro-Yakutskaya railways, creation of the Yakutsk-Magadan, Yakutsk-Viluisk-Mirny, Zeleny Mis-Bilibino-Pevek and Petropavlovsk-Kamchatski-Palana roads, creation of road-transport bridges across the Amur River near Khabarovsk and Blogoveshchensk).
- Creation of really operating International Transport corridor "TransSib", "Primorye-1", "Primorye-2";
- The development of trans-shipping facilities at the ports of Vladivostok, Nakhodka, Vostochny, Vanino, Posiet and Zarubino;
- The development of international boundary transitions and terminals, providing the increment of technological and custom processing and comfortable conditions for the passengers.

The information outlined above concerning the elements of Russia's transport strategy, i.e. of basic cargo growth rates and the development and problems of development of Far Eastern transport networks, indicates that the Far Eastern transport system is steadily developing, but that the tempo of development is insufficient and that potential possibilities and demand for development growth faster today. The key aim of the Far Eastern transport today is to provide more rapid growth which will allow Russia to integrate into the international transport market. If not , there will be little prospects for the Far Eastern transport system.

Strategic Plan for the Russian Far East

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1. Natural Resources in Russia

Natural resources are regarded as one of the most attractive features of Eastern Siberia and the Russian Far East for trading companies. Without doubt, these two regions rely on abundant natural resources as their most important advantage.

Of the resources they possess, coal reserves in these areas comprise 90% of total coal deposits in Russia.

Rich forestry resources also exist in the Russian Far East and we can easily see forests spread widely over Siberia when we fly over. These forestry resources account for nearly 77% of those in Russia.

Regarding oil and natural gas, oil reserves in Siberia are extremely plentiful and Tyumen Province produces 75% of Russia's oil. The area north of this region has very generous natural gas deposits and production there is equivalent to 35% of the total volume in the world.

This is why Russia is said to be the country richest in natural resources.

2. Development Gap in Natural Resources in Russia

Although the country abounds in natural resources, there is a gap between east and west in terms of their development. Unbalancement is the general feature of Russia, highly developed in west, poorly made in east, because of difference of population (European area (78.5%)/Asian area (21.5%)). It seems that local demand associated with population significantly affects the development of natural resources.

Unfortunately, there are no densely-populated areas in Eastern Siberia or the Russian Far East. For example, the Far East is one-third of the area of Russia, but its population comprises less than 5% of the country's total. Moreover, population density is only one person per square kilometer and the local Gross Domestic Product[1] is one-sixteenth that of the nation. In particular, the Republic of Sakha-Yakutiya, which is the largest province in terms of area, is eight times the size of Japan yet only has a population of 950,000 people (2002). Even Yakutsk, the capital city of the Republic of Sakha-Yakutiya, has a population of only 210,000 and is ranked 90th among Russian cities.

If there is insufficient demand in Yakutsk City, the transportation costs of developing resources will be quite high because of the distance to densely-populated Western Siberia where higher demand exists.

We therefore suggest that development in Eastern Siberia and the Russian Far

East should not depend entirely on domestic demand.

3. Marubeni's Business

Three examples are presented below for the importing of raw materials from these regions handled by our company.

We purchase timber from Malaysia, New Zealand, Canada and Russia. From Russia, we import pine timber to the value of approximately US$20 million a year (out of a total of about US$82 million).

Concerning coal, we import thermal coals in the amount of roughly 50,000 tons annually.

As for transportation routes, the cargoes are hauled by truck from the extraction site to the nearest railway station, and then transported by train over the SLB (Siberian Land Bridge) to Nakhodka or the port of Vostochny.

The problems with this route are that:

(1) The operation of the SLB is not reliable enough. Usually our contracts are based on FOB (free on board). While we arrange vessels for the day the cargo is estimated to be ready, delays in railway services sometimes result in demurrage.

(2) Priority is given to energy resources and certain high-price cargoes (no priority is given to timber because the price is relatively low).

(3) Berths at the ports are under exclusive use and so they are difficult to obtain (it is said that some new financial cliques control them and it makes usage fees expensive).

We used to purchase iron scraps at a spot market. At that time, the cargoes were transported by truck from the market to Yakutsk, and from there the loads were carried on the Lena River by barge to Tiksi, the port facing the Arctic Sea. We then used the Arctic Sea Route to Japan. Transportation problems were not experienced at that time, but it did take four days for our company representatives just to visit Tiksi.

In order to develop and activate the trade of resources there, it is necessary to solve various problems.

4. Potential of the Russian Far East

And now, in considering how to activate Russian Far East, still of course, the development of the natural resources would be the key.

However, after the dissolution of the USSR, domestic industrial product growth has been conspicuously stagnant and the Russian Far East has lost its markets because of the collapse of the supply system controlled by the State Committee for Material Technical Supply (GOSSNAB[2]).

Therefore, in order to develop, it is necessary to introduce and utilize foreign capital because significant support from the Russian government cannot be anticipated at this stage.

Sakhalin I (Exxon-Mobil, Marubeni, Itochu, Rosnefte, ONGC (India)) and

Sakhalin II (Shell, Mitsubishi, Mitsui) are examples of development by foreign investment based on Production Sharing Agreements. These schemes should be expanded to not only the development of oil and natural gas, but also to other natural resources in order to cultivate them. There is also the possibility of new demand from the Pan-Pacific area stemming from such schemes.

The creation of demand should be aimed not at the Russian domestic market around Western Siberia or the European Area, but at the entire Pan-Pacific region (Japan, Korea, China, USA and Southeast Asia).

Besides, the simple development of natural resources cannot bring long-term promotion of the local economy, and it is not enough to merely invite foreign capital. Similarly, we do not need isolated development, but rather comprehensive trans-border development so that relevant sites can be connected in a development network.

5. Scenario of Economic Growth for the Russian Far East (Steps 1 & 2)

If there is no demand in an area, the advantages of developing natural resources are limited to the direct impact of selling those resources and would not translate into comprehensive economic development. For the total activation of the local economy, such development is what is required.

With this in mind, a possible scenario for economic development in the Russian Far East could be:

<Step 1>

We propose the institution of a free economic zone in the Amur River basin. The Amur River Free Economic Zone (ARFEZ), so to speak, based on foreign capital, should be promoted to supply products to the major markets and companies in the Pan-Pacific region and China in the fields of automobiles, IT and even an initiative in producing and processing paper could be established.

This free economic zone should be a bonded zone where companies operating in it could enjoy certain tax incentives, etc. which would attract Japanese, Chinese and Korean capital.

A similar concept has already materialized in Khabarovsk as the Khabarovsk Techno Center and two Japanese companies are considering inclusion, although it is not a free economic zone yet. Our company, in collaboration with other Japanese companies, is also performing feasibility studies concerning stock operations of giant tires for construction machinery used in the development of mines and forests.

A pulp factory, which is said to be one of the largest Chinese investments in Russia (production capacity of 600,000 tons), is also the subject of a feasibility study. The operator will be a company from Harbin in Heilongjiang Province, and investment in the first stage of development is RMB (renminbi) 3 billion (42 billion yen) to produce 200,000 tons of high-quality long-fiber pulp products.

<Step 2>

As the next step, the Russian Far East would be developed as a supply station for the raw materials for these economic zones. If we can establish demand in more proximate locations, the development of supply stations and transportation projects should be definitely expanded. The pulp factory is a pertinent example. If the pulp factory's production site is developed, that would naturally facilitate the development of natural resources as raw materials for supply to production sites.

The potential markets of demand in Steps 1 & 2 are:

(1) Export of raw materials to the Pan-Pacific region, including Japan (similar to our company's existing import business).
Methods of how to develop natural resources, which have not yet been fully explored, would be a problem as they may not be attractive enough for foreign capital. Therefore, it is difficult to envisage rapid expansion.
This kind of development still remains local.

(2) Supply of raw materials to the ARFEZ.
This area, developed by foreign capital, is an area for producing and processing products to supply to markets in the Pan-Pacific region and China. By increasing the supply of primary and secondary products to those final markets, demand for natural resources in the Russian Far East as raw materials will necessarily increase and that in turn will activate natural resource development. Development could be expected to progress not in isolation or in a piecemeal fashion, but rather on an interrelated and comprehensive basis among the various resources.

(3) We could then begin to envisage raw material exports to huge potential markets such as the Chinese seaboard regions and also even to some inland regions.

6. Study of Transportation Routes

One possible transportation option is by railway. China, Mongolia and Russia are connected by a railway network, but there is a problem: the difference in railway gauges.

From Russia to Kazakhstan and Mongolia, a wide gauge is used (1,520 mm), while China uses a standard gauge (1,435 mm). Cargo transfer at the border would thus be required.

This may in turn result in damage to the cargo and the need for certain handling facilities. The traceability of the cargo could likewise be an issue.

Regarding raw material exports to China, perhaps a standard rail route could be used as far as Nakhodka, and then ocean shipment could be undertaken to Tianjin and to Shanghai in China. From Shanghai, barges on the Yangtze River could be used to Wuhan where Nissan Automobile and parts companies are already operating, or other regions. In any case, Chinese inland routes should be properly considered.

7. Scenario of Economic Growth for the Russian Far East (Step 3)

<Step 3>

The next step would be to develop the supply stations of the raw materials into supply stations of high value-added primary or secondary products.

At this stage, local demand in the Russian Far East itself becomes primary.

Yakutsk, Irkutsk and Chita would be the centers of demand for primary and secondary products and demand there would be for associated processing factories for pulp, coal liquid factions and copper refining. Infrastructure such as power plants (new plants or reconstructions), roads, communications, ports and other facilities would be required as well and so too construction machinery, dump trucks and trailers. Job opportunities would thereby be created.

More benefits would result if the stock operations of giant tires mentioned above was performed at Yakut or Irkutsk, as the supply base for the raw materials should be located at either of these places for this stage.

Through these three steps, a comprehensive network would be established and connected to the ARFEZ.

The transportation system suffers from permafrost, very severe weather conditions and inhospitable meteorological environment. Any construction must therefore be completed as quickly as possible and a modular method is recommended.

As the plant should be built and then transported to the actual construction site, certain modules may become troublesome and transportation via the SLB difficult because of the limitations on carrying capacity through the tunnels and on bridges. (Height limitations for SLB cargo, which comes from limitation of tunnel and bridge sizes, are 3.6 m and 2.6 m for cargo width). It is also hard to arrange trailers or dollies for heavy cargo in the area (gas turbines for power plants are sometimes as heavy as 260 tons).

8. Possibility of the Artic Ocean Route

This is why the Northern Sea Route (NSR) - ocean transportation - is an important alternative.

The possibilities of utilizing this route are:

(1) at first, existing natural resources could be transported from areas located away from railway connections and near the Lena River, such as the Southern Yakutsk and Zlyansk coal mines, and also for some timber products.

(2) At Step 3, modules for power and pulp production plants could be shipped to Eastern Siberia and Russian Far East via the NSR.

Modules would be built in order to minimize the installation period at the site and these could be transported with transportation equipment such as dollies and trailers in the summer time to Tiksi, over the Arctic Ocean by heavy duty vessels and transferred to special barges (Ro-Ro barges), which would then carry the cargo on the Lena River. Finally, the modules would be offloaded at provisional jetties constructed near the site and carried by special trailers (dollies) to their required destinations.

9. Conclusion

If certain development and economic effects were realized through Steps 1 & 2, investment capital would be attracted to the regions. And in order to assist in this outcome, local governments would definitely need to help with infrastructure projects such as road construction, ports, harbors and power plants using these funds.

As resource development projects require huge investment, commercial risks are not on a scale that the private sector could bear. Infrastructure projects however, would be attractive propositions for private companies like ourselves (of course it is not so easy to finalize contracts with Russian companies).

Unfortunately it is quite difficult to utilize the NSR at the present time for general cargoes because of economic reasons. However, as in Step 3 mentioned above, transportation for local plant construction, for which we would have no alternative, would be greatly benefited by the existence of the NSR.

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[1] Gross Domestic Product: Total value of products and services after the deduction of costs of raw materials, fuel, repair and maintenance of fixed assets etc.

[2] GOSSNAB: When a centrally planned economy existed in the USSR, two government committees named "GOSPLAN" and "GOSSNAB" controlled all production, distribution, consumption of materials, exports and imports. GOSSNAB was responsible for implementation, while GOSPLAN, as its name suggests, took care of planning.

Transportation System of Natural Resources in Korea

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1. Introduction

The final consumption of energy in Korea has increased from 75.1 million TOE in 1990 to 164.3 million TOE in 2003. It has more than doubled during those 13 years and increased at an average recorded rate of 6.5% per year. Oil as a dominant energy resource in Korea accounted for 52% of total energy consumption in 2002.

Since oil fields do not exist in Korea, almost all of the oil consumed is imported from various countries in the Middle East, Southeast Asia and in Africa, etc. Moreover, most of the imported crude oil comes from Middle Eastern countries. For this reason, Russia is strategically important to Korea as a new alternative energy source in accordance with Korea's strategy of diversifying the countries it imports from.

From a logistical point of view, the security of marine transportation routes for crude oil between Northeast Asia and the Middle East has been seriously threatened by piracy, conflicts among Asian countries and military affairs. Therefore, it is necessary for Korea to seek alternative transportation systems for its oil and gas supplies.

In this paper, the current situation of oil supply and demand and alternative transportation routes to Korea will be examined. Moreover, some points will be discussed that are inter-related with energy transportation systems.

2. Oil Consumption and Sources of Oil

Korea is the fourth largest oil importing country, as well as the tenth largest oil consuming country in the world. About 2.3 million barrels of oil and 2.6 billion cubic feet of LNG per day were consumed in 2003, and more than 97% of total energy in Korea was imported.[1]

Table 1 Consumption of Oil and Natural Gas

Unit: Thousand bbl/day, billion cf/day

	2000	2001	2002	2003
Oil	2,229	2,235	2,282	2,303
Natural Gas	2	2.2	2.5	2.6

Source: BP annual report, 2004.

Fig. 1 shows how the proportion of energy consumption by sector has changed. The upper segment indicates the movement in consumption by the transportation sector, the middle segment by the household and commercial sectors and the bottom segment by the industrial sector. The energy consumption of the industrial sector accounted for 55.5% of total consumption. However, the proportion of consumption by each sector has not changed dramatically since 1996.

Table 2 Energy Consumption by Sectors

Unit: Million TOE, (increasing rate)

	2001	2002	2003	2004(est.)
Industry	85.2 (1.5)	89.2 (4.7)	91.1 (2.2)	93.6 (3.3)
Transport	31.9 (3.1)	33.6 (5.8)	34.6 (2.5)	36.0 (3.3)
Household & Commercial	32.9 (1.6)	34.3 (4.3)	35.1 (2.5)	39.9 (5.8)
Public	3.0 (13.8)	3.2 (6.8)	3.4 (6.1)	3.3 (-6.0)
TOTAL	152.9	160.4	164.3	172.8

Source: Korean Energy Statistics, 2004

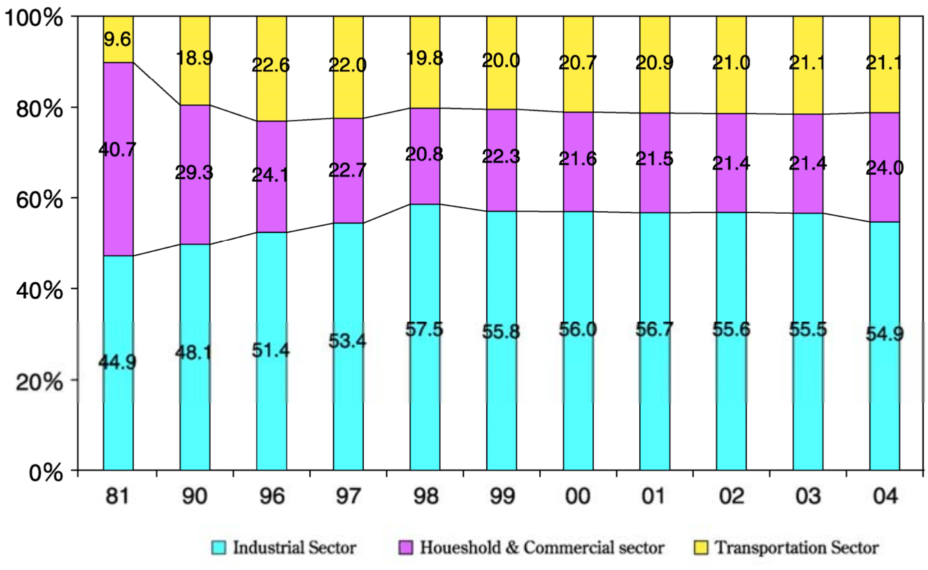

Figure 1 Proportion of Oil Consumption by Sectors

The import of crude oil is heavily dependent on Middle Eastern countries with supplies from the region accounting for 79% of the total quantity imported by Korea. Korea's dependency rate on crude oil from the Middle East rose from 57% in 1985, to 77.9% in 1995 and to 79.5% in 2003.

Table 3 Crude Oil Import Origin to Korea

Unit: Mil. Bbls, %

	1985	1995	2003
Middle East	113 (57.0)	487 (77.9)	639 (79.5)
S. E. Asia	48 (24.2)	82 (13.1)	102 (12.8)
Africa	12 (6.0)	38 (6.1)	32 (4.0)
America/EU	25 (12.8)	18 (3.0)	30 (3.7)

Source: www.mocie.go.kr

As shown in Table 3, the share from other regions decreased during the period, especially from Southeast Asian countries, one of the important energy supply regions, decreased its share of oil supply to Korea. Because of this, Korea has realized that a diversification in the countries it imports from is necessary.

Table 4 shows how Northeast Asian countries such as Korea, Japan and China are heavily dependent on Middle Eastern countries for their oil supplies. Their dependency rate on crude oil from the region is forecast to rise to 80% in 2005 and to 85% in 2010.[2]

Table 4 Share of Crude Oil Import Origin of North East Asia

Unit: %

	Korea		Japan		China		Taiwan	
	1989	1999	1989	1999	1989	1999	1989	1999
Europe				0.4		14.7		1.4
M. East	72.1	72.3	70.9	85.6		45.9	79.5	61.8
Africa	5.5	12.5	0.3	0.8		19.8	2.6	25.6
Asia/Pac.	21.1	10.7	23.9	11.7		18.7	11.4	10.7
America	1.3	4,5	4.9	1.5		1.0	3.5	0.5
Others							3.0	
Total	100	100	100	100		100	100	100

Source: www.mocie.go.kr

LNG, as an alternative energy source, was imported to the tune of 5.08 billion dollars in 2003. Nonetheless, the major origins of LNG imports did not exceed five countries in 2003.[3] The import share from Indonesia, which was similar to Qatar and Oman in 2003, decreased from 66.5% in 1998 to 26.6% in 2003.

Table 5 Share of LNG Import Origin to Korea

Thousand tons, %

	1993	1998	2003
Indonesia	4,108 (92.2)	7,050 (66.5)	5,085 (26.6)
Malaysia	290 (6.5)	2,893 (27.3)	2,792 (14.6)
Brunei		596 (5.6)	548 (2.9)
Qatar			5,691 (29.8)
Oman			4,711 (24.6)

Source: www.mocie.go.kr

On the other hand, Russia is now considering the Angarsk-Nakhodka and Murmansk oil pipeline projects, whose target markets are Northeast Asian countries and the west coast and northeast regions of the US.[4] If Russia intends to supply gas to Northeast Asia, a unified gas network will be constructed.

Recently, it has been reported that Russia's Unified Gas Network System is expected to be subjected to the government's approval process. In the case of the Unified Gas Network, connection with the West Siberia and East Asian natural gas fields should be considered and a linkup with the Sakhalin natural gas field is also being planned for the long-term.

3. Transportation Routes for Natural Resources

3.1 Ocean Routes

Almost all of the crude oil that Korea imports from Middle Eastern countries is discharged from the ports of Ulsan and Yeosu. The distance between these countries and Korea is roughly 12,000 km and vessels carrying crude oil and LNG must pass through the Strait of Malacca during their sea voyage.

For the countries of Northeast Asia, the most inexpensive crude oil imports in terms of freight per ton are from Southeast Asia and the second cheapest are from the Middle East. However, the fast-growing Southeast Asian countries cannot afford to increase the volume of oil exports because they are consuming more and more of their own oil in order to produce their own goods.

Many countries in Northeast Asia have strengthened their naval power in order to protect and control their exclusive economic zones (EEZ) and to prepare against conflicts regarding the dominions of islands and oceanic borders should security problems on ocean routes arise. Furthermore, with the possibility of armed conflicts occurring over island dominion issues, of maritime military drills between neighboring countries and of the actual use of armed force, the safety and regional security of marine transportation routes have been seriously threatened.

Recently, the jurisdiction and restrictions over the Strait of Malacca and nearby islands, which the Malaysian and Indonesian governments have discussed, are being expanded for security reasons and for the protection of the marine environment.

Moreover, an increase in piracy in the Strait of Malacca and the seas around Indonesia has greatly threatened trade between the Pacific and Indian Oceans.

For these reasons, cooperative measures should be taken into account in order to decrease and eventually remove problems among Asian countries. To establish cooperative measures, it is necessary to take a discreet and practical approach, and one that gradually expands from a small region of a few participants or from an easily operable field.

3.2. Railways

3.2.1 TKR (Trans-Korean Railway)

As an alternative energy transportation method, the utilization of the TKR should be considered and the reconnection project of the TKR is in progress. The reconnection of the TKR has an important political and economical significance for South Korea in terms of cooperation, openness and the stimulation of economic relations with North Korea.

Furthermore, the idea of connecting the TKR and the Trans-Siberian Railway (TSR), which is Russia's main East-West artery running 9,297 km from Vladivostok to Moscow, is being promoted. If the two railways are connected, the TKR will be linked to lines running further west to such European countries as Germany and Finland.

Reconnection of the TKR will establish a new international transportation network that covers not just the Korean Peninsula, but also the whole of Northeast Asia, creating a new Silk Road in the form of a railway linking Asia and Europe.[5] More specifically, the connection of the TKR and the TSR will replace marine transportation between Korea and Russia.

Three possible TKR railway routes such as the Kyung-ui line, the Kyung-won line and the Donghae line have been recommended for future international trade, especially trade in natural resources. In April 2002, South and North Korea agreed to reconnect the Kyung-ui line and the Donghae line, but no agreements have so far been made regarding the reconnection of the Kyung-won line.

(1) Kyung-ui Line (Western Corridor of the TKR)

This line runs to North Korea from Busan via Seoul, traveling north along the west coast to Shinuiju and then on to China. This line has the highest priority for reconnection and provides a total stretch of 945 km from Busan to Shinuiju, including 454 km between Seoul and Shinuiju.

The 12 km of track between Moonsan and the Military Demarcation Line (MDL) in the 454 km stretch between Seoul and Shinuiju was disconnected before the reconnection project commenced. After the reconnection agreement was concluded, however, both sides completed reconnection work on that section.

If the Kyung-ui line were used, the cost of transportation would fall from \$720/TEU, which is the cost of marine transport between Incheon and Nampo, to \$200/TEU.[6]

(2) Kyung-won Line (Central Corridor of the TKR)

This line runs through Busan and Wonsan via Seoul and Pyunggang. The total stretch of the Kyungwon line is 1,313 km. 31 km of the 222 km Kyungwon line between Seoul and Wonsan was disconnected (16.2 km between Shintanri and the MDL in the south and 14.8 km between Pyunggang and Wonsan).

The reconnection of the Kyungwon line would be a low priority due to the reluctance of North Korea.

Table 6 Possble Routes Linking the TKR and the TSR

Name	Routes	Distance(km)	Transshipment
Manzhouli/ ZabaiKalsk	Busan-Shinuiju-Dandong-Shenyang-Manzhouli-Zabaikalsk-Chita -TSR	8,437 (Dandong-Moscow)	Manzhouli/ Zabaikalsk
Mongolia	Busan-Shinuiju-Dandong-Shenyang-Beijing-Erenhot-ZamynUdd -Ulaanbaatar-Naushki-Ulanude-TSR	9,007 (Dandong-Moscow)	Erenhot/ ZamynUdd
TCR*	Busan-Shiuiju-Dandong-Shenyang-Beijing-Zhenzhou-Alashankou-Druzhba -Kazakhstan-Russia-TSR	9,735 (Dandong-Maoscow)	Alashankou/ Druzhba
Tumangang/ Khasan	Busan-Wonsan-Rajin-Tumangang-Khasan-Ussuriysk-TSR	9,437 (Khasan-Moscow)	Tumangang/ Khasan

* TCR: Trans-China Railway

Source: Hisako Tsuji (2004): 'A Competitive Environment for Linking the TSR & TKR', International Symposium held by the Association of Korea Maritime and Logistics, pp.39

(3) Donghae Line (Eastern Corridor of the TKR)

This line connects various cities such as Busan, Pohang, Donghae, Wonsan, Chungjin, Rajin and Khassan in Russia. This line is disconnected between Kangnung and the MDL (9.0 km) on the south side and from the MDL to Onjungri (18.5 km) on the north side.

South Korea has a plan to extend the line southward as far as Busan. For the purpose of extending the line, the line between Samcheok and Pohang will be constructed (171 km) by 2010. Along with the existing track, these new sections will make direct rail transportation between Busan and Russia possible.

Recently, Russia and North Korea have agreed to construct a railway between Rajin and Khassan. That means that the reconstruction process of the Donghae line will be dispatched as North Korea prefers to reconnect this line rather than the Kyungwon line.

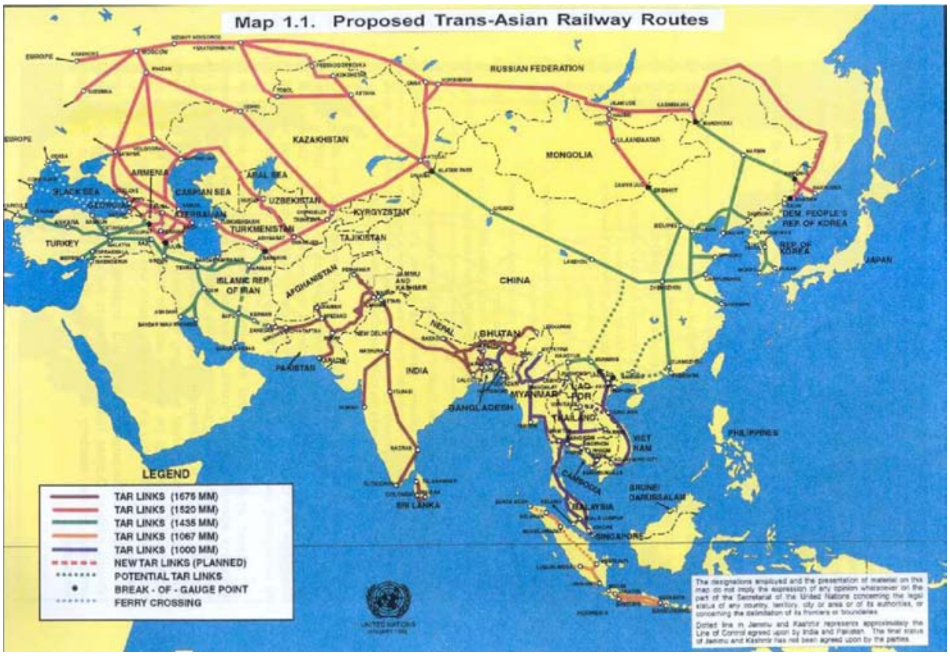

Figure 2 Proposed Tran-Asian Railway Routes

3.3 Pipelines

Energy imports from Russian Far Eastern Regions (RFER) are strategically vital for Northeast Asian countries to diversify their energy supplies and to stabilize deliveries. In the RFER, the Sakhalin-2 project has already entered the implementation stage. Oil has been drilled since 1999 and Korea is one of its buyers.

Currently, Russia is considering an oil pipeline project between Angarsk and Nakhodka, whose target market is the Northeast Asian countries. Transneft,[7] which has the exclusive right to the construction and operation of Russia's oil pipeline, recently determined the Far East pipeline route internally and referred it to the Russian government. The tentative pipeline route, as shown in Fig. 3, starts from the Tayshet oil field in the northwest from Angarsk, and skirts around the north side of Baikal Lake to Nakhodka.

Meanwhile, Southeast Asian countries such as Thailand, Singapore and Indonesia are competing to construct a pipeline for the passage of oil between Middle Eastern countries and Northeast Asian countries, especially Korea, China and Japan.

The exploitation of natural gas in RFER is going to start in 2007 and Korea is planning to import 1.5 million tons per year from 2008. Rosneft, a large stockholder in the Sakhalin-1 project, is going to merge with Russia's gas giant Gazprom. The merger will give significant impetus to the Sakhalin-1 project and may lead to new development.

For natural gas production, the Russian government will develop the Kovykta natural gas field and Gazprom has been selected as the main operator of the project.

Figure 3 From Eastern Siberia to Japan: Oil Transportation Route

However, the Kovikta project, whose goal is to supply natural gas from southern Siberia to China and Korea via the gas pipeline, has been suspended.

4. Conclusion and Inter-related Issues

Korea is the fourth largest oil importing country, as well as the tenth largest oil consuming country in the world. Nonetheless, transport routes and systems of crude oil importation are so undeveloped. The transport of oil is heavily dependent on ocean transportation systems, along with passage through the Strait of Malacca and accordingly, may be threatened by blockades in times of war or conflicts among neighboring countries that have interests in the Strait.

In response to the threat to ocean routes, it is necessary to exploit various other transportation routes and modes for natural resources, especially for crude oil and natural gas. As a solution to the threat, the possibility of international railways and pipeline routes for oil and gas has been analyzed. Specially, the possibilities of a TKR-TSR connection and its availability have been discussed. In addition to the exploitation of transportation routes, naval cooperation among the countries in East Asia should be reinforced to promote maritime safety. Also, cooperative measures such as joint purchasing and transportation among Asian countries have been suggested.

Moreover, the potential of Russia's oil and gas pipeline routes to Northeast Asia has been indicated. As the Far East oil pipeline project will be brought forward if negotiations over financing between Russia and Japan are successful, Korea should pay attention to future movements related to pipeline routes.

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[1] BP Annual Report, 2004.

[2] Yeong-Seok Moon and Dal-Sok Lee (2002): "Energy Cooperation in Northeast Asia: Efficiency Measures for Crude Oil Import Logistics in Northeast Asia," Korea Energy Economics Institute, pp. 2-3.

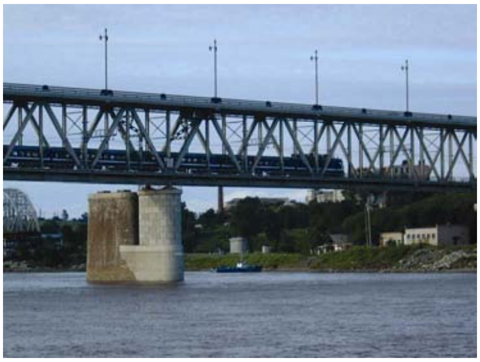
[3] www.khnp.co.kr

[4] Woo-Jin Chung and Gyeong-Lyeob Cho (2004): "Energy Cooperation in Northeast Asia: Analysis of Northeast Asia Energy Market and Study for Applying the Information," Korea Energy Economics Institute, pp. 3-4.

[5] Hisako Tsuji (2004): 'A Competitive Environment for Linking the TSR & TKR,' International Symposium held by the Association of Korea Maritime and Logistics, pp. 18-20.

[6] Ibid, p. 36.

[7] Transneft is a state owned company that manages, services and is responsible for developing the transportation system. The company is charged with ensuring the transportation of crude oil in appropriate volumes and by routes specified in the transportation export schedule produced by the Russian Government's International Commission.



Transportation of Coal from the Russian Far East via Land, Rivers, the Sea of Okhotsk and the Northern Sea Route

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1. Introduction

The Russian Far East region is rich in coal. After the collapse of the former social system in Russia, the federal and regional governments have been unable to formulate viable strategies for the development of its coal resources in the regions. Lack of efficient transport infrastructure has been fatal to the development of the coal industry, although a number of projects for road construction, motorways, railways and port facilities have been announced and some are proceeding. Currently, massive coal consumption in China together with an active demand from the international steel industry, is stimulating the coal industry in the Russian Far East and it seems to have a promising outlook over the next few decades.

The developed and reconnoitered resources of carboniferous fields in Siberia such as the Kemerovo region, Chita region and Krasnoyarsk territory, as well as in the Far East such as the Primorski Krai and Khabarovsk territory, are located in the area close vicinity to the TransSiberian and the Baikal-Amur railways and so coal has been carried with the advantage of these railways for export to Asian markets mostly through the ports in the Primorski Krai.

The Republic of Sakha is blessed with an abundance of high quality coal and only the Republic has deposits of bituminous coal in the Far East. In total, it has nine collieries producing 42 million tons per year, including three opencast mines yielding 33 million tons of coal per year. The region's collieries, however, cannot directly enjoy the benefit of the aforementioned railways.

Accordingly, possible transportation routes for the coal exports from the Republic of Sakha to Asian markets will be discussed in this paper through an evaluation of their technical and economic viability. The paper will provide suggestive information of coal resources in the region to Asian markets.

2. Delivery of Coal from the Russian Far East to Asian Markets

2.1 Transport Infrastructure in the Republic of Sakha

The current transport infrastructure in the Republic of Sakha, including roads, railways and riverways in service and in construction and planning stages, is outlined in Table 2.1.

Table 2.1 Main Transport Systems in the Republic of Sakha

No.	Route	Length (km)	Year Service Commenced	Remarks
	Railway			
1.	Bamovskaya-Yakutsk	1,205.9		
	Bamovskaya-Tynda-Bercakit	401.5	1972	Existing railway line.
	Bamovskaya-Tynda, connected to the TransSib and BAM	The length of the main line is 180. 5 km.	1972	Existing railway line.
	Tynda-Bercakit	221	1972	Existing railway line.
	Bercakit-Yakutsk	804.6	2010 (expected to be completed)	Under construction. A rail/road bridge between Nizhni Bestyag and Yakutsk is to be constructed; total length 2,870.86m. (through the Tabaginski pass)
	Bercakit-Tommot-Yakutsk (Nizhni Bestyag)	360	Construction started in 1985 and is planed to be put into service by 2010.	
	Bercakit-Tommot Tommot-Nizhni Bestyag	444.6	Expected to be in service in 2010, attaining the designated traffic capacity by 2009-2012.	
2.	**Elga-Ulak**	320 (to the BAM)		Construction has been suspended.
3.	Yakutsk-Magadan		2030-2040	Planned to be constructed.
4.	Alaska(USA)-Cape Uelen-Yakutsk with a tunnel under the Bering Strait		2030-2040	Proposed
	Motorway			
1.	**"Lena"** Amur-Yakutsk motorway(AYM) Bolshoy Never-Tommot-Yakutsk	1,157	To be reconstructed by 2020. 2010	Existing motorway (Bercatit-Tommot railway under construction runs along the AYM). Federal paved road of the third category.

2.	**“Vil’ui”** Yakutsk- Mirnii-border of the Irkutsk region	1,607	2007-2010	956.15km, firmly surfaced.
	“Vil’ui” Yakutsk-Viluisk-Suntar- Mirnii		2003-2006	Extension and reconstruction
3.	**“Amga”** Amga-Ust-Maya-Ugoryonok-Vostretsovo			Extension and reconstruction.
	Amga-Ust-Maya	181.0	2003-2006	
	Ugoryonok-Eldikan	64.0	2007-2010	
4.	**“Kobyai”** Asima-Byas-Kuel-Kobyai-Sangar	310.0	2008	Extension and reconstruction
5.	**“Kolyma”** Yakutsk-Magadan	More than 2,000 km	To be finished by 2020.	Federal construction: 1,872 km has been completed.
	Riverway			
1.	The Lena River: Isit-Zhigansk (Yakutsk port); Zhigalovo-Tira (Osetrovo port).	408 500		
2.	The river Vil’ui: from the river mouth to Sungar	746		
3.	The Aldan River:from the river mouth	100		

2.2 Major Coal Deposits and the Delivery Routes to Asian Markets

Possible transportation routes for coal in the Republic were chosen, taking account of geographical advantages in the distances between the collieries and roads and rails in service, under construction and in the final stages of planning.

In the Republic, the promising coal reserves exist in the Dzhebariki-Khaiya, Belogors and Elga coal deposits. Their estimated reserves are about 500 million tons of stone coal for opencast mining.

1) Dzhebariki-Khaiya coal deposit

Khandyga is the centre of coal mining and the centre of Tomionski and Dzhebariki-Khaiya districts and coal transport is greatly dependent upon the Aldan River. In the ice-free season the river is navigable, but in winter, when the river is fully frozen, it is as a winter road. There is a motorway from the settlement of Khandyga to Yakutsk and to another settlement Ust’-Nerun, which handles general freight traffic.

2) Belogorsk coal deposit

The Belogorsk coal deposit is located in the Sangar carboniferous area. It produces 7 billion tons of coal, though only a part of the coalfield has been able to be developed by opencast mining. Through river shipping in summer and vehicle traffic on the frozen river in winter, the Lena River plays a crucial role in transportation in the area. There is a improved graveled road about 40 km in length, from the coalfield to the settlement of Sangar. A working coal mine and river wharf working comprise a major industry for the towns.

3) Elga coal deposit

The Elga coal deposit of coking coal is in a part of the Uzhno-Yakutsk basin and has an estimated 2 billion tons of reserves. The Elga coal deposit has the geographical advantages in terms of coal transportation, as it is close to the Baikal-Amur Railway (BAM). In the recent few years, the government had sped up the construction of a railway branch connected directly to the BAM, however, suddenly at the beginning of 2003, the Ministry of Railways announced the discontinuation of the work. The Elga coal deposit has thus lost some of its promise for the time being.

These three coal mines have been chosen to be the subjects of feasibility studies of coal export routes to Asian markets.

<u>Route 1</u>

Coal from the Dzhebariki-Khaiya and Belogorsk coal deposits in the Lena basin is transported to Asian markets by road and river with the aid of advanced coal-handling facilities at river ports on the Lena and Aldan rivers. River-sea vessels will cruise on the Northern Sea Route (NSR) and the Pacific Ocean. An alternative is transportation by large bulk carriers, shipping from the port of Tiksi. The coal would be reloaded at the port from river-sea vessels onto large bulk carriers (Route 1b).

<u>Route 2</u>

Coal in the Lena basin is to be exported to Asian markets via the sea port of Magadan. To Magadan, transportation is by road for the present time and it can be anticipated by rail in future (from 2020). In addition, a federal motorway between Yakutsk and Magadan (“Kolyma”) is under construction and could handle the transportation of coal from the Dzhebariki-Khaiya deposit and the Belogorsk coal mines.

<u>Route 3</u>

Coal in the Lena and the Uzhno-Yakutsk (Elga deposit) basins is transported by rail up to the ports in the Southern Primorie (the ports of Vanino, Vostochni, etc.), where it is then transferred onto large bulk carriers and taken to Asian markets.

<u>Route 4</u>

Coal from the Dzhebariki-Khaiya and the Belogorsk deposits in the Lena basin is transported by rail (under construction from Yakutsk to the mines) to the ports of the Southern Primorie (the ports of Vanino, Vostochni, etc.) and transferred onto large bulk carriers and taken to Asian markets.

The routes mentioned above more or less rely on land, river and sea transportation via the NSR, the Sea of Okhotsk, the Japan Sea and the Pacific Ocean.

The routes are outlined in Table 2.2.

Table 2.2 Coal Delivery Routes to Asian Markets

Route	Outline	Prerequisite
Route 1a	By road from coal deposits in Yakutia (Dzhebariki-Khaiya and Belogorsk deposits) to river ports and reloaded onto river-sea vessels to be taken to Asian markets (Japan)	Road from the deposits to river ports to be constructed. Advanced cargo-handling facilities at river ports are to be provided.
Route 1b	By road from coal deposit in Yakutia (Dzhebariki-Khaiya deposit) to river ports and reloaded onto river- sea vessels. Transference onto large bulk carriers at the port of Tiksi to be then taken to Asian markets (Japan)	Road from the deposit up to river ports is to be constructed. Advanced cargo handling systems are to be provided at river ports and the port of Tiksi.
Route 2a	By road from coal deposit in Yakutia (Dzhebariki-Khaiya deposit) to the port of Magadan and reloaded onto large bulk carriers at the port of Magadan to be taken to Asian markets (Japan)	Road from the deposit connected to the "Yakutsk- Magadan" motorway is to be constructed. The "Yakutsk- Magadan" motorway is to be put into service.
Route 2b	By road from coal deposit in Yakutia (Dzhebariki-Khaiya deposit) to the railway station and by rail to the port of Magadan. Reloading onto large bulk carriers to be taken to Asian markets (Japan)	Road from the deposit to the railway station and the railway to Magadan are to be constructed.
Route 3	By rail from coal deposit in Yakutia (Elga deposit) to the ports of Vanino or Vostochni. Reloading onto large bulk carriers at either port to be taken to Asian markets (Japan)	Railway branch from the deposit connected to the Baikal-Amur Railway is to be constructed. Advanced cargo handling facilities at the ports of Vanino and Vostochni are to be provided.
Route 4	By road from coal deposit in Yakutia (Dzhebariki-Khaiya deposit) to Yakutsk and by rail to the ports of Vanino or Vostochni. Reloading onto large bulk carriers to be then taken to Asain markets (Japan)	Road from the deposit to Yakutsk is to be constructed. Advanced cargo handling facilities at the ports of Vanino and Vostochni are to be provided.

3. Evaluations of Coal Exporting Routes to Asian Markets

The cost and time of delivery of the coal are crucial factors in discussing the appropriate route for coal exports to Asian markets, taking all considerations into account, such as combined transportation by road, rail, river and sea, and cargo handling at ports and railway stations concerned.

The transportation costs of coal by sea and by river were calculated on the basis of the cost of the daily operation of vessels ("vessel-day") and the transportation distances and types of vessels used.

The distances of the seaways and river-ways are shown in Table 3.1.

Table 3.1 Distances of the Seaways and Riverways

Line	Distance	
	Nautical miles	km
Tiksi-Japan	4,842	8,967
Magadan-Japan	2,190	4,056
Port Vostochni-Japan (Osaka)	829	1,535
Port Vanino-Japan (Osaka)	1,265	2,343
Reloading site close to Sangar - Tiksi	375	695
Reloading site close to Khandyga - Tiksi	534	990

Distances of seaway transportation of coal from ports in the Russian Far East to the ports of the Southeast Asian countries were taken from the officially published "Table of Distances" and the courses follow recommended shipping routes.

The types of ship were categorised and three were chosen for this study from the "Technical and economic characteristics of vessels of marine fleet" (1997) directory. The data of the Lena River Shipping company was also used. The main particulars of the selected ships are shown in Table 3.2.

Table 3.2 Main Particulars of the Ships

Type of ship		CH-50	CH-8	Volga 4001
Displacement (t)		66,030	11,380	6,813
Tonnage (t)	gross	52,450	7,520	3,900
	net	49,200	7,000	3,300
Principal dimensions	length over all (m)	215.20	122.30	140.00
	breadth(m)	31.80	17.80	16.65
	depth(m)	17.00	8.30	6.7
	draft(m)	12.30	7.00	3.74
Speed (kn)	Fully loaded	14.7	13.5	20.6
	Ballasted	15.5	20.6	—

Cargo handling costs were estimated and modeled on the accounting data of coal handlings at ports in the south of Primorski Krai. The current average rate of coal handling was found to be 87 rubles per ton (US$ 3).

The costs and distances of transportation by rail were calculated according to the data published by the Commodity Office of the Vladivostok Branch of the TransSib.

The average cost of transportation by road was assumed to be 1.67 rubles/ton/km.

As an example, Osaka in Japan was chosen as the target export destination for the Asian markets.

The estimated transportation costs of coal for each route are given in Tables 3.3 ～3.9.

Table 3.3a Calculation of Transportation Costs (1/2)

Route	Type of ship	Distance (nm)/ Time (day)	Period of Transportation (day)				Cargo Weight (1000 t)
			At Sea	On the berth		Total	
				Port of Loading	Port of Unloading		
Route 1a							
Khandyga (Dzhebariki-Khaiya coalmine) - Osaka	Volga	5,376/ 10.2	43.9	0.7	0.4	45.0	3.3
Sangar(Belogorsk coalmine) - Osaka	Volga	5,217/ 10.2	42.6	0.7	0.4	43.7	3.3
Route 1b							
Tiksi-Osaka	CH-8	4,842/ 13.5	29.9	1.2	0.5	31.6	7.0
Route 2							
Magadan-Osaka	CH-50	2,190/ 14.7	12.4	0.7	0.6	13.7	49.2
Route 3, 4							
Vanio-Osaka	CH-50	1,265/ 14.7	7.2	0.7	0.6	8.5	49.2
Vostochini-Osaka	CH-50	829/ 14.7	4.7	1.0	1.6	6.3	49.2

Volga 4001: Volga

Table 3.3b Calculation of Transportation Costs (2/2)

Route	Freightage (10^3Rbl/ day)	Loading & unloading costs (10^3Rbl/ day)	Freightage for one voyage (10^3Rbl)	Total Freightage	
				Rbl/t	US$/t
Route 1a					
Khandyga(Dzhebariki-Khaiya deposit)-Osaka	158.34	105.56	7,070.57	2,142.60	73.88
Sangar(Belogorsk deposit)-Osaka	158.34	105.56	6,864.89	2,080.27	71.73
Route 1b					
Tiksi-Osaka	224.76	187.01	7,035.88	1,005.13	34.66
Khandyga(Dzhebariki-Khaiya deposit)-Osaka	158.34	105.56	806.91	244.52	8.43
Sangar(Belogorsk deposit)-Osaka	171.99	105.56	643.04	194.86	6.72
Route 2					
Magadan-Osaka	563.60	466.45	7,614.66	154.77	5.34
Route 3,4					
Vanino-Osaka	563.60	466.45	4,659.27	94.70	3.01
Vostochni-Osaka	563.60	466.45	3,408.05	69.27	2.20

Table 3.4 Transportation Costs: Route 1a

Coal Deposit	Belogorsk Deposit	Dzhebariki-Khaiya Deposit
Distance from the deposit to the river port close to Sangar (Khandyga), km	40	70
Cost of transportation by road, Rbl/t	67	117
Cargo handling costs at river port, Rbl/t	87	87
Distance from the river port to Osaka, nm	9,662	9,956
Freightage at river and sea, Rbl/t	2,080.27	2,142.60
Total distance of transportation, km	9,701.88	10,026.35
Total Freightage, Rbl/t	2,234.27	2,346.6
Total Freightage, US$/t	77.04	80.92

Rbl : ruble

Table 3.5 Transportation Costs: Route 1b

Coal Deposit	Belogorsk Deposit	Dzhebariki-Khaiya Deposit
Distance from the deposit to the river port close to Sangar (Khandyga), km	40	70
Cost of transportation by road, Rbl/t	67	117
Cargo handling costs at river port, Rbl/t	87	87
Distance from the river port to Tiksi, km	695	990
Freightage at river to Tiksi, Rbl/t	194.86	244.52
Cargo handling costs at Tiksi, Rbl/t	87	87
Distance from Tiksi to Osaka, km	8,967	8,967
Freightage at sea, Rbl/t	1,005.13	1,005.13
Total distance of transportation, km	9,701.88	10,026.35
Total Freightage, Rbl/t	1,440.99	1,540.65
Total Freightage, US$/t	49.69	53.13

Table 3.6 Transportation Costs: Route 2a

Coal Deposit	Dzhebariki-Khaiya Deposit
Distance from the deposit to Khandyga, km	70
Cost of transportation by road, Rbl/t	117
Distance from Khadynga to Magadan, km	1,755
Transportation costs from Khadynga to Magadan, Rbl/t	2,930.85
Cargo handling costs at Magadan, Rbl/t	87
Distance from Magadan to Osaka, km	4,056
Freightage at sea, Rbl/t	154.77
Total distance of transportation, km	5,881
Total Freightage, Rbl/t	3,289.62
Total Freightage, US$/t	113.44

Table 3.7 Transportation Costs: Route 2b

Coal Deposit	Dzhebariki-Khaiya Deposit
Distance from the deposit to Khandyga, km	70
Cost of transportation by road, Rbl/t	117
Distance by rail from Khadynga to Magadan, km	1,860
Transportation cost by rail from Khadynga to Magadan, Rbl/t	1,755
Cargo handling costs at Magadan, Rbl/t	87
Distance from Magadan to Osaka, km	4,056
Freightage at sea, Rbl/t	154.77
Total distance of transportation, km	5,986
Total Freightage, Rbl/t	2,113.77
Total Freightage, US$/t	72.89

Table 3.8 Transportation Costs: Route 3a

Coal Deposit	Elga Deposit
Distance by rail from the deposit to the port of Vanino, km	1,650
Cost of transportation by rail, Rbl/t	156.6
Distance at sea from Vanino to Osaka, km	2,343
Transportation cost by rail from Khadynga to Magadan, Rbl/t	1,755
Cargo handling costs at Vanino, Rbl/t	87
Distance from Vanino to Osaka, km	2,343
Freightage at sea, Rbl/t	94.7
Total distance of transportation, km	3,993
Total Freightage, Rbl/t	338.3
Total Freightage, US$/t	11.67

Table 3.9 Transportation Costs: Route 3b

Coal Deposit	Elga Deposit
Distance by rail from the deposit to the port of Vostochni, km	1,765
Cost of transportation by rail, Rbl/t	171.1
Distance at sea from Vostochni to Osaka, km	1,535
Cargo handling costs at Vostochni, Rbl/t	87
Freightage at sea, Rbl/t	94.7
Total distance of transportation, km	3,300
Total Freightage, Rbl/t	352.8
Total Freightage, US$/t	12.17

Table 3.10 Transportation Costs: Route 4a and 4b

Coal Deposit	Dzhebariki-Khaiya Deposit	
Distance from the deposit to Yakutsk by road, km	249	249
Cost of transportation by road, Rbl/t	415	415
Distance from Yakutsk to the port of Vanino by rail, km	2,928.00	—
Distance from Yakutsk to the port of Vostochni by rail, km	—	2,454
Cost of transportation by rail from Yakutsk to the port of Vanino	264.77	—
Cost of transportation by rail from Yakutsk to the port of Vostochni	—	220.05
Distance at sea from Vanino to Osaka, km	1,535	—
Distance at sea from Vostochni to Osaka, km	—	2,343
Cargo handling costs at Vanino or Vostochni, Rbl/t	87	87
Freightage at sea, Rbl/t	69.27	94.70
Total distance of transportation, km	4,878	5,212
Total Freightage, Rbl/t	670.04	650.75
Total Freightage, US$/t	23.10	22.44

4. Comparison of Transport Costs of Coal Exports to Osaka, Japan

The calculations of the transport costs of coal exports from the coalfields in the Republic of Sakha to Osaka, Japan are shown in Table 4.1.

Table 4.1 Comparison of Transportation Costs of Coal from the Sakha Coal Deposits to Osaka

Route	**1a**	**1b**	**2a**	**2b**	**3a**	**3c**	**4a**	**4b**
Port of coaling	River port, Lena	Tiksi	Maga-dan	Maga-dan	Vanino	Vosto-chni	Vanino	Vostochni
Belogorsk Coal Deposit								
Distance	9,702	9,702						
Time	43.75	35.78						
Rbl/t	2,234.3	1,441						
US$/t	77.04	49.69						
Dzhebariki-Khaiya Coal Deposit								
Distance	10,027	10,027	5,881	5,986			5,212	4,878
Time	45.08	37.11	15.26	15.35			10.57	8.98
Rbl/t	2,346.6	1,540.7	3,289.6	2,113.8			650.8	670.0
US$/t	80.92	53.13	113.44	72.89			22.44	23.10
Elga Coal Deposit								
Distance					3,993	3,300		
Time					9.88	7.80		
Rbl/t					338.3	352.8		
US$/t					11.67	12.17		

"Distance" in km and "Time" of transportation in days.

Indirect expenses were not included in the cost calculations.

For Route 3, the development of the Elga coal deposit and the transportation of coal by the Baikal-Amur railway to the port of Vanino will be key factors as it could significantly shorten the distance and journey by about 600 km by utilizing the Trans-Siberian railway to the port Vostochni. Advanced coal handling systems and more efficient general-cargo handling facilities at stations and river and sea ports will be other vital considerations for coal exports from the Republic of Sakha (Yakutia).

5. Conclusions

1. The largest coal reserves in the Russian Far East exist in Yakutia, particularly in the Dzhebariki-Khaiya, Belogorsk and Elga coal deposits, which are mostly available by opencast mining.
2. Those coal mines regrettably lie in an undeveloped area with poor transport infrastructure and two of them in particular - the Dzhebariki-Khaiya and the Belogorsk coal deposits - lack suitable means for coal transportation at the present time. With this in mind, the establishment of an efficient transport infrastructure is vital to the export of coal products from those coalfields and also to the social and industrial development of the Republic as a whole.
3. The current combined land, river, and sea transportation of coal, even if a new railway line is constructed between Yatutsk and Magadan, would not be able to compete successfully with other coal export markets.
4. In addition to the construction of new motorways and railways, the modernization of cargo handling facilities and vessels on rivers and at sea is crucial to the success in developing the coal industry in Yakutia.
5. The Elga coal deposit, close to the Baikal-Amur Railway, has a geophysical advantage in terms of coal transportation. The most promising way of coal transporting coal from there is the route via the Baikal-Amur railway to the port of Vanino, and then by large bulk carriers to Asian markets.
6. The transportation of coal from Yakutsk via the NSR would not be sufficient enough to compete against other coal providers, even under the most favorable conditions such as year-round navigation on the Lena River and efficient cargo handling at the port of Tiksi. One of the shortcomings in the transportation routes via the NSR is the long distances involved.

   If some means of much larger-scale transportation with lower fuel consumption could be developed in the future, the coal routes via the NSR would become a an attractive proposition. According to academic reports on the Arctic Ocean, sea ice along the NSR is expected to considerably diminish over the next few decades. Such a forecast could stimulate the coal routes via the NSR from the Republic.

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Fishery Resources in the Sea of Okhotsk

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1. Introduction

It is widely known that icy seas and adjacent areas provide abundant fishing grounds, such as the Bering Sea and the Sea of Okhotsk. In this type of sea, the high level of primary production sustains rich zooplankton and strengthens the food chain, leading to the presence of benthos, fish, marine mammals and birds.

In the Sea of Okhotsk, a very unique and delicate ecosystem exists through the interaction of forests, rivers, the cold winter climate and geological and oceanic conditions. A massive amount of nutrient salts, upon which phytoplankton feed, is carried into the Sea of Okhotsk from the East Siberian forests by the Amur River. The vertical circulation of seawater caused by the process of saline freezing forces to emerge nutrient salts from the sea bottom. Furthermore, the lower surface area of sea ice provides for phytoplankton, upon which zooplankton feed during the cold winter. The ecosystem of the Sea of Okhotsk is thus very unique and sustains copious fish stocks.[1]

Commercial fishing vessels from Russia, Japan, Korea and China operate in the Sea of Okhotsk. According to the FAO, however, the total catch in the Sea of Okhotsk declined from 6 million tons in the 1980s to 2 million tons in 2000. The main commercial species are walleye pollock, Pacific cod, flounder, herring, Pacific salmon, halibut, Pacific sardines, Pacific saury, capelin, sand eel, smelts, squid, crab, shrimp and scallops. Among these, the most abundant species is the cod family, such as the walleye pollock and Pacific cod, whose stocks are estimated at about 10-15 million tons. Further, the catch of this family of species exceeds the total catch of all others combined.[2,3]

2. World Marine Catch

According to FAO statistical data, four major marine fishing areas account for more than 60% of world marine capture fisheries production. Among them, the northwest Pacific is the most productive fishing area in the world.

Fig. 1 shows the world marine catch by marine fishery areas. After reaching about 80 million tons in the late 1980s, the global marine catch fluctuated between 77 and 86 million tons, with a record high of 86.7 million tons in 2000 and a slight decline to 84.4 million tons in 2002. It is clear that there are three highly productive areas, namely the Pacific Northwest, Pacific Southeast and Atlantic Northeast. Most of the fluctuations in recent years have been the result of changes in a few highly productive areas, particularly in the northwest and southeast Pacific, while total catches in the majority of other fishing areas followed more or less the same general trend.[4]

The Pacific Northwest area, which is one of the most productive fishing grounds in the world, consists of the Northwest Pacific Ocean, the Bering Sea, the Sea of Okhotsk, the Japan Sea, the Yellow Sea and the East and South China Sea. Fig. 2 compares catches from each fishing area in the Northwest Pacific. From the mid 1970s to the late 1980s, the Sea of Okhotsk was the most productive fishing ground. However, in 2003, the catch in the Sea of Okhotsk has decreased dramatically to one-third of the largest record and is in a trend which corresponds to catches in the West Bering Sea.

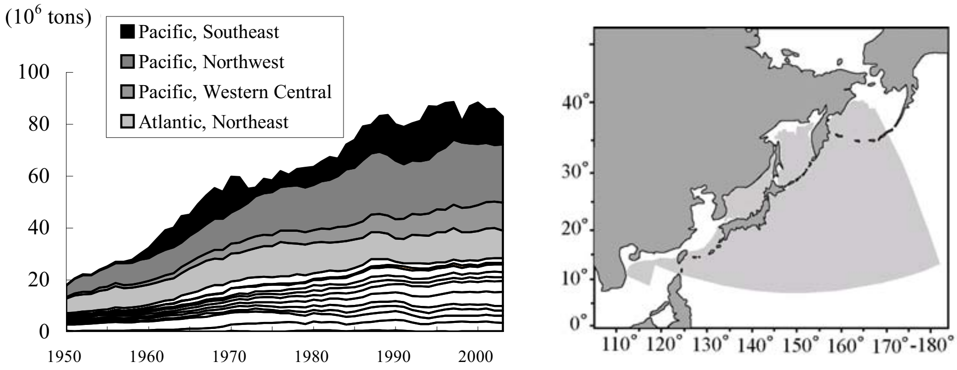

Figure 1 World Marine Capture Fisheries Production

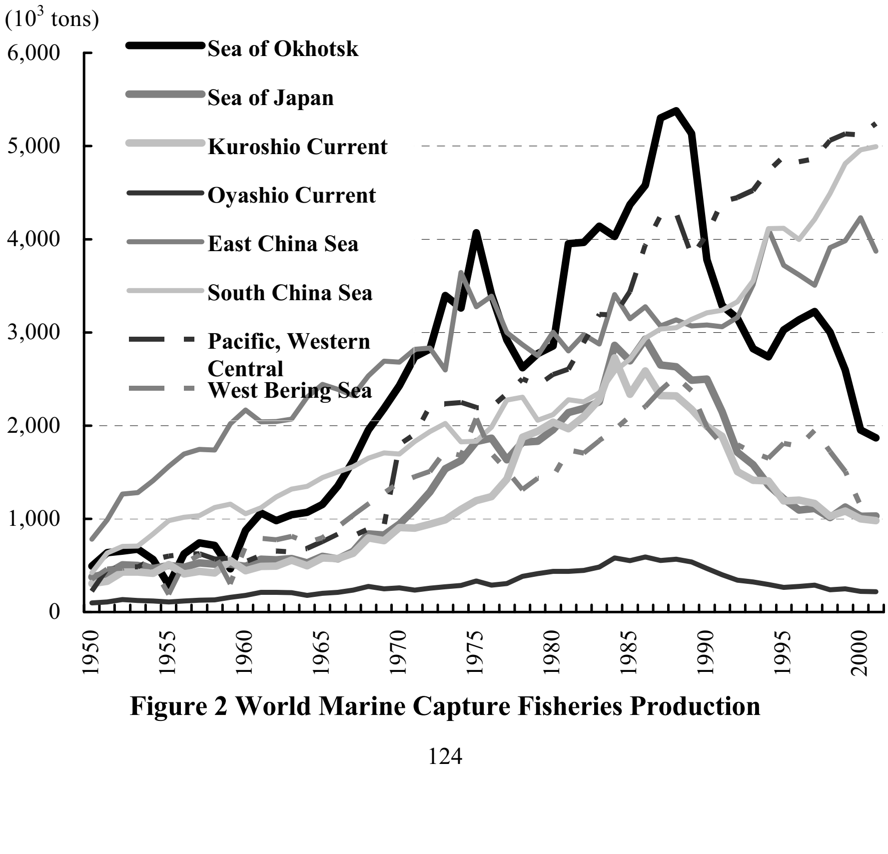

Figure 2 World Marine Capture Fisheries Production

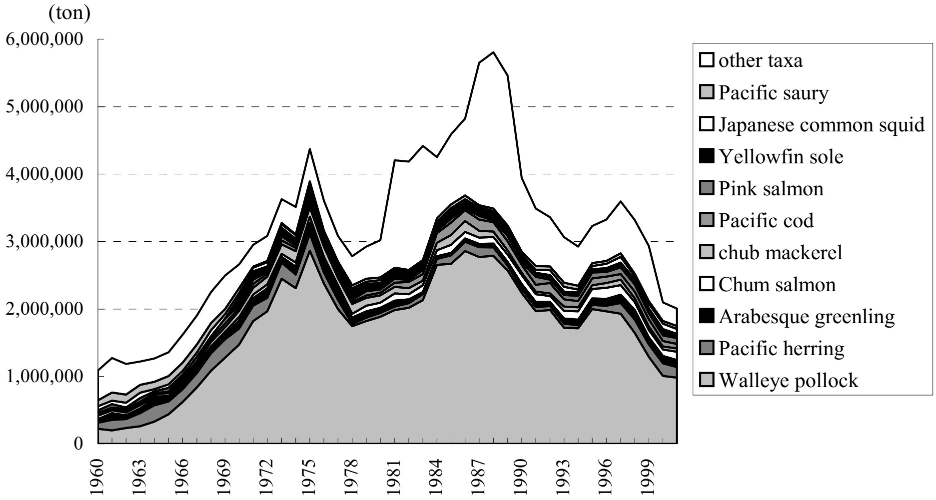

Figure 3 Fishing Catch by Species in the Sea of Okhotsk

In the Sea of Okhotsk, 24% of the Pacific Northwest catch was caught in 1988 and 10% in 2002. It is still a highly productive area in world marine fisheries. Total catches in the area grew steadily from about 0.5 million tons in 1950 to an initial peak of 4.38 million tons in 1975. It declined to 2.8 million tons in 1978, but increased again to the largest ever catch of 5.84 million tons in 1988. After 1988, it decreased substantially to 2.05 tons in 2002. This trend of peaks and gaps in recent years corresponds to the total catch of the Pacific Northwest area. In the Sea of Okhotsk, mainly four countries - Russia, Japan, South Korea and China – have been operating and the Russian and Japanese catches make up about 56% and 28% of the total catch, respectively.

Fig. 3 shows the fishing catch by species in the Sea of Okhotsk. It is clear that walleye pollock (48%) is the most abundant species and that fluctuations in the total catch are due to this fish. Other dominant species are Pacific herring (7.5%), Chum salmon (6%), pink salmon (4%), arabesque greenling (5%), squid (4%), Pacific cod (3%) and yellowfin sole (3%).

3. Major Fishing Species in the Sea of Okhotsk [5,6,7]

3.1 Walleye Pollock

For capture fishery in the Sea of Okhotsk, the most dominant fish species is walleye pollock. The catch has decreased in recent years, but it still maintained its place as the second-most abundant commercial fishing species in the world in marine capture fisheries production. It is also abundant in the northwest Pacific.

The walleye pollock is widely found from the Korean Peninsula to Southern California in the North Pacific Ocean, the Sea of Japan, the Sea of Okhotsk and near the continental shelf of the Bering Sea. Walleye pollock is predominantly found in areas where water temperatures are 2-10°C. Adult fish migrate to their spawning grounds from winter to spring and return to feed from summer to fall individually.

They usually spend daylight hours near the sea floor and rise to mid-level depths during the night. In general, walleye pollock is distributed in the mid-range of the sea.

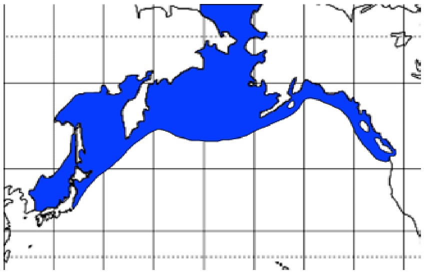

Figure 4 Fishing Grounds of Walleye Pollock

3.2 Arabesque Greenling

Arabesque greenling is widely found around the coastal areas of Hokkaido, from the Shakotan Peninsula to the north of the Japan Sea, the southwestern coast of Sakhalin Island and the Okhotsk Sea coast of Hokkaido. This is a common food fish in northern Japan. It is thought that stocks of arabesque greenling have risen significantly in comparison to the 1980s and that they are still on the rise. And the stock condition of this species is accordingly in good shape in 2004.

3.3 Japanese Sand Lance

Japanese sand lance is widely found around Japanese coastal waters excluding Okinawa and the Korean and Shandong peninsulas. They live in sandy bottom areas in depths of 40 - 80 m and often under the sand on the sea bottom at night. It is estimated that levels of Japanese sand lance are low and that the trend in the amount of the resource in recent years has been decreasing, according to the CPUE. It is necessary to take account of the condition of stocks in Russian waters in order to clarify the precise state of the species.

3.4 Pacific Cod

The Pacific cod is found on both sides of the upper north area of North Pacific from LAT 34°, from the Korean Peninsula to North America. The fish inhabits a wide area of the continental shelf and its sloping areas, generally remaining near the bottom and ranging from inshore regions to deep waters, some 550 m deep. The total stock level in the Sea of Okhotsk and the western and southern areas off Hokkaido are estimated to be low and stable, based on the CPUE in 2003 and the trend over the past five years.

3.5 Pacific Herring [8,9]

The distribution of herring extends from the Pacific to the Arctic Ocean via the Bering Strait, and it can be found as far west as the White Sea and found in the Barents Sea as the southwestern border. Herring also inhabit the Gulf of Alaska and from the Bering Sea to the Sea of Okhotsk, the Sea of Japan, the Gulf of Bohai and the northern part of the Yellow Sea along the Asian side.

The Hokkaido/Sakhalin subpopulation is found on the northwestern coast and Okhotsk Sea coast of Hokkaido, as well as the coast of Sakhalin Island. However, this subpopulation has scarcely existed around the Hokkaido coast since 1960. After recording 970,000 tons in 1897, the catch continues to decrease and there have been few catches around Hokkaido since 1955. The Hokkaido-Sakhalin subpopulation reappeared in 1985 and 1988, though this did not lead to the recovery of the resource as the amount of increase was only slight in later years and catches remained small.

3.6 Kichiji Rockfish

The Kichiji rockfish is considered a delicacy in Japan and fetches high prices. The Okhotsk subpopulation of Kichiji rockfish is found in the sloping area of the continental shelf to the east of the Kitami-Yamato Sea Bank and the Shiretoko Peninsula. The area ranges from 300 m to 1,200 m in depth. The stock is at a low level and is stable according to the trend in recent 19 years and the trend in recent 5 years.

3.7 Pointhead Flounder

The pointhead flounder is found off the Sakhalin and Hokkaido coasts, from the Kuril Islands to Fukushima Prefecture off the Pacific coast of Honshu, and from off the coast of the Sea of Japan to the northern part of the East China Sea. Recently, it has shown a downward trend, but catches increased in 2003, the twelfth highest in 19 years (1985-2003). Accordingly, the resource level is estimated to be in the medium range and the trend appears stable.

3.8 Brown Sole, Small-mouthed Sole

The brown sole is found around the Tartar Strait and west of Sakhalin Island, from off the southeastern Sakhalin coast to the South Kuril Islands along the northeastern Hokkaido coast in the Sea of Okhotsk, from the South Kuril Islands to the Bohso Peninsula along Hokkaido and off the east coast of Honshu in the Pacific Ocean. On the basis of the amount of the resource in 2002 (4,989 tons), which is the fourth highest ever since 1981, together with the increasing trend from 2001, the resource level is estimated to be high and the trend stable.

3.9 Giant Ezo Scallop:

The giant Ezo scallop is found along the Kuril Islands, Sakhalin Island, Hokkaido and the northern part of Japan, the northern part of the Korean Peninsula and Primolsky Krai in Russia. On the Okhotsk Coast, predominantly re-seeded scallops are caught. Due to the 4-step rotational harvesting development method,[10] the scallop's production in the Hokkaido area has continued to increase dramatically since the 1970s, and reached 451,000 tons in 2002.

3.10 Hair Crab:

The hair crab is widely found in the northern Pacific Ocean from the eastern part of the Bering Sea to the Kuril Islands, off Sakhalin Island, off the coast of Hokkaido, off the upper-middle Pacific coast of Honshu and northwestern coast of the Sea of Japan, as well as near the Korean Peninsula. It is abundant off Hokkaido to the Kuril Islands and the Kamchatska Peninsula. And it mostly lives in depths of 150 m or less in sandy or muddy sandy areas on the sea bottom in water temperatures of less than 15°C.

Pacific Saury

Arabesque Greenling

Chum Salmon

Kichiji Rockfish

King Crab

Hair Crab

Giant Ezo Scallop

Walleye Pollock

Figure 5 Major Fishing Species in the Sea of Okhotsk

The government of Hokkaido has devised measures to prevent the rapid decline of hair crab resources caused by overfishing. In 1968, fishing limits were imposed on the species and scientific monitoring has been conducted for many years.

4. Marine Fishery Resources in the Sea of Okhotsk

4.1 Global Trends in the State of Marine Fishery Resources[11]

Fig. 6 shows the state of world fishery stocks in 2004 assessed by the FAO. These figures give percentages for 441 species and rates their condition as “R” - recovering, “D” - depleted, “O” - over-exploited, “F” - fully-exploited, “M” - moderately-exploited and “U” - under-exploited. According to this data, 77% of species are exploited at or beyond MSY (Maximum Sustainable Yield), as calculated by F+O+D+R. Meanwhile, Fig. 7 provides more detail by region. The percentage of stocks exploited at or beyond MSY ranges from 43% in the eastern central Pacific to 100% in the western Indian Ocean and the northeast Atlantic. On the other hand, and referring to UNCLOS, which requires fishing activities to be conducted at or below MSY, 11 of 17 regions have had at least

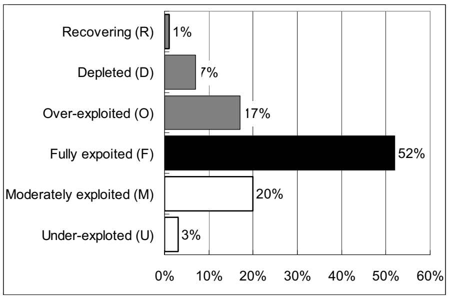

Figure 6 State of World Fishery Stocks in 2004

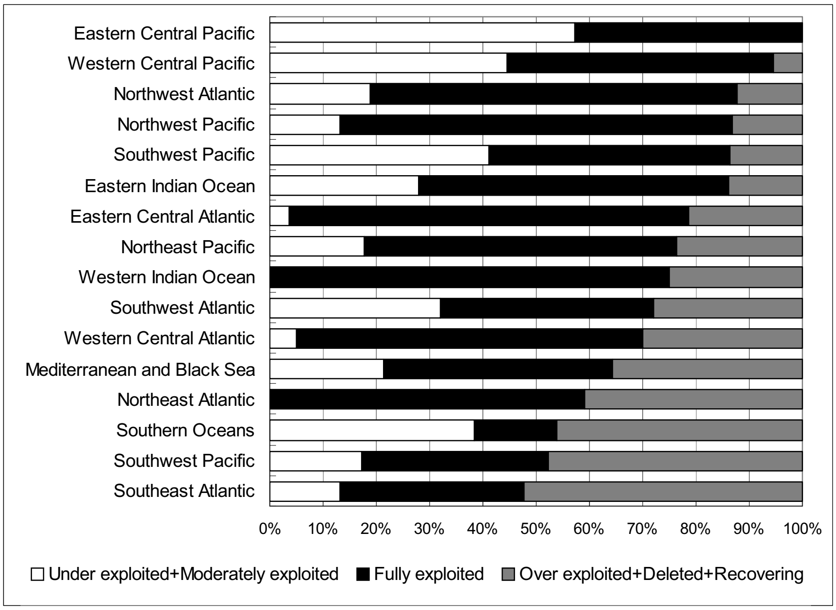

Figure 7 State of Regional Fishery Stocks in 2004

70% of their stocks exploited at or below MSY. In the northwestern Pacific, about 87% of stocks are already fished at or beyond MSY, but stocks fished beyond MSY level (over exploited + deleted + recovering) is 13%, that is the fourthly lowest area of 17 regions.

4.2 Fishing Activities in the Sea of Okhotsk

(1) Japanese Fishing Activities in the Sea of Okhotsk

Japan's total catch in the Sea of Okhotsk was 390,848 tons or more in 2002.[12] That comprised more than 27% of Hokkaido's and 7% of Japan's entire catch. By catch, giant Ezo scallop, salmon, walleye pollock and arabesque greenling were dominant, while by value, giant Ezo scallop, salmon, walleye pollock, Kichiji rockfish and arabesque greenling were the major species. In Japanese waters, the stock condition of 23 fishery species are scientifically estimated and strict regulations for fishing operations and catch limits have been implemented.

(2) Russian Fishing Activities in the Sea of Okhotsk

Russia's total catch in the Sea of Okhotsk was 868,600 tons in 2003 (quick estimation). By catch, Pacific saury (25%), squid (20%) (including the Pacific coast along the Kuril Islands) and seaweed (14%) were the major species, while by value, crab, shrimp, sea urchin and walleye pollock were dominant. Among these species, yellowfin sole and Kichiji rockfish are of importance in the Sakhalin Oblast. And there are 25 salmon hatcheries including Chum salmon, pink salmon, and silver salmon on Sakhalin Island. In Sakhalin Oblast, fishing regulations are enforced by the Coast Guard.

4.3 Condition of Fishery Resources in the Sea of Okhotsk in Japan

Table 1 shows the condition of fishery resources in the Sea of Okhotsk assessed by the Fisheries Agency and Fisheries Research Agency of Japan.[13] Species whose stocks are low are walleye pollock, Pacific herring, Japanese sand lance, Pacific cod and Kichiji rockfish, while those that are decreasing include walleye pollock, Pacific herring, longfin codling and hair crab. Here, king crab could not be assessed due to the lack of data in Russian waters. On the other hand, according to the NPAFC (North Pacific Anadromous Fish Commission), Pacific Rim Salmonid stocks have been high since 1990 and the replenishment of stocks has mostly been by natural spawning, except in Japan and southeast Alaska.[14]

Table 1 Condition of Fishery Resources in the Sea of Okhotsk

Species	Condition	Trend
Pacific Saury	High	Increasing
Walleye pollock (Japan Sea north subpopulation)	**Low**	**Decreasing**
Walleye pollock (Nemuro Strait subpopulation)	**Low**	Stable
Walleye pollock (Okhotsk Sea south subpopulation)	**Low**	Stable
Walleye pollock (Pacific subpopulation)	**Low**	Stable
Pacific herring (Hokkaido, Sakhalin subpopulation)	**Low**	Undefined
Japanese sand lance (Soya Strait subpopulation)	**Low**	**Decreasing**
Longfin codling	Medium	**Decreasing**
Pacific cod (Hokkaido subpopulation)	**Low**	Stable
Arabesque greenling (Pacific Ocean subpopulation)	High	Stable
Arabesque greenling (Northern Hokkaido subpopulation)	High	Increasing
Kichiji rockfish (Okhotsk/Hokkaido east and south subpopulation)	**Low**	Stable
Brown sole (Hokkaido north subpopulation)	High	Stable
Pointhead flounder	Medium	Stable
Snow crab (Okhotsk subpopulation)	**Low**	Stable
Hair crab	Medium	**Decreasing**

4.4 Concerns about Fishery Resources in the Sea of Okhotsk

In the Sea of Okhotsk, it is clear that there are some commercially important species at risk. The catch of walleye pollock has decreased to less than 40% of that in the 1980s and those of Kichiji rockfish, hair crab, king crab and snow crab are also in decline. Moreover, there has been few catches of Pacific herring around Hokkaido since 1955. As a result, the marine fishery catch for 2002 decreased to about a third of the largest catch in 1988 in the Sea of Okhotsk. In response to this, multimodal fishing regulations and resource management have been implemented and enhanced both in Japan and Russia, although it will be some time before tangible results are achieved.

The Sea of Okhotsk is surrounded by the east coast of Sakhalin Island, the southeastern coast of the Russian Far East, the Kamchatska Peninsula, the Kuril Islands and the northeast coast of Hokkaido. That is, the Sea of Okhotsk is surrounded by Japan and Russian coast. However, fishes, marine mammals and other species have no borders of their own. In fact, many of them migrate across Japanese and Russian waters. Despite this, statistical data of marine catches is treated separately by Japan and Russia and compiled according to their own individual methods. Moreover, scientific observations and studies tend to be carried out separately as well. Thus, for some of the important fishery species, statistical data is insufficient to investigate the precise status of the resource. In order to investigate the fishery resource condition properly, it is necessary to correct precise statistical data of fishing catch in the Sea of

Okhotsk, and to share this information between two countries.

5. Conclusion

It is widely known that the Sea of Okhotsk is one of the world's richest sea areas. Walleye pollock is the second most caught species in the world and its primary harvest area is the Sea of Okhotsk. However, the total catch of this fish, which is the most abundant species in the area, has decreased to less than 40% of that in the 1980s, while the overall catch and stocks in the Sea of Okhotsk have decreased significantly since the late 1980s. In order to enforce recovery measures for marine resources in the sea,

Correcting and reviewing statistical data
Observing and studying scientific data

by the countries concerned is vital.

In the JANSROP II Project, a new GIS system, the "JANSROP-GIS" was developed and released in the summer of 2005. [15] This GIS system includes environmental, biological and fisheries information about the Sea of Okhotsk. Although the fisheries information is not enough to cover every species nor the entire area of the sea, at least it provides data on the current status of resources from information collected by the working group of the JANSROP II Project.

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The JANSROP-GIS and Its Application

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1. Introduction

We certainly need a wide range of knowledge to develop concrete scenarios, such as how people are living, what weather conditions are like, what infrastructure exists, what environmental issues may arise and so forth. The area with the greatest possibility of utilizing the eastern part of the NSR and the Sea of Okhotsk is not well known to people in Asia or even to Russian people living on the European side. It could be time consuming and tedious work to gather such data and to look at several different factors projected on a single map. The JANSROP-GIS is designed to support this kind of work employing GIS (Geographic Information System). GIS has the benefit of combining several categories of data as users desire and of being able to project them onto a detailed map. The JANSROP-GIS provides general geographic data, natural resource and environmental data through databases with ArcIMS provided by the ESRI. Although the Northeast area in Russia is rich in natural resources, it is sparsely populated, experiences harsh weather conditions and has poor

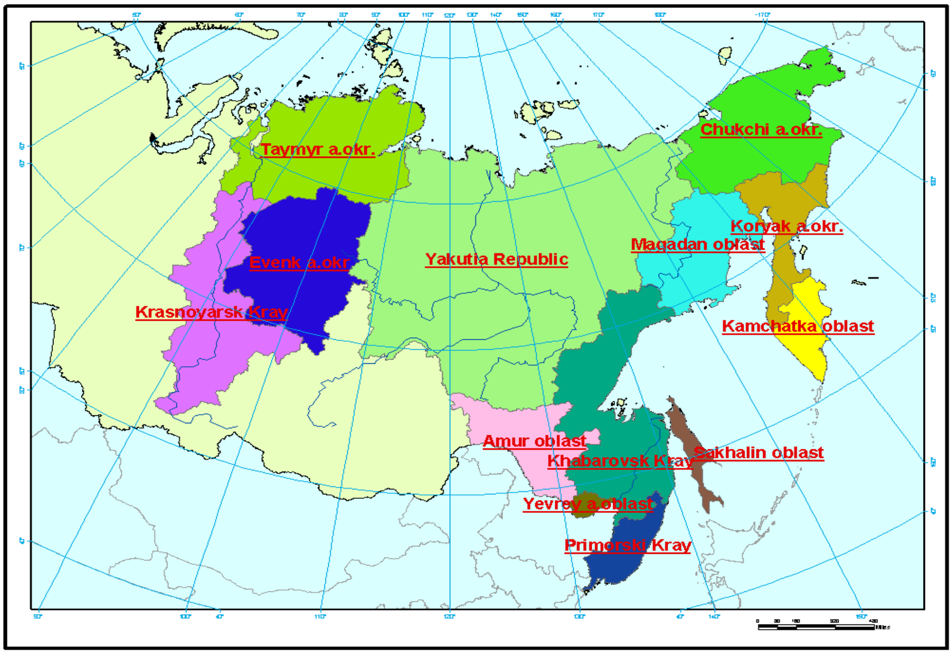

Figure 1 13 Administrative Regions Covered by the JANSROP-GIS

transportation systems. As the environment there is vulnerable and has weak self-generating mechanisms, we have been requested to undertake development in the region with a focus on creating a harmonious relationship with the delicate ecosystem. If a development scenario is found that could overcome environmental issues, the area would bring wealth to East Eurasia. The JANSROP-GIS is a GIS developed as part of the JANSROP II project. It stores information on the general geography of the 13 administrative regions located in the Russian Far East and adjoining districts, the natural resources of minerals, forests, marine products and the transportation network, as well as associated natural environment data on specified geographical locations.

2. The JANSROP-GIS

2.1 General Geography

When we are looking at a development scenario, we certainly need general knowledge of the region in question from the very beginning. In this section, we present information on general geography for a specific region such as population, geography/ecosystem, climate, natural resources, economy/industries, major companies, infrastructure, short, local history flight schedules and we have also attached several photographs to provide a visual impression of the area. We selected 10 administrative regions belonging to the Far East administrative district and three adjoining regions as the Northeast Russia and are assuming that these 13 administrative regions in total would contribute to expanding the use of the eastern part of the NSR or sea lanes in the Sea of Okhotsk in the future. The 13 regions account for approximately half of the entire area of Russia, though their populations comprise only 5% of Russia's total and they are therefore very sparsely populated.

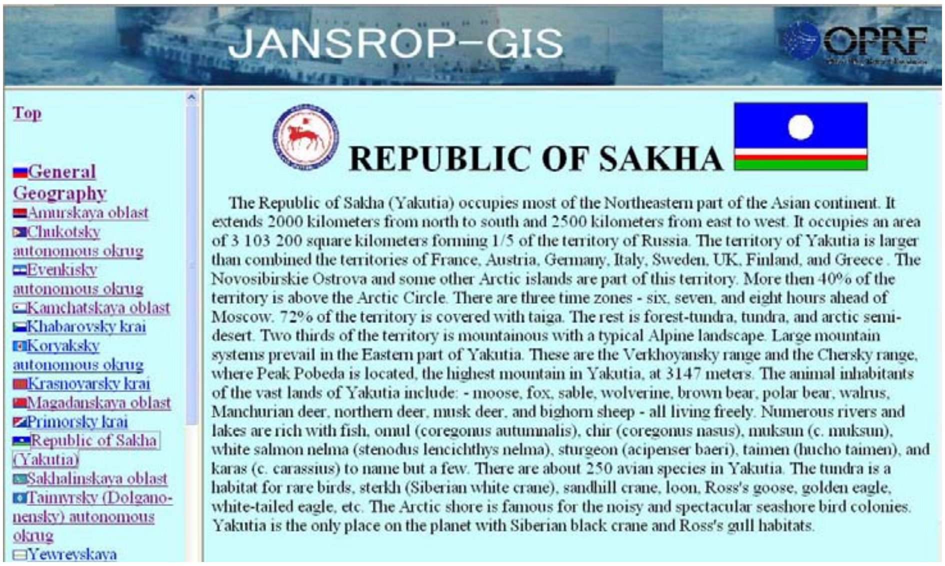

Figure 2 An Example Frame of General Geography in the JANSROP-GIS

2.2 Natural Environment Data

When we consider plans for the development of natural resources such as minerals, forests and fisheries in the northeast of Russia, we need to assess the associated effects on the natural environment in developed areas and along transportation routes from production sites to markets as the Arctic and Subarctic environments are especially fragile in the harsh winter season. In this section, we present meteorological, oceanographic and biological data as environmental data covering the northeast of Russia in the form of GIS-data. GIS is a useful tool in the projection of environmental data on geographic maps showing transportation routes through the layering of different groups of data.

Natural resources located in the inland of Russia will be transported to markets by connecting roads, railways, rivers and sea-lanes in the Arctic Ocean and the Sea of Okhotsk. We require knowledge of the duration of freezing and the ice conditions of rivers, ports and sea-lanes in order to evaluate difficulties in transportation.

The Sea of Okhotsk is one of the most resource-rich sea areas in the world in terms of biological resources including various fishes, marine mammals and birds etc. We have to evaluate the effect on these biological resources caused by the development of these assets and transporting them to markets. GIS-data will support us when performing such environmental impact assessments.

As for the sea areas, we divide them into three sections; the Artic, the Bering and Okhotsk Seas. In each sea area, we present four categories of natural environment data, namely meteorological, oceanographic, sea ice and biological data. This data is plotted on digital maps and it is possible to project various groups of data together by switching the title of the layer. Note that the environmental data on the Arctic Sea is derived from the INSROP (International Northern Sea Route Program)-GIS created between 1993 and 1998.

2.2.1 Natural Environment of the Sea of Okhotsk

We present meteorological, oceanographic, sea ice and biological resource data for the Sea of Okhotsk in the form of GIS data. The Far Eastern Regional Hydrometeorological Research Institute (FERHRI) provided the meteorological and oceanographic data.[1,2] The data was obtained from 58 coastal observatories and ships. Ship observation data was collected in the range of latitude 44-63^{o}N and longitude 135-165^{o}E, and stored and analyzed on an observation grid consisting of 1^{o} latitude by 2^{o} longitude. The data was collected over the period from 1981 to 2000, and the historical data was created by month and year. Meteorological data is comprised of air temperature, cumulative freezing degree-days, sea-level pressure and wind speed/direction, etc. FERHRI also provided wind wave, swell, surface water temperature and surface water salinity as oceanographic data.

The Institute of Low Temperature Science at Hokkaido University contributed some of the oceanographic data[3,4] gathered from recent international research projects, including detailed data such as the spatial distribution of net heat flux, near-surface circulation observed with the ARGOS system and distributions of potential temperature, salinity and oxygen content.

This section features sea ice data and the Japan Meteorological Agency[5] has kindly allowed us to place the statistical data of sea ice No. 3 on this site, which is listed as the “Analysis of 5-day sea ice concentration in the Sea of Okhotsk”, “Maximum, normal and minimum sea ice extent in the Sea of Okhotsk” and “"Probability of sea ice existence in the Sea of Okhotsk” for the 30-year period (approximately) from 1971 to 2000.

The Institute of Low Temperature Science also provided the data[6] showing the relationship between ice motion and surface wind and the data relevant to ice production, which was obtained from satellite data from the Special Sensor Microwave Imager (SSM/I) of the Defense Meteorological Satellite Program (DMSP).

We present 35 GIS maps for biological data[7] through coordination with CNIIMF. The maps show a wide range of biological environmental data covering the entire Okhotsk Sea and a part of the Bering Sea. The data was originally mineralized by the “Ecoproekt” company on the basis of maps of ecological sensitivity designed by the group of specialist biologists at the Saint-Petersburg State University and the Arctic and Antarctic Research Institute.

We present meteorological, oceanographic, sea ice and biological resource data for the Bering Sea as GIS data. The FERHRI provided the meteorological, oceanographic and sea ice data. This data was obtained from 22 coastal observatories and ships. Ship observation data was collected in the range of latitude 50-66^{o}N and longitude 160^{o}E-156W, and stored and analyzed in the observation grid consisting of 1^{o} latitude by 2^{o} longitude as well as for the Sea of Okhotsk. The data was collected

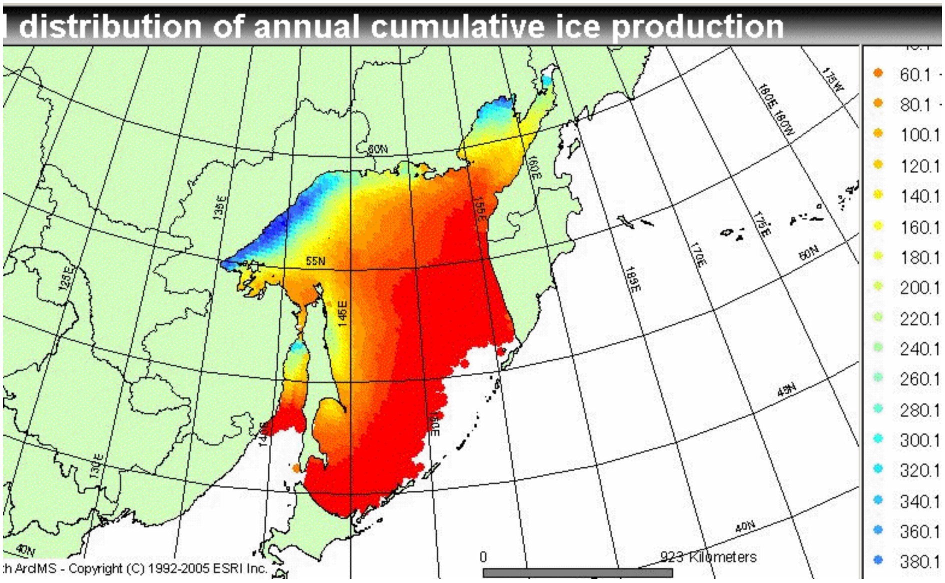

Figure 3 An Example Frame of Sea Ice Data in a Section of the Sea of Okhotsk

over the period from 1981 to 2000, and the historical data was created by month and year. Meteorological data is comprised of air temperature, cumulative freezing degree-days, sea-level pressure and wind speed/direction, etc.

FERHRI also provided the data for wind wave, swell, surface water temperature and surface water salinity as oceanographic data. The sea ice data is comprised of ice concentration, ice age, forms of floating ice, ice hummocking and snow cover depth, etc. Portions of the data are, however, coarse. The biological data is merged with that of the Sea of Okhotsk and the contents are identical.

2.2.2 Natural Environment Data for the Arctic Ocean

We have transferred the GIS data developed in the INSROP to the JANSROP-GIS. The data covers the coastal area of the Arctic utilized by the NSR. The data consists of meteorological, oceanographic, sea ice and biological information. The main frame of the INSROP-GIS was created in its Phase I between 1993 to 1995 and upgraded in the Phase II between 1997 and 1998 to include navigation and biological data concerning the NSR. Meteorological data consists of the average air temperature in January for the period from 1964 to 1994, sea-level pressure data by month and year for the period from 1964 to 1994, and wind direction data by month and by year for the period from 1953 to 1990.

Oceanographic data contains current speed/direction data, temperature/salinity data for surface water measured by observation buoys placed along the Artic coastal area in summer seasons between 1953 and 1990.

Sea ice data consists of average concentration and thickness data by month and year for the period from 1970 to 1991 covering the Arctic coastal area, and data for ridge and floe size distributions along the main navigation route of the NSR by month and year for the period from 1953 to 1990.

Although the data is coarse, information for marine birds, fish and marine mammals is presented as biological data.

2.3 Natural Resources

Although the northeast of Russia is abundant in natural resources, this rich endowment is not well known. We identify minerals, forestry products and marine products as natural resources here and they are regarded as most promising from a commercial viewpoint. There are some difficulties in assembling data from existing literature while maintaining quality and consistency. As detailed mineral data is especially legally limited, it is essential to collaborate with Russian institutions in order to assemble data from the public domain written in Russia. As for forests and fisheries, most of the data has been collected from materials published in Japan. Note that fishery data only covers the adjoining areas of Hokkaido, namely the south of the Sea of Okhotsk and part of the Sea of Japan.

2.3.1 Mineral Resources

CNIIMF had compiled literature on sources from published papers, which approximate locations of deposits in order to interface properly with the

Figure 4 An Example Frame in a Section of Mineral Resources

JANSROP-GIS, collaborating with Professor D. A. Dodin[8]. As for area, the locations covered are differentiated by the type of mineral, and there is no consistency in minerals here. Some mineral data covers the whole of Russia and some other data covers the northern area only. This GIS contains 12 types of mineral, namely antimony, coal, diamond, fluorite, gold, iron, mercury, natural gas, oil, tungsten, tin and titanium. The related short explanations, the tables of deposit locations, the sizes of deposits and historical changes in production, etc. are attached.

Concerning oil and gas, four maps and related explanatory reports[9] are additionally provided by VNIGRI (All-Russia Petroleum Research Exploration Institute) for those people especially interested in energy topics.

2.3.2 Forestry Resources

Russia possesses the largest forested area and related resources in the world and this resource is one of the most important natural resources that can stimulate the utilization of the eastern section of the NSR. Some are of the opinion that forestry resource utilization is the only possible measure to develop and vitalize industries in the Russian Far East. The forested area in Russia amounts to 851 million ha and accounts for approximately 50% of the entire territory (FAO, 2001). Statistically, it accounts for 23% of the area and 22% of the stock of world forestry resources respectively, while 55% of the world's coniferous trees exist in Russia. Russian forestry statistics concerning the vast Russian lands are published in the "State Forest Account" and updated every five years. As Russia's forests are very sensitive to the environment, environmental organizations are very concerned with the country's actions as an issue at the earth level. Many research projects have been conducted - such as "Land resources of Russia" led by IIASA[10] - as large-scale international projects and they offer many excellent papers and comprehensive databases. In Japan, Kakizawa et al. recently published a book[11] reporting on the inside stories of the forestry industry in Russia. In the JANSROP-GIS, we gather and assemble useful information from these and other published sources in order to present a general view of Russian forests.

2.3.3 Fish Resources

Ice-covered seas and adjacent areas provide abundant fishing grounds, such as the Bering Sea and the Sea of Okhotsk. In this type of sea, the high level of primary production sustains rich zooplankton and strengthens the food chain which leads to benthos, fish, marine mammals and birds.

The Sea of Okhotsk has a unique ecosystem susceptible to the environmental change which is produced by the interactions of flora, water system, and geological, climatic and oceanographic conditions. Via the Amur River, the East Siberian forests provide plenty of nutritious substances to phytoplankton in the Sea of Okhotsk. Freezing process of seawater also creates a favorable environment for phytoplankton, upon which zooplankton feeds, particularly on the lower surface area of sea ice, and simultaneously it causes a vertical circulation of sea water and nutrients. The Sea of Okhotsk is thus peculiar in its ecosystem and sustains large amounts of fish stocks.

The Sea of Okhotsk then provides a great fishery to commercial fishing activities by Russia, Japan, Korea and China. The major commercial species are walleye pollock, Pacific cod, flounder, herring, Pacific salmon, halibut, Pacific sardine, Pacific saury, capelin, sand eel, smelt, squid, crab, shrimp and scallop. The cod family such as the walleye pollock and Pacific cod, which is the most abundant species among these, has an estimated stock of about 10-15 million tons[12]. The catch of this family of species exceeds the total catch of all the other combined. It should be noted that according to the FAO, the total catch in the Sea of Okhotsk declined from 6 million tons in the 1980s to 2 million tons in 2000.

3. GIS Architecture and Data Structure

The JANSROP-GIS is developed using one of the most common of the self GIS software ArcViw/ArcIMS released by ESRI and WDDB (World Digital Database) supplied by Rand McNally & Company and is adopted as a digital map to project various GIS data. Fig. 5 shows the schematics of the JANSROP-GIS. Users can access the JANSROP-GIS via the Internet with an ordinary PC whose OS is MS-Windows 2000 or Windows XP and that has MS-IE 6.0 or higher installed as a web-browser, with no additional or special software required. Each time users request a GIS-map, the required data is uploaded from the GIS database and the requested chart is created in ArcIMS.

Fig. 6 illustrates the main directories of the GIS database. The database is divided into three sections: general geography, natural resources and natural environment. These are further divided into smaller directories by sea area and type of natural resources, etc. Users can select data by sea area and also by the type of data. In addition, the data sorted by year and month can be selected from the menu or with the

GIS layer switch button.

Considerable data is stored in the GIS, equivalent to create approximately 19,800 GIS frames, meaning that its size is about six times that of the INSROP-GIS.

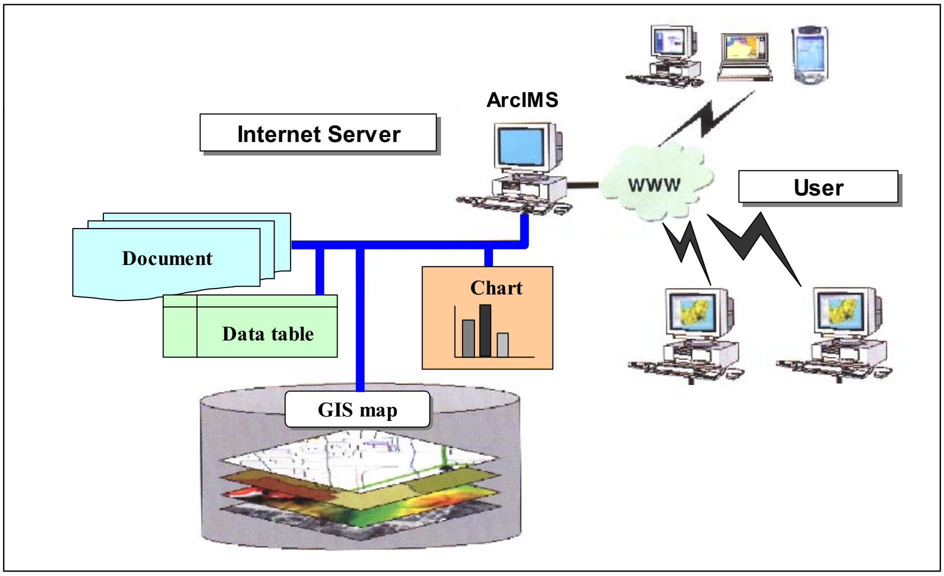

Figure 5 The JANSROP-GIS System's Schematics

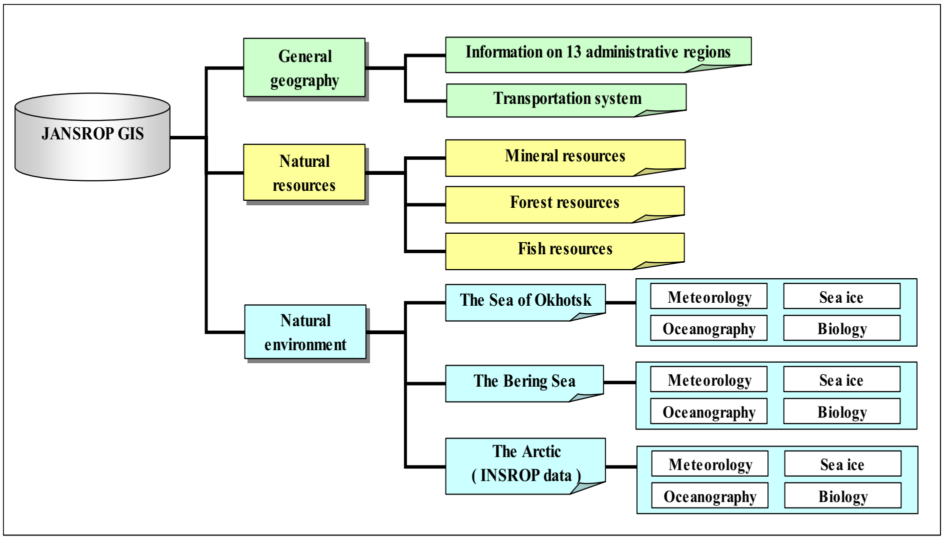

Figure 6 Data Directories of the JANSROP-GIS

4. Application

As the JANSROP-GIS is able to be operated on a website using GIS-software, users can principally use the analytical functions of the software to some extent. In reality, however, users often cannot handle massive amounts of data and complicated analysis due to the limitations of the Internet. The JANSROP-GIS is designed to fit the following task levels from item 1) to 4), and a help menu is attached for user convenience. ArcGIS is able to handle item 5) after data is downloaded to the user's PC, although this function is not included in the current version. Fig. 7 shows an example of measuring distance from a certain mineral deposit to a railway.

1) Simply use as digital maps of northeastern Russia by zooming in
2) Browse GIS-maps in default form for natural resources and environmental data in certain areas by clicking on the hyperlinks contained in the JANSROP-GIS
3) Switch layers of data in GIS-map to customize and zoom in/out to get better maps
4) Measure distances between certain points
5) Obtain environmental data for a certain route and investigate the difficulty of transportation and identify protected/hazardous areas

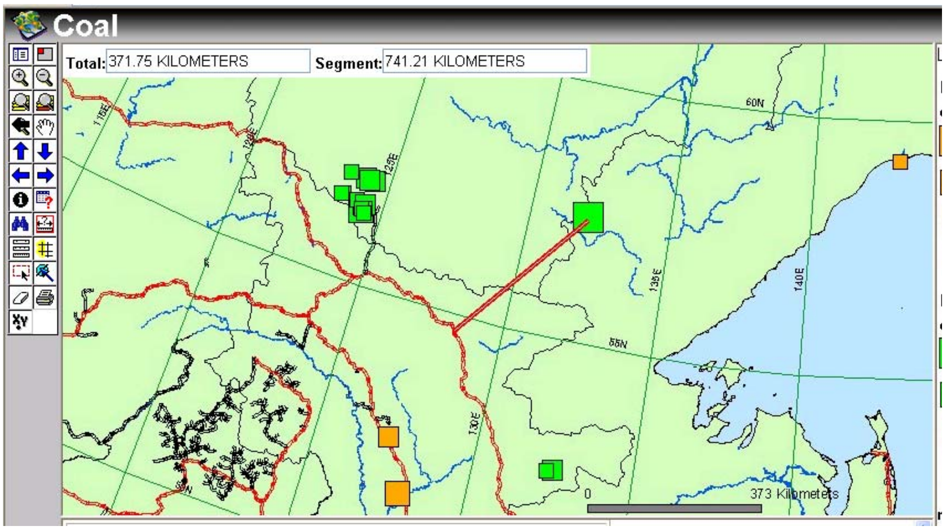

Figure 7 An Example of Measuring Distance in the JANSROP-GIS

5. Conclusion

The JANSROP-GIS can be the first website providing databases of both natural resources and environmental data in the form of GIS with attached explanatory documents. Although more research work and detailed data is necessary for actual projects, we trust that the JANSROP-GIS will present sufficient data for feasibility studies of natural resource development and associated environmental impact assessments. Users can try the JANSROP-GIS by accessing the Website of the Ocean Policy Research Foundation and we hope that many users will enjoy it.

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Far East Russian-Asian Region: Its Prospects

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Russian Far East: An Outline of Its General Features

The JANSROP-GIS gives us an excellent overview of the Russian Far East region with digital data including statistics of various items, factors, illustrated figures and photos.[9] Some key points of the general features of the region can be summarized as follows;

- land area: about 40% of the Russian Federation,
- sweltering summer in the south and frigid winter in the north,
- existence of permafrost,
- appearance of seasonal ice in the Sea of Okhotsk,
- remarkable biodiversity,
- abundance of mineral resources,
- rich oil and gas resources,
- rich forest resources; tundra, arctic tundra, taiga, and conifer-broadleaved forests,
- preserved wildnesses for tourism,
- rich fishery resources in the Sea of Okhotsk,
- sparse and rather shrinking population,
- indigenous societies,
- poor social infrastructure, except for several major cities, and
- poor transportation system.

Outlook for the Russian Far East

Most Asian countries, particularly Japan, have scarcely realized how rich the Russian Far East is until energy development plans were implemented on the Sakhalin shelf. Vast in area, rich in resources but thinly populated, the Far East and parts of eastern Siberia are sparsely developed lands. Only the big cities have civilized features and the region in general lacks modernized living and transportation infrastructures mainly due to the severe natural conditions. Mineral resources were strategically developed in the former social system, but most of the natural resources still remain unexploited, particularly in the Russian North. The region is also blessed with timber and fishery resources and is inherently rich in energy resources. The Sea of Okhotsk has afforded excellent fishing, and the catches and stocks of fish in the Sea significantly have fallen significantly since the late 1980s. On the other hand, the region's industries could have been developed with the support of rich sources of energy and low labor costs, but in reality was only developed in a selective manner within a national framework.

Actually, the region is still reliant on raw material exports and low levels of government investment are part of the problem. After the collapse of the former social system, a sharp decrease in state financing for exploitation work on major mineral resources caused serious socio-economic upheaval. The region is fortunate in that the development of the energy industry has undoubtedly been the driving force behind its economy.

Well founded and reliable data is vital in implementing strategies to investigate and manage resource development, and to control pollution caused by development and transportation to markets. With the active collaboration of Russian institutes, the JANSROP II project has formed the first multi-disciplinary GIS for the Russian Far East.[9] The JANSROP-GIS contains a wealth of new information that enables responsible resource managers, decision makers and environmental scientists dealing with the preservation of marine environments to design plans and measures necessary for sustainable development. We are sure that the JANSROP-GIS will be invaluable to almost any application and purpose, and hope that users will expand upon it and make it more comprehensive.

Development of the Region [2,5,6,9]

Blessed with abundant mineral, energy, timber and fishery resources as well as low labor costs, it was widely believed that the Russian Far East could add value to products from these resources for both domestic and international markets. It was also expected that rebuilding energy infrastructure would also eventually ensure a reliable supply for the region itself. If this sort of transformation could occur with environmental controls in place, the region would make real strides toward sustainable development into reality.

Premised on better access to foreign markets, greater cooperation with foreign investors is undoubtedly necessary. Information on the Russian Far East is still relatively poor and sparse in the most of Asian countries. The painstaking activities on publicity for the region should be the primary action. The region should then devote considerable efforts to modernizing transportation infrastructure such as vessels, ports, railways, well-paved roads and a distribution system. For these activities, direct foreign investment securely led by state financing will be required.

In general, a federal structure is some sort of compromise between centripetal and centrifugal forces within a state. Fortunately, the Russian centre and its relation with the region seems to be progressing from the early, formative stage in which the federal government policy was wavered between decentralisation and recentralisation. The recent trend will provide better conditions for foreign investments.

Bitter criticism still remains that the Russian Far East remains typical of a region dominated by extractive industries. An outcome of the JANSROP II suggests that the Russian Far East cannot base its future development on the extractive industry alone, and that the region faces obstacles in finding alternatives such as in manufacturing and nontraditional industries.

If foreign-managed energy and mining projects could shift their focus to support direct foreign investment in manufacturing, renewable energy production, progressive environmental practices and underdeveloped sectors such as ecotourism and non-timber forest product businesses, which could produce competitive value-added products, regional progress toward sustainable development would begin to take place. It must be a reassuring sign that the federal government recently adopted an ambitious plan to increase processing fourfold by 2010.

At the International NSR Conference in Tokyo, proposals and suggestions from Russia, Norway, Canada and Japan, also provided many positive suggestions for sustainable development in the Russian Far East.[5,7,21,25,27]

Development of Resources

1) Energy Resources[5,15,26,27,28,29,31]

The Sakhalin energy development projects are already in the stage of active production with oil and natural gas pipelines being opted for in favor of transportation via tankers. If the current unusually high price of oil lasts much longer, energy exploitation will extend the area of production further to the north. When the rate of energy production becomes high, shortages in transportation capabilities in existing and planned pipeline systems favor energy transportation via tankers and carriers to a great extent, and they would become competitive again in the world energy transportation market. At the same time, Asian island countries would be blessed with the a reinvigorated shipping industry.

Abundant coal resources in the region could raise prospective and quite different scenarios in the future, if coal liquefaction technology is able to find novel solutions suitable for market requirements. The current world market in energy and steel production will prompt the coal industry to undertake further development, but weaknesses in transportation infrastructure and out-of-date cargo handling facilities in ports might decelerate the pace of growth. Effective measures that should be taken include foreign investment led by state financing to modernize and quicken the transportation system and improvements in the cargo handling capabilities at ports.

2) Timber and Forestries[8,9,14,16, 30]

According to the JANSROP-GIS, there are more than 21 billion cubic meters of timber reserves in the Russian Far East and almost half of these are in Sakha, where the trees are primarily larch and have an extremely low growth rate. About 40% of the region’s forests remain inaccessible due to mountainous landscapes and a lack of infrastructure. Large-scale and wasteful extraction inducedby a reliance on raw materials exports mostly in the former social system has diminished the number of accessible reserves.

Forestries in the Far East certainly need to overcome a range of difficulties in order to survive in the present world market. Solutions are rather clear in theory, but in practice, schemes for the survival of the regional forest industry will not be easily carried out on market principle. Modern forestry management technology should firstly be introduced or at least examined in the region such as plant succession control, crown closure control, ground clearance, stream works, methods to dry stems without limbing, the shelterwood system, normal forest policy, density control, rational development of substitution forests including environmental, community and industrial afforestations, accurate stumpage appraisal, aerial photogrammetry and a forestry information system. Increasing productivity and product control over the long term which could meet the needs of the times and of the market should then follow. Development of the wood industry in the region with modernized technologies is also vital for a sustainable forest industry, including the production of compressed wood, thick low-density particle board, insulation board, overlaid plywood, liquid wood, etc. Sawing machines should be replaced by more effective and automatic versions with improved accuracy and bucking efficiency. To fully utilize bark, chips and waste, government-led development projects are highly recommended.

To develop, the industry needs experience in packaging and marketing products domestically and abroad, and to introduce tax incentives to encourage production and exports. Foreign investment is also crucial as Russian producers believe international markets hold the most promise.

In reality, despite federal and regional government efforts, sawn-wood and plywood production are at unprecedented lows. The region is even more reliant now on raw material exports than ever before.

The development of non-timber forest products has strong potential along the Sikhote-Alin Mountain Range (Primorsky and Khabarovsk Krai) and the products include medicinal plants such as ginseng and berries.

The timber business, with the help of direct foreign investment, has the potential to produce competitive value-added products.

3) Fisheries[12,18,20]

The oceans outside of national territorial waters are common waters and the fish and mammals in them are also common resources. The current trend of major nations to adopt EEZs has turned some fisheries from completely open shared resources into closed national areas that only are domestic fishing industry an access. However, as biology has pointed out, there could not exist any border for living species in the oceans. Excess fishing has for a long time been destroying fisheries in the Sea of Okhotsk and without an internationally controlled fishery framework, the industry does not have a very hopeful future there. The establishment of catch quotas for the entire industry, however, is one of the measures toward creating sustainable fisheries. Regulations for the total catch will be helpful for increasing fishes, and as a consequence, they will often stimulate to increase the number of fishermen and capability of fishing vessels. At the end, the fishermen might have difficulties in competing and surviving.

Some alternative methos are as follows:

・to issue a restricted number of licenses and to allow only licensed fishermen to be

included in catch quotas,
・to tax the catches,
・or to allocate fishing rights with transferable and saleable quotas to fishermen.

NGOs have helped highlight the linkages among a number of international conventions and institutions relevant to the ocean environment. They have begun to tackle the applicability of a wide rage of international legal instruments to particular sectors or issues like marine fisheries, the introduction of alien species and protected coastal and marine areas. NGOs are thus playing a major role in defining the trade-environment nexus, with specific reference to marine fisheries. In a few decades' time, NGOs will become much more active and powerful in finding reasonable solutions to conflicts between fishery markets and ecological environmental protection.

In the Sea of Okhotsk, scientific studies on the ecosystem are urgently needed and fundamental investigations, such as the 'International Amur-Okhotsk Project', conducted by Hokkaido University as one of the core institutes, will be more important in regenerating the fishery stocks in the Sea to levels comparable to the beginning of the last century.[32,33,34]

The Amur River basin occupies an important geographical position and has played a significant role in the economic development of the Far East Russian-Asian region. The basin is rich in minerals (oil, coal, gold, nonferrous metals, etc.), biology (timber of precious species; sturgeon, salmon and other species of fish; terrestrial animals with commercial value, medicinal, melliferous and other kinds of plants), agriculture (ecologically pristine areas for livestock and agricultural farming), water resources (industrial, drinking, mineral and medicinal water), and recreation resources (natural, historical, archaeological, paleontological, and ethnographical sites of international significance, in particular for tourism) and building materials (high quality sand, etc.). However, from the point of view of the marine ecosystem, the key to the Amur River is the capability of providing biogenic and lithogenic suspending particle flux, in particular, dissolved ferrous one into the Sea of Okhotsk. The Amur River also has direct and indirect effects on the ecosystem by discharging vast amounts of fresh water into the Sea and contributing to the generation of sea ice there.

The Project will firmly assess the physical, chemical and ecological impact of the Amur River on the Sea of Okhotsk and will eventually provide valuable suggestions for sustainable economic development in the region.

4) Other Resources[3]

Gold and diamond have failed to contribute to local infrastructure in the regions to any substantial extent. Exports and the gold and diamond industry will develop steadily in rather limited circles at least for several decades and accordingly Far East Russian-Asian societies will not benefit a great deal from this industry.

The global electronic industry is looking for new sources of rare metals and elements, both of which are potentially abundant in the region. The production of rare metals and elements is supposed to be realized within a few decades, although creating a new refinery industry will rely heavily on the federal government and foreign investment.

The exploitation and development of natural resources will extend to further north beyond the Subarctic areas and marine transportation will play a major role, just as in the development of Canadian Arctic resources.[23,24,25]

We would like to hope that the future of the Russian North is bright, led by the development of various natural resources. The Canadian experience demonstrates that a mature, strong, clear and stable regulatory regime can contribute to sustainable development.

Construction and Transport Industry [3,10,19]

Social infrastructure in the Russian Far East region has been scarcely developed, since the collapse of the former social system. After the privatization of the governmental industries, most of the construction enterprises in the Far East have been of a relatively small scale. This indicates that the region's construction industry lacks the capability to modernize its machinery and effectiveness in their market and construction activities. The energy sector would hopefully rejuvenate this industry through the building of relevant facilities, access roads, port facilities and pipelines. However, pipeline construction projects under the seabed will restrict the number of enterprises and some foreign companies may even close their businesses. In any event, the governments -both federal and regional- and foreign investment will be vital to the improvement of local infrastructure in the development of the construction industry.

In order to achieve stable economic growth, the Far East would need to attract foreign investment and develop exports to its western and eastern neighbors. Regrettably, however, in the current political situation this realignment does not seem imminent.

Apart from the two major railroads, i.e., the Trans-Siberian and the Baikal-Amur Mainlines in the southern regions, the northern regions have no railroads of their own and very few paved roads. Permafrost, a common occurrence, makes the construction and maintenance of roads and railroads difficult and expensive. Transportation via great rivers such as the Lena, Indigirka and Kolyma could be an alternative method to those on land. However, inland water transportation has to find a way of overcoming obstacles such as frozen surfaces in winter, shallow waters in summer, flooding in late spring and weak river banks.

Tourism [11]

The tourism season is short, but the wilderness in many parts of the Russian Far East is spectacular and fortunately much of it remains in its original state. Ecotourism does show potential in numerous parts of the Far East, but while Russian people are well disposed to visitors, facilities such as cabins and transport vehicles are poor and lacking. With the proper regulations in place, however, ecotourism could become a viable source of income, particularly for small communities in scenic areas of the region who currently depend on one type of resource, mostly on logging, mining, or fishing for most of their income.

The possible pollution caused by the development and transport of natural resources could be localized in particular areas subject to the highest exposure to human activity. Tourists, however, will travel to any place that captures their interest. Sporadic tourism behavior will not significantly nor immediately impact on the environment and ecosystem, but a bustling industry would produce adverse effects on them in the long term. One of the direct hazards of ecotourism on wildlife might be the transmission of diseases from tourists to people living there as pathogens would be transferred by mud on clothing and vehicles.

Wealthy visitors get to see rare and spectacular wildlife and enjoy magnificent scenery, while local governments and organizations derive advantages from the cost of their visits. In turn, the income from tourism should furnish the funds to protect the environment, animals and their habitats. Regions rich in biodiversity often lack the funds to build social infrastructure. The benefits of ecotourism blind them to the impact of tourism in the long term, which might endanger the survival of wildlife and upset the well-balanced ecology in the region.

The Far East Russia-Asia region is undoubtedly rich in biodiversity benefit, enchanted scenery and wildness. At present, tourism activities in the region, though rapidly increasing, remain very limited in number and scope, and almost all of the tourist vessels fly Russian flags. The Russian vessels satisfactorily meet the safety and environmental requirements for their operations.[7,31] Sooner or later, however, enthusiasm for wildlife would demand touring cruises operated by foreign vessels.

In order to cope with increasing tourism in the future, new international regulations and the adoption of a liability regime for environmental damage should be discussed, on which tour operators and agents will rely for their operations. The region is also likely to establish an association such as the International Association of Okhotsk Tour Operation, similar to the International Association of Antarctic Tour Operation.

Indigenous Peoples [2]

About seventy-six percent of the regions' total population is concentrated in urban areas. Nevertheless, Koryakia for example, still remains primarily rural and large settlements of indigenous peoples remain. In 1989, there were about nine million indigenous peoples in the regions, and most of them were widely dispersed in rural areas.

Paleo-Siberians are believed to have been the first indigenous peoples to inhabit the Russian Far East. This ethnic assemblage includes the Chukchi, Yakagir, Koryak, Kerek, Asiatic Eskimos, Nivkhi and others. The largest populations of indigenous peoples are in Sakha, Khabarovsk and Chukotsk. Economic development and any regulations on fisheries should not have any harmful or negative influences on these people. We should first thoroughly understand their rights, cultures, traditions and ways of life first and then do what we can to protect them.

NSR [1,4,17,21,22]

Russia recorded its maximum cargo volume on the NSR in 1987, but since then the volume of cargo has gradually decreased. The collapse of the former socio-economic system accelerated this decrease. Transit shipping has almost dried up, but a few Russian institutions predict that cargo volume will tend to increase over the next few decades. Oil development will certainly vitalize the western part of NSR, for instance through oil transport from Timano-Pechorsk province. On the contrary, in the eastern part of the NSR, no positive development scenarios which could activate the route have been presented.

The International Arctic Science Committee of the Arctic Council has indicated that the current Arctic sea ice trend implies improved shipping accessibility around the margins of the Arctic Basin, i.e., the NSR. Such sea ice conditions could lighten the requirements of vessels navigating the NSR. Over the coming few decades therefore, the NSR can anticipate a prosperous future.

Sustainable Development [2,6,7,13]

The concept of sustainable development which incorporates the notions of equality and conflict avoidance brings land and marine resources conservation to the forefront as an objective of global governance. Even solving ocean issues, the problems of sustainable development are rarely simple. They comprise effects from various human activities on land and at sea, some of which may originate far from the initially affected marine area. The larger natural system has to be defined in a logical manner, taking account of ecosystem dynamics and linkages among land, fresh water, terrestrial, marine and atmospheric systems.

Resource exploitation and production often take precedence over long-term environmental effects to attain relatively short-term economic growth. At all stages of development, the effective preservation of the environment should be recognized as an essential factor in long-term human progress.

We are fully aware that oceans are extremely sensitive and that radical changes in any balance can produce significant damage not only to biological, chemical and physical activities in oceans but also to the earth's atmosphere, flora and fauna that are profoundly affected by oceans. We should prevent and resolve conflicts between the increasing use of the ocean and its resources and marine pollution, which may deny such use in the long term. The effective management of the marine environment will ultimately affect the ability of our earth to support life as it is known today and thereby the future of humanity.

The effects of pollution on ocean ecology should be evaluated in physical, biological and economic terms. Effective ocean environmental management can be profitable as well as responsible. One challenge is to obtain quality data on ecosystems, so that it can be used by the responsible resource managers and decision makers. Every stage of decision making relevant to the economic and industrial developments of the region should be transparent.

It is apparent that more direct foreign investment is needed for the region to achieve real progress. But investment has flowed almost exclusively into resource extraction projects and, been biased towards offshore oil and gas development in Sakhalin and gold mining in Magadan. The region’s reliancy on extractive industries has produced low levels of economic growth and failed to distribute revenue evenly. Such a pattern of foreign direct investment appears to be perpetuating the region's unhappy conditions together with unforeseen negative environmental impacts. For the meantime, the region does not appear to have received the potential benefits of western technology for modernizing light, timber and manufacturing industries.

Some economists have highlighted the problems of economies in remote and sparsely populated regions, by pointing out that the supply of domestic capital is low, and that the regions’ firms tend to focus on short-term profits rather than on long-term development.

Nonetheless, progress is being made. Small and medium-sized businesses in food, trade and services are being established.

Concluding Remarks

Abundant minerals, energy, timber, fishery resources and low labor costs should have transformed the Russian Far East into a manufacture of value-added products utilizing these resources for domestic and international markets, and in so doing, led the region toward sustainable development. In reality, however, the region has become even more reliant on raw material exports. The Russian Far East simply cannot base its future development on extractive industries.

Reasons for this are varied and complex, having much to do with how the planners of the former social system developed the region as a raw materials base. For the moment, low levels of government investment, both federal and regional, are a major part of the problem.

Direct foreign investment levels in the Russian Far East have been relatively low, particularly from the major consumer markets of China, Japan and South Korea. Instability in taxation law and regulations, together with weaknesses in the legal system and power relations between the government and industrial enterprises have deterred foreign investment in the regions: not to mention the fact that black markets still remain prevalent.

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PROTECTION OF ENVIRONMENT FOR THE SEA OF OKHOTSK

Natural Condition of the Sea of Okhotsk

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The Sea of Okhotsk, located between 44 and 60°N latitude, is bounded by Kamchatka Peninsula, Siberia, Sakhalin Island, Hokkaido, and the Kuril Island chain. The Sea of Okhotsk is covered by sea ice for part of the year (see Figure 1); thus, it is called a seasonal sea ice zone (SSIZ). The sea ice cover begins to form in late November and expands to cover much of the sea by early March. Over the following three months, the ice retreats with only small ice-covered areas by the beginning of June. The sea is ice free or nearly ice free on average for 6 months of the year, from June through November. The fact that the Sea of Okhotsk is the southernmost SSIZ in the Northern Hemisphere makes this region unique and of great scientific interest.

The importance of the relationship between the Sea of Okhotsk ice cover and regional climate has long been recognized and the fact that the interannual variability of its sea ice cover is large suggests that it may have an impact on large-scale oceanic and atmospheric circulations. Indeed, recent work has tied the extreme maximum and minimum wintertime extents of the sea ice cover to large scale changes in atmospheric circulation patterns. Most recently, the idea has been put forth that the Sea of Okhotsk may be the origin of North Pacific Intermediate Water with the salinity-minimum, cold and rich-oxygen properties which exists in the depth range 300-800 m below the surface of the North Pacific. Beyond its influence on the subsurface circulation of the North Pacific Ocean, there is good reason to believe that the Sea of Okhotsk also is a site where a relatively large amount of CO_2 is removed from the atmosphere by the ocean. This is due to the effect of the strong seasonal cycle in the Sea of Okhotsk on the biological productivity there; the very high productivity apparently results in a large atmosphere-to-ocean carbon flux. Thus, there are important climate issues that are associated with the Sea of Okhotsk.

Despite this potential importance of the Sea of Okhotsk, little is actually known about its circulation in both physics and chemistry. This is due to the fact that the wintertime environment in the Sea is generally harsh and is not conductive to making high quality measurements, and also because of historical political problems associated with carrying out work in the region.

We recently have had four times cruises aboard a Russian research vessel Professor Khromov from 1998 through 2001, making intensive oceanographic observations in the almost entire Sea of Okhotsk for the first time with Japan-Russia-US joint research project. The topics of the joint project are as follows; (1) Growth history, seasonal and interannual variability of sea ice, (2) Ocean circulation, especially for East Sakhalin Current, (3) Water mass production, especially for dense water formation, (4) Water exchange between the Sea of Okhotsk

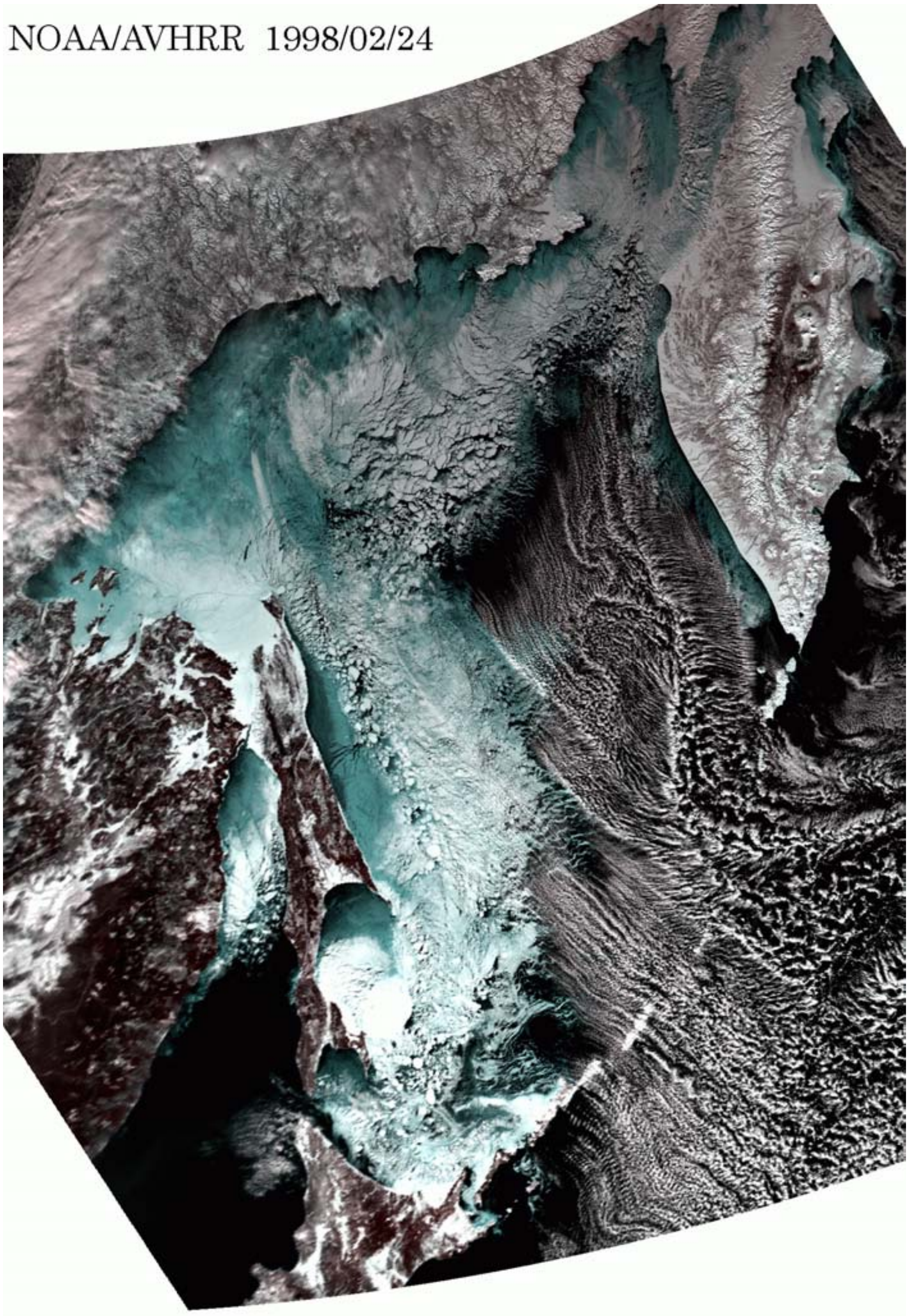

Figure 1 NOAA/AVHRR Image of Okhotsk Sea-ice Cover on 24 February, 1998 (Provided by Kitami Institution of Technology)

and the North Pacific, (5) Air-sea interaction, (6) Material cycle, and (7) Paleoceanography.

1. Sea Ice

1.1 Ice Production Area

Ohshima et al. [2003] have estimated the amounts of sea ice production using a heat budget calculation, under the following assumptions: (A) sea ice is produced both in open water and ice areas only in the ice-covered pixels (a pixel having ice concentration of more than 70% is assumed to be an ice-covered pixel); (B) oceanic heat flux from below is negligible; and, (C) amount of ice production corresponds to negative value of net heat budget in each pixel. Figure 2 shows the spatial distribution of annual cumulative ice production averaged over 1987-2001, calculated under the above assumptions. It is found that most of the ice production in the Sea of Okhotsk is accomplished in the coastal polynyas. The highest production area is over the

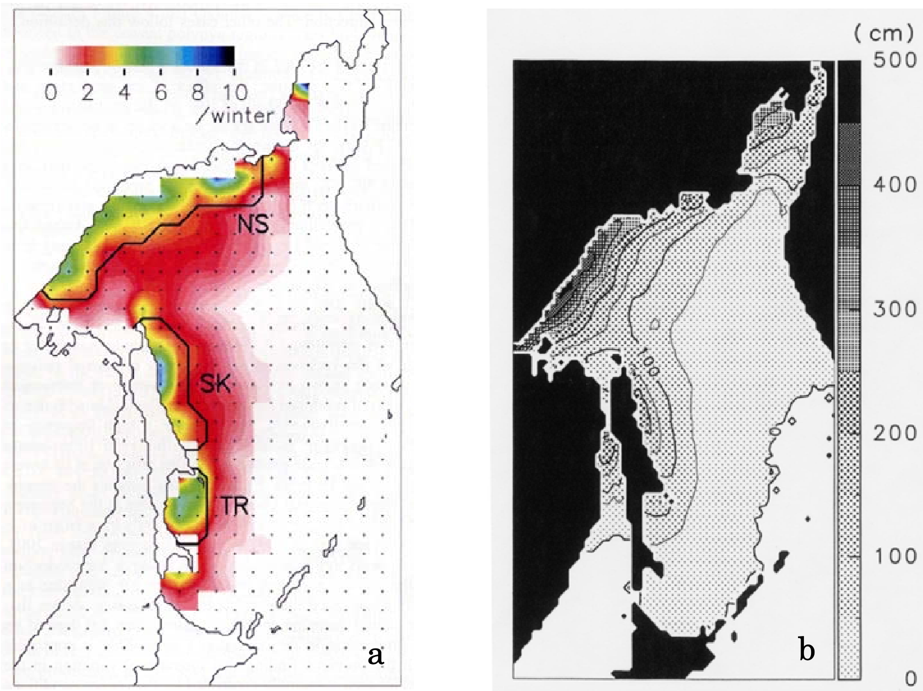

Figure 2 (a) Spatial Distribution of Annual Cumulative Ice Production (Represented by the Ice Thickness in cm) Averaged over 1987-2001 Enclosures labeled NS, SK and TR indicate the Northern Shelf Polynya, Sakhalin Polynya, and Terpenia Polynya, respectively. Data points spaced at 75 km are shown by dots.
(b) Spatial Distribution of Mean Area of Ice Production in a Unit Area during One Year Averaged over 1991/1992-2000/2001

northwest shelf within 100 km of the coast. According to the estimate, the annual cumulative ice production over the entire Okhotsk Sea reaches 13 $\times 10^{11}$ (m^3), about 30 % of which occurs over the northwest shelf within about 120 km of the coast. The second and third highest production areas are Shelikov Bay, and the northern Sakhalin shelf, respectively.

On the other hand, Kimura and Wakatsuchi [2004] also have examined the amounts of ice production in the Sea of Okhotsk, using daily data of sea ice velocity and concentration which were derived from images of the Defense Meteorological Satellite Program (DMSP) Special Sensor Microwave Imager (SSM/I) for 10 winters (December-April) from 1991/92 to 2000/01. The daily ice velocity field derived from the satellite microwave data enabled us to derive the local production and reduction of ice area. Figure 2(a) shows the total ice production during the winter season averaged over the 10 winters. It is clear in Figure 2(a) that Okhotsk sea ice is significantly produced in the coastal polynya regions. This high value in the coastal areas is caused by the higher productivity of sea ice in these areas and longer duration of ice existence. The geographical distribution of ice production areas is very similar to the result of a thermodynamic model study by Ohshima et al.[2003].

The results of the above examinations [Ohshima et al., 2003; Kimura and Wakatsuchi, 2004] shows that almost all the sea-ice extent in the Sea of Okhotsk forms in a semi-open water area, called as a coastal polynya, over the northwestern continental shelf. In the coastal polynya, the cold, severe northwesterly wind continuosly blows out to sea, produces sea-ice, blows it out into the ocean, produces more sea-ice, and blows it out. This cycle results in the production of an extremely large amount of sea-ice. The northwestern continental shelf in the Sea of Okhotsk is the location where the largest amount of sea-ice is produced in the Northern Hemisphere [Ohshima et al., 2003].

1.2 Ice Thickness

The ice thickness distribution is one of the controlling factors of heat exchange between atmosphere and ocean. As pointed out by Maykut [1978], the ice thickness distribution plays an important role in estimating turbulent flux in the Arctic ice area, particularly over thin ice, because the turbulent flux increases drastically with the decrease of ice thickness especially for ice thinner than 1 m thick. Worby and Allison [1991] also showed that leads and thin ice have the impact on total heat exchange in the Antarctic.

Systematic ice-thickness measurements are fairly limited in the Sea of Okhotsk. In the southwestern part of the sea, Toyota et al.[2004] carried out ship-based monitoring to measure thickness of ice floes turned into side-up positions with a downward-looking video camera in 1996-99. They showed that the average thickness in early February varied from 0.19 m in 1996 to 0.55 m in 1997. From ice structure analysis, they also revealed that granular texture occupies about three quaters of the total ice thickness and that the ice exhibits a layered structure with unit thickness averaging 0.05 to 0.1 m.

Recently, long-term ice thickness measurements were directly conducted off the

Hokkaido coast by Fukamachi et al.[2003].They obtained for the first time a spatial section of draft across 855 km of sea ice in the southwestern part of the Sea of Okhotsk near Hokkaido in winter of 1999, using a moored ice-profiling sonar along with an ADCP. The draft evolved from 0.20 m in mid-February to 1.45 m in late March with the overall value of 0.72 m. The maximum draft measured was about 17 m. Their measurements also showed that the draft characteristics were quite different before and after the period of strong winds. Ice volume was dominated by the contribution from portions of deformed ice. The above in-situ observations of ice thickness distribution suggest that dynamic ice thickening processes such as frazil ice growth and piling up are more significant than congelation growth at least in the southwestern part of the Sea of Okhotsk.

2. Water Circulation

The Sea of Okhotsk is the important location for the ventilation of the North Pacific Intermediate Water (NPIW) characterized by a salinity minimum centered at 26.8 σ_θ [Talley, 1991; Warner et al., 1996]. The Okhotsk and its water exchange with the North Pacific play an important role not only in the local environment but also in determining the water properties of the North Pacific. Within the Sea of Okhotsk, the northwest shelf has been considered as the location of the ventilation of the intermediate water, where dense water up to 27.05 σ_θ can be produced by brine rejection due to active sea-ice formation [Kitani, 1973; Alfultis and Martin, 1987; Gradyshev et al., 2000]. However, it is still unknown in detail where and how such ventilated water circulates and is modified within the Sea of Okhotsk and finally flows out to the Pacific Ocean, mainly due to the lack of flow field data in the Sea of Okhotsk.

The Okhotsk Sea circulation has been presented schematically in several Russian papers [Leonov, 1960; Moroshkin, 1962; Luchin, 1998]. According to their schematics, the major feature is a cyclonic gyre with a western boundary current along the east Sakhalin coast, historically called the East Sakhalin Current. Watanabe [1962; 1963] inferred, from the water mass distribution and ice drift, that the East Sakhalin Current leaves the coast 48°N and flows eastward in summer, while it continues southward along the coast and reaches the Hokkaido coast in fall and winter. The southward continuation of the East Sakhalin Current has been suggested by observations that the less saline surface water originating from the Amur River in summer arrives at the Hokkaido coast in November [Watanabe, 1963; Itoh and Ohshima, 2000], and that very cold, oxygenated water intrudes southward from the northwest shelf along the Sakhalin coast from the subsurface to about 1000 m depth [Talley, 1991].

In the southern Okhotsk Sea, Wakatsuchi and Martin [1991] showed the existence of an anticyclonic circulation in the Kuril Basin, based on the dynamic topography. Within this circulation, several eddies with diameter of 100～150 km are also observed in the hydrographic data [Wakatsuchi and Martin, 1990; 1991] and in satellite imagery [Wakatsuchi and Martin, 1990; Bulatov et al., 1999].

Although there are several papers that describe the flow field of the Okhotsk Sea (a comprehensive review is given in Talley and Nagata, 1995), most studies are based on indirect measurements (such as dynamic topography, water mass distribution, ice or ship drift) or on a composite of sporadic short-term direct measurements. By this reason, for example, no quantitative estimate for the East Sakhalin Current has been made: its width, extension, velocity structure, volume transport and seasonal variability have not yet been clarified.

2.1 Surface Circulation

Figure 3 displays the deployment locations and the trajectories for twenty drifters deployed during the period from 28 August to 21 September 1999 from research vessel Professor Khromov of Far Eastern Regional Hydrometeorological Research Institute, Russia [Ohshima et al., 2002]. The drifters were tracked by satellite by means of the ARGOS system. Of the 20 drifters that were released in the Sea of Okhotsk, 12 ceased

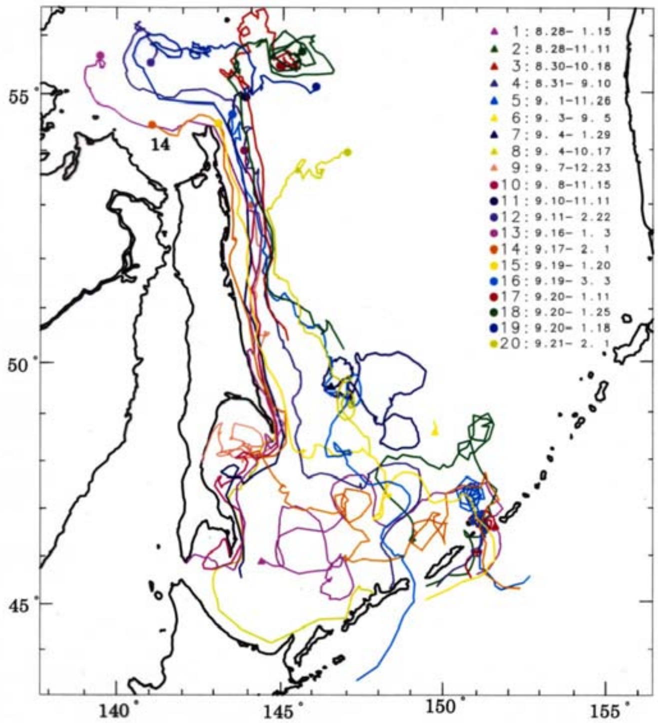

Figure 3 Deployment Locations and Trajectories for 20 Surface Drifters with Sampling Interval of 1 Day

Circle and triangle symbols indicate the deployment locations for each drifter. Dates of first and last observations are listed in the upper right. Months of 8-12 are for year of 1999 and months of 1-3 are for year of 2000. For the case that a drifter flowed out to the Pacific, plotting is stopped 10 days after the outflow.

within the Sea of Okhotsk owing to the crush to land or sea ice by February 2000, and the remaining 8 went out to the Pacific Ocean. By February 2000, about 1900 days of drifter data had been acquired through Service Argos. The drifter trajectories show some general characteristics of the flow field.

The most significant feature seen in the trajectories is the existence of the East Sakhalin Current: most of the drifters east of the Sakhalin Island moved southward following the depth contours of the slope. All the drifters that were deployed upstream of the East Sakhalin Current flowed southward from the northern tip of Sakhalin Island to Terpeniya Bay with a typical traveling time of 1 month. After that their paths split in two: one group (five drifters) flowed farther south near the coast following the depth contours, the other group (four drifters) turned eastward into the Kuril Basin and traveled east with anticyclonic eddy-like motion (diameters of 100～200 km) for 2-3 months, and finally entered the Pacific through Bussol' Strait. These suggest that the surface water in the Kuril Basin and east Sakhalin shelf has relatively short resident time of less than 1 year, and that Bussol' Strait is the main pathway for the surface water to exit the Okhotsk.

On the other hand, two drifters remained in the Central Basin for nearly a half year and finally ceased due to the crush of sea ice. The resident time of the water in the Central Basin appears to be much longer than that in the Kuril Basin or east Sakhalin shelf. Figure 4 is a schematic of the circulation and mesoscale features of the Okhotsk

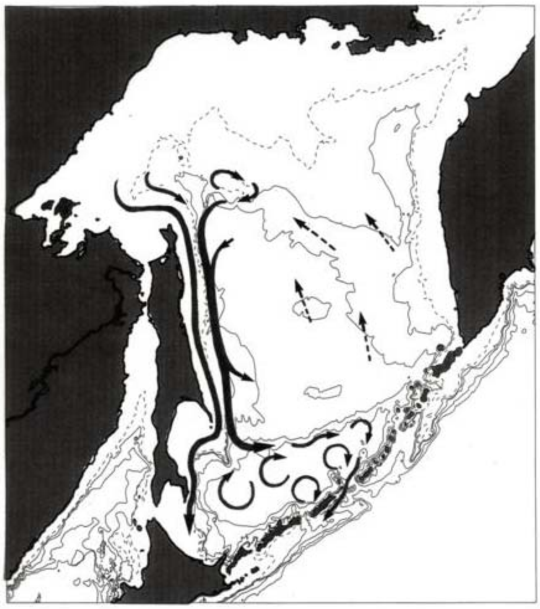

Figure 4 Schematic Illustration of Near-surface Circulation for the Sea of Okhotsk as Derived from Satellite-tracked Drfter Data

Thicker arrows represent the stronger flow. Currents in the eastern part are depicted by dotted lines because they are based on speculation.

Sea derived from the surface drifter data [Ohshima et al., 2002]. Observed circulation is basically compatible with the schematics of Leonov [1960] and Moroshkin [1966]. In particular the structure of the East Sakhalin Current is well described. This current is strongly controlled by bottom topography and confined to the region shallower than 1000 m. The East Sakhalin Current appears to consist of two cores: one exists near the coast (50～150 m depths) with typical speeds of 0.3～0.4 m $s.^{-1}$ and the other over the shelf slope (300～900 m depths) with typical speeds of 0.2～0.3 m $s.^{-1}$. Existence of the two cores in the East Sakhalin Current is particularly evident in the north and in September-October. In the upstream of the currents the nearshore core appears to originate from the northwest shelf while the shelf slope core from the east.

On the other hand in the downstream, the nearshore core may be relevant to the southward branch extending toward the southern tip of the Sakhalin Island while the slope core to the eastward branch turning to the east around Terpeniya Bay and flowing eastward as far as Bussol' Strait. It is expected that the northward flow should exist in the eastern part of the Okhotsk Sea to compensate the observed southward flow in the east Sakhalin shelf. We think that the shelf slope core of the East Sakhalin Current can be regarded as the western boundary current of the cyclonic gyre in the Okhotsk Sea.

2.2 East Sakhalin Current (ESC)

We conducted long-term current mooring measurements off the east coast of Sakhalin from 1998 to 2000, to clarify the structure and seasonal variability of the flow field near the western boundary of the Sea of Okhotsk [Mizuta et al., 2003]. Figure 5(a) shows a map for the locations of moorings. In most of the mooring period a persistent southward flow, namely, the East Sakhalin Current, was observed along the east coast of Sakhalin, which extends from the surface to a depth around 1000 m, as shown in Figure 5(b). The speed of this southward flow clearly changed seasonally. The peak monthly-mean speed along 53 °N at a depth of 200 m attained a maximum of 37 ± 9 cm s^{-1} in January and a minimum of 10 ± 8 cm s^{-1} in July.

Three different cores of intense flow were identified in the southward flow. The first core was centered over the continental slope and had rather large vertical extent, reaching the bottom on the slope. The second core was trapped over the shelf near the surface and was observed from October to November. This core was associated with less saline surface water affected by the Amur River discharge. The third core was intensified toward the bottom on the slope. The spatial and temporal distribution of this bottom-intensified core coincided with that of dense shelf water, which is formed over the broad shelf in the north. The intensity of this core damped within a few hundred kilometers from the northern end of Sakhalin probably because of strong mixing of dense shelf water with surrounding waters. The total transport of the southward flow at 53°N was 6.7×10^6 $m^3s.^{-1}$ in the annual average, varying from a maximum of 12.3×10^6 $m^3s.^{-1}$ in February and a minimum of 1.2×10^6 $m^3s.^{-1}$ in October, as shown in Figure 5(c). Most of the transport was maintained by the first core of the southward flow.

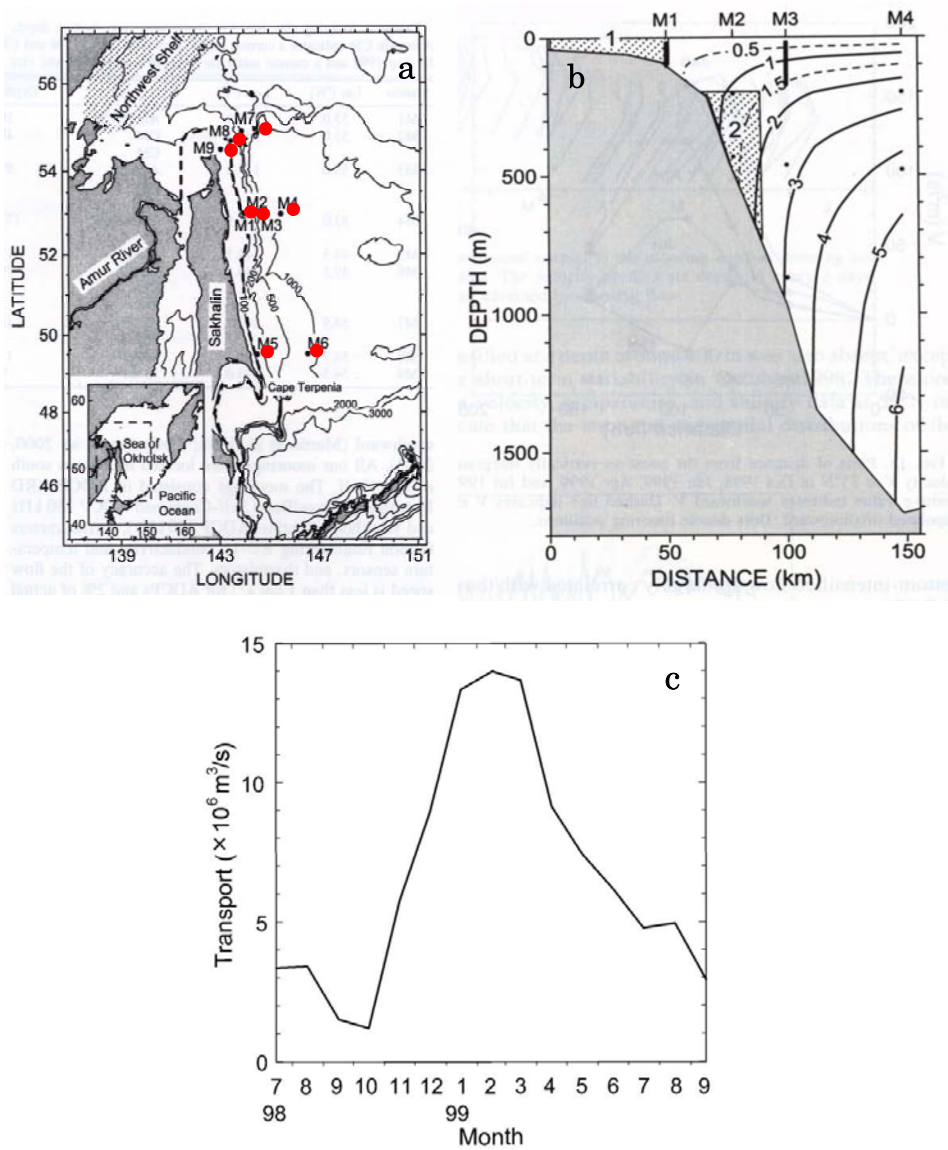

Figure 5 (a) A Map for the Locations of 9 Mooring Sites (Dots)

(b) Contours of the annual-mean transport (Sv), which is integrated from the surface at the coast to a given point, along a vertical cross section at 53°N

Contour interval is 0.5 or 1 Sv. Areas 1 and 2 are regions of the surface-trapped flow associated with ESCW, and the bottom-intensified flow associated with DSW, respectively. Dots represent positions at which velocity data were obtained.

(c) Time Series of the Monthly Mean Transport (Sv) for ESCW at 53°N

2.3 Mechanism for Cyclonic Gyre and ESC

The major feature of the Okhotsk circulation is a cyclonic gyre with a southward boundary current (ESC) along the east Sakhalin coast. In regard to the driving mechanism of the ESC and/or the cyclonic gyre, however, little theoretical consideration has been made so far, partly because the flow field itself had not been clarified quantitatively before Japan-Russia-US joint project. Recently, Simizu and Ohshima [2002] suggested that the nearshore core of the ESC can be interpreted as "arrested topographic waves", that is, a coastal current driven by the alongshore wind stress with the onshore Ekman transport being trapped [Csanady, 1978]. Thus this current is only prominent in strong northerly wind seasons (October-February). A density current driven by fresh water flux from the Amur River is also a component of the nearshore core [Mizuta et al., 2003]. On the other hand, in regard to the driving mechanism of the shelf-slope core, a main component of the ESC in terms of volume transport, and the associated cyclonic gyre, no specific theoretical consideration has been made so far.

Ohshima et al. [2004] have examined the wind-driven circulation and Sverdrup balance in the Sea of Okhotsk by using all available hydrographic data, profiling-float data, wind-stress data, and simple numerical experiments. The examination by them have shown that, in the Central Basin (the area excluding the northern shelves and the Kuril Basin), Sverdrup balance driven by positive wind-stress curl is roughly satisfied in the interior region and that the main part (shelf-slope core) of the ESC can be regarded as the western boundary current of the wind-driven cyclonic gyre. In the south, the anticyclonic circulation in the Kuril Basin cannot be explained by the wind-stress curl at all.

When sea ice is present, the wind stress on the ocean is modified both in magnitude and direction. At present, it is still difficult to assess how sea ice modifies the wind stress applied into the ocean especially for the Sea of Okhotsk, where no measurements of momentum exchange in ice-covered areas have been made. However, the area with relatively long ice-season is confined to the northern shelf region, and the Central Basin where the wind-driven circulation is proposed has a relatively short ice-season. For the Central Basin, eight months (May-December) are almost ice-free. Even for the ice-covered season, averaged ice concentration over the enclosed area is only 12% in January, 28% in February, 32% in March, and 14% in April, based on the SSM/I data during 1987-2001. Presumably, the inclusion of sea-ice does not change the scenario of the wind-driven circulation considerably.

The Sea of Okhotsk is located at the western margin of the North Pacific Ocean, connected through the Kuril Straits. The wind stress in the North Pacific would affect the Okhotsk circulation in the sense of island rule [Godfrey, 1990]. The Kuril Straits are also the sites where extraordinarily strong tidal currents and mixing occur, which is also a possible affecting factor on the circulation. The in- and outflow and the strong mixing in the Kuril Straits may be related to the anticyclonic circulation in the Kuril Basin, which cannot be explained by the wind-driven circulation inside the Okhotsk Sea. There is also a possibility that the in- and outflow through the Kuril Straits affects the circulation even in the central/northern region and modifies the scenario of the

Sverdrup balance and the cyclonic circulation presented by Ohshima et al. [2004].

3. Production of NPIW Source Water and Its Outflow to North Pacific

3.1 Production of Dense Shelf Water

The Sea of Okhotsk is a marginal sea in the subpolar gyre of the northwestern Pacific. It is separated from the open ocean by chain of Kuril Islands with several fairly deep straits between them. Net inflow of the water through the deepest northern strait, Kruzenshtern (1.9 km deep). and net outflow through the deepest Bussol' Strait (2.3 km deep), combined with positive windstress curl, sets the general cyclonic circulation in the basin. A combination of harsh wintertime conditions, wide shelves, and relatively high background salinities makes the Sea of Okhotsk the principal ventilation site for the intermediate density waters of the North Pacific [Talley,1991]. This overturn is driven by brine rejection, accompanying ice formation on the northern shelves of the sea [Kitani, 1973].

Figure 6(a) schematically shows prosesses of dense shelf water (DSW) production in the coastal polynya on the northwestern part of the Okhotsk Sea. Shcherbina et al. [2003] carried out direct observations of brine rejection using two bottom moorings during the winter of 1999-2000. Figures 6(b) and 6(c) shows the bottom mooring locations (triangles), and seasonal variations of bottom water properties, salinity (upper pannel) and potential temerature (lower pannel), respectively at the moorings. As shown in Figure 6(c), DSW formation is evident in the bottom salinity and potential temperature time series. A salinity increased associated with brine rejection started as the inshore (western) mooring on 20 January, soon after ice cover at the site was established. A near-linear salinity increase continued through 23 February, reaching a maximum salinity of 33.45 psu, for a total of 0.83 psu salinity increase in 35 days. This corresponds to a 0.68 kg m^{-3} potential density increase, reaching a maximum potential density of 26.92 kg m^{-3}. DSW

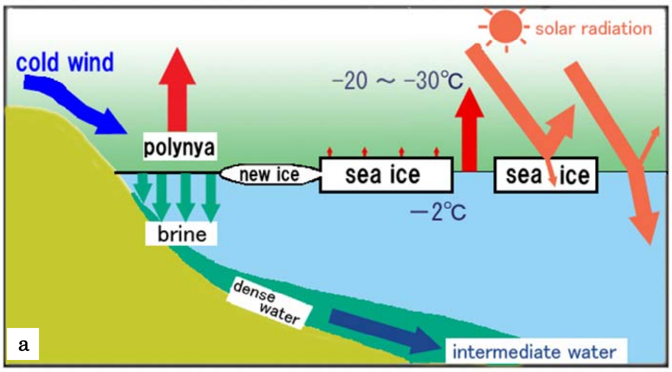

Figure 6 (a) Schematical Illustration Showing Prosesses of Dense Shelf Water (DSW) Production in the Coastal Polynya on the Northwestern Part of the Okhotsk Sea

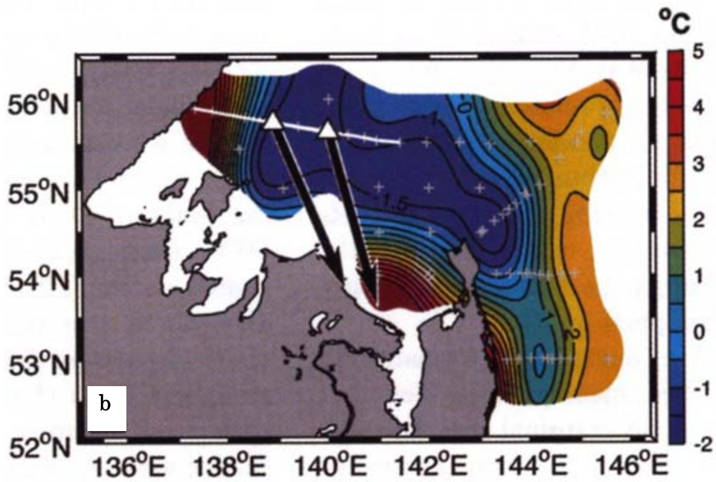

Figure 6 (b) Bottom Mooring Locations (Triangles)

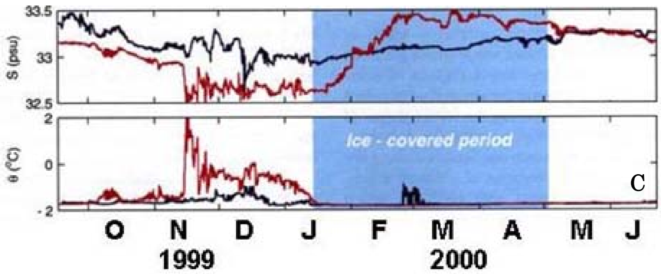

Figure 6 (c) Seasonal Variations of Bottom Water Properties, Salinity (Upper Pannel) and Potential Temerature (Lower Pannel) at the Moorings

formation in 1999-2000 was confined to the area shoreward of the deeper, offshore mooring. No significant salinity increase was observed at the offshore mooring, indicating no active brine rejection penetrating to the bottom.

Figure 6 (d) shows the vertical section of calculated Δ pCFC-12 along a line from northwest (northwestern continental shelf) to southwest (Bussol' Strait) across the Sea of Okhotsk [Yamamoto et al., 2004]. As shown in Figure 6(d), Δ pCFC-12 reached a maximum at the intermediate layer in the Sea of Okhotsk though CFC concentration had a maximum at the subsurface layer (dichothermal water) and gradually decreased with depth. This indicates that the higher CFC concentration in the dichothermal water of the Sea of Okhotsk compared to that of the Pacific was mainly due to the colder temperature during the air-sea gas exchange process. The Okhotsk Sea Intermediate Water (OSIW) had a higher pCFC than the intermediate water in the Pacific. This means that the OSIW is well ventilated. The tongue of high pCFC excess, spreading from the northwestern continental shelf, clearly shows the ventilation of OSIW by

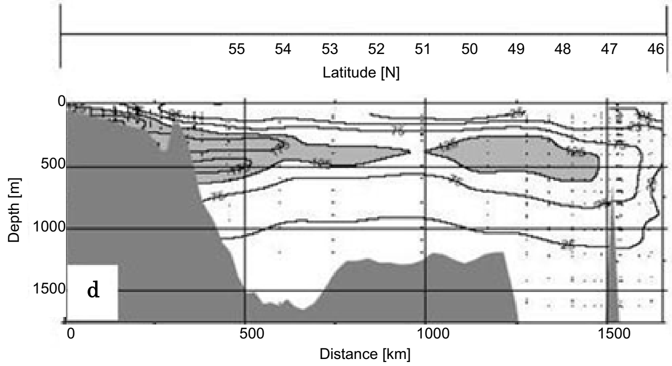

Figure 6 (d) The Vertical Section of Calculated Delta-pCFC-12 along a Line from Northwest (Northwestern Continental Shelf) to Southwest (Bussol' Strait) across the Sea of Okhotsk

DSW. Estimations of the average DSW transport by several investigators have been made indirectly (0.6 Sv, Wong et al., 1998; 0.2-0.4 Sv, Martin et al., 1998; 0.6 Sv, Gladyshev et al., 2003; 0.67 Sv, Itoh et al., 2003) and directly (0.02-0.75 Sv, Shcherbina et al., 2003; 0.21 Sv, Fukamachi et al., 2004).

3.2 Water Exchange through the Bussol' Strait

Katsumata et al. [2004] measured an outflow from the Sea of Okhotsk to the North Pacific at the Bussol' Strait, the largest strait connecting these basins from 31st August to 11th September 2001. They performed yo-yo casts of a lowered acoustic Doppler current profiler at 13 stations across the narrowest part of the strait. Time series covering more than approximately 24 hours were obtained for each station and the semidiurnal and diurnal tides were separated. The diurnal tide at the spring tide shows a remarkable peak of the amplitude of 1.1 m s^{-1} at the depth below 1000 m in the western channel of the strait, as shown in Figure 7(a). The upper part of the mean component flows toward the Pacific and the lower part in the opposite direction (see Figure 7(b)). The outflow is in excess of the inflow and net transport through the strait is 8.2 to 8.8 Sv (1 Sv=10^6 m^3s^{-1}). The outflow is strong in two density ranges, as shown in Figure 7(c). The upper layer peak around 26.8 σ_θ corresponds to the density of North Pacific Intermediate Water and the temperature-salinity characteristics of this outflow were actually observed in this density range across downstream the Oyashio off the southeastern coast of Hokkaido. Net heat and salt exchanges between the Sea of Okhotsk and the North Pacific are estimated; net heat flux of -34 TW and net salt flux of -1.9×10^6 kg $s^{-1}$are exchanged from the Sea of Okhotsk to the North Pacific (see Figure 7(d)).

4. Material Cycle

Sinking particles collected at two depths at two sites off Sakhalin Island in the

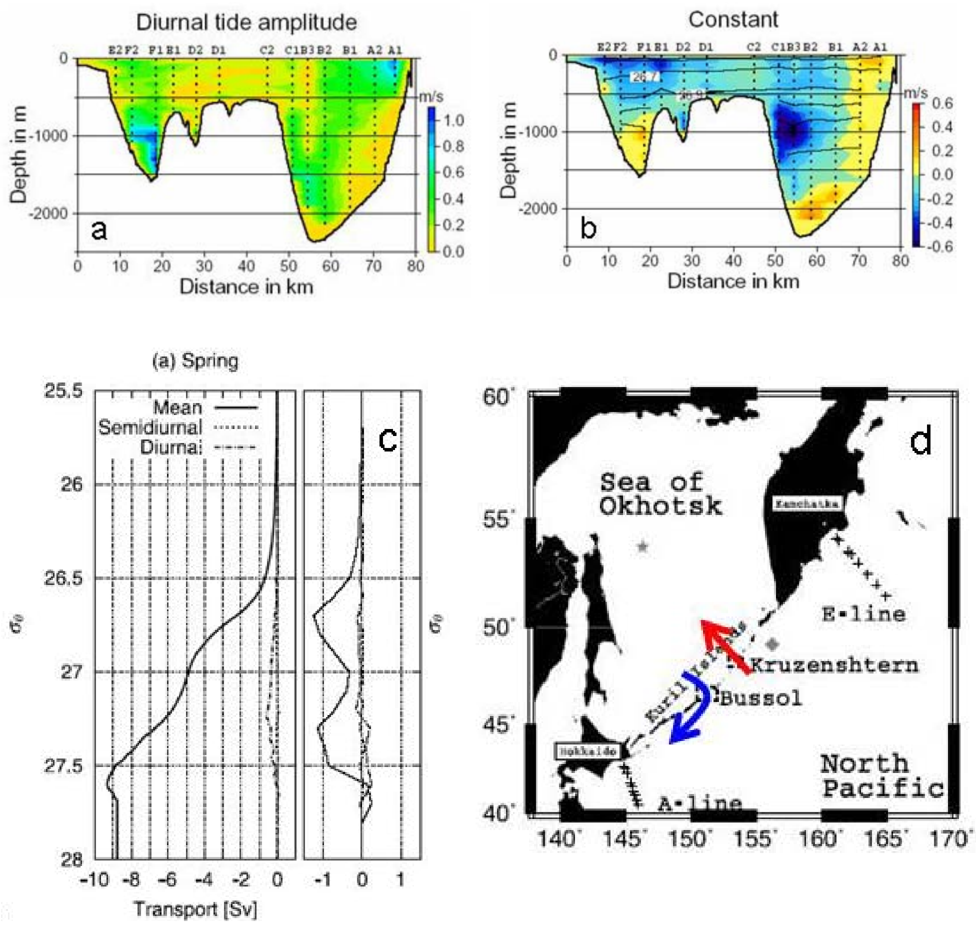

Figure 7 Vertical Sections of

(a) Diurnal-tide Magnitude and

(b) Mean Component across the Bussol Strait

The positive sign indicates the flow toward the Okhotsk, into the paper. Isopycnals are shown by contours with the interval 0.2 kg m^{-3}.

(c) Transport as a Function of Density for the Spring Tide

Thin line shows the transport in 0.1 σ_θ range. Thick line shows transport integrated from the surface to the bottom. Solid, dotted, and dash-dotted lines indicate mean component, tidal transports by the semidiurnal, and the diurnal tides, respectively. Positive is toward the Okhotsk.

(d) Water Exchange through Two Straits between the Sea of Okhotsk and North Pacific

Locations of observational lines (A- and E-lines) used for data analyses of heat and salt transfer between the two basins.

western region of the Sea of Okhotsk were analyzed to determine their major chemical components (lithogenic material, biogenic opal, calcium carbonate (CaCO3), and total organic carbon (TOC)). The lithogenic and opal fluxes increased downward, indicating the lateral input of resuspended sedimentary particles into the lower traps, while the CaCO3 or TOC fluxes did not change greatly between the upper and lower traps [Nakatsuka et al., 2004a]. Figure 8 shows temporal variation of lithogenic

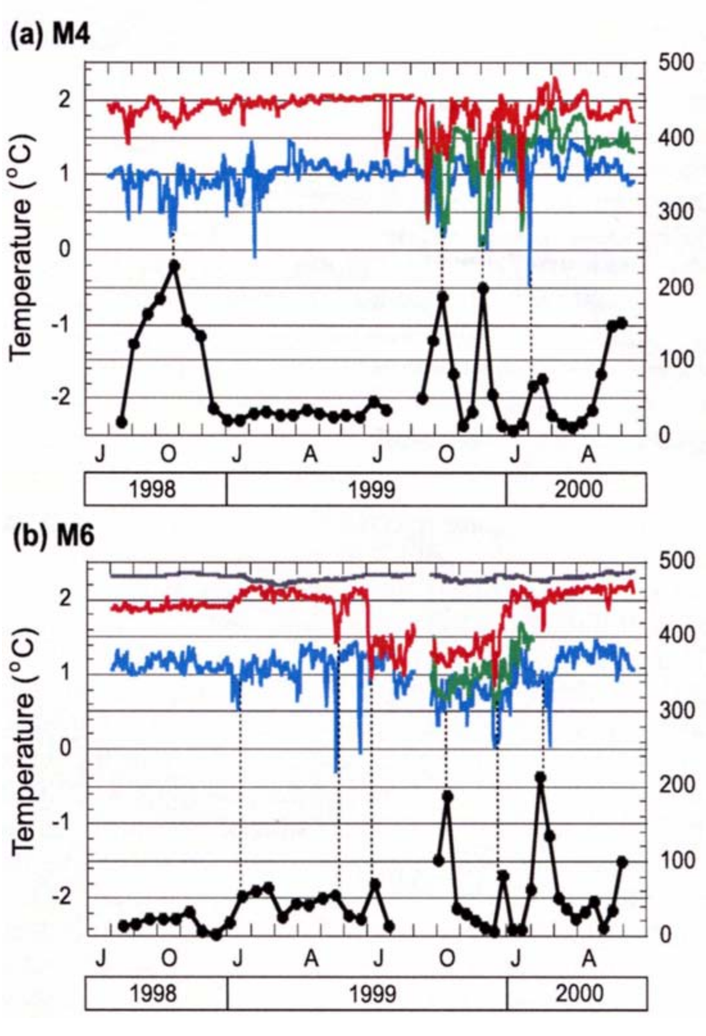

Figure 8 Temporal Variations in Lithogenic Particle Flux (Solid Circles) at the Lower Traps of (a) M4 and (b) M6 Sites, and Daily Average Temperatures at Upper (280 m), Middle (370 m), and Lower (480 m) Positions of the Intermediate Layer and at the Bottom Layer (750 m), Respectively of the Mooring Sites

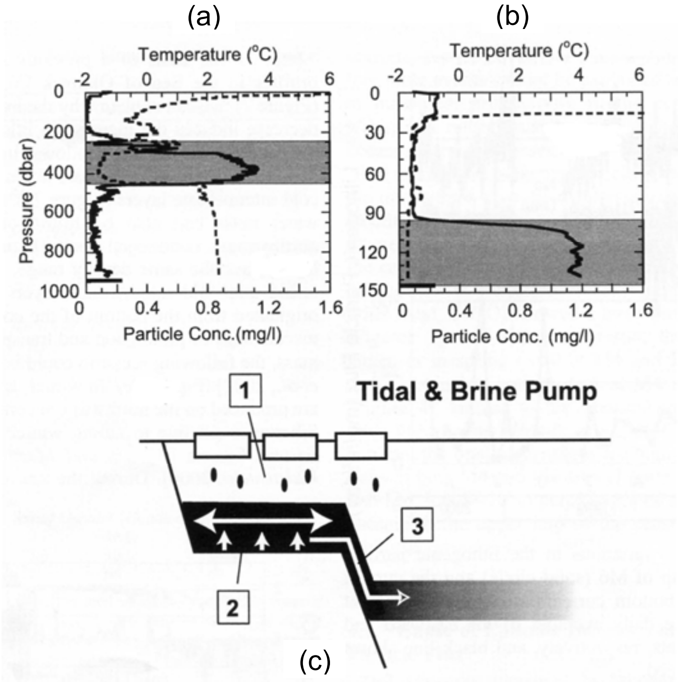

Figure 9 Vertical Profiles of the Turbidity (Solid Line) and the Temperature (Dashed Line) at Two Sites, (a) 78 (Northeast off a Northern Tip of Sakhalin) and (b) 61 (Northwestern Continental Shelf). (c) A Schematic Diagram Explaining Causes of the Extremely Turbid and Cold Intermediate Water Masses in the Sea of Okhotsk: 1, deposition of cold and dense brine waters on the shelf bottom due to the sea ice formation; 2, resuspension of sedimentary particles into a benthic boundary layer due to a tidal mixing; and 3, outflow of the cold and turbid water masses into the oceanic intermediate layer.

material flux at the lower trap and the time series data for water temperature measured at several different depths at the mooring site. The lithogenic particle flux in the lower traps showed intermittent increase events frequently during periods when cold water masses penetrated into the intermediate layer at the mooring sites. This coincidence between the flux increase and the cooling of the intermediate layer clearly indicates that the cold and turbid Dense Shelf Water (DSW) is discharged from the bottom of the northwestern continental shelf to the pelagic intermediate layer, supplying large amounts of particulate matter onto the bottom of the slope and deep basin (see Figure 9).

After removing the effect of the lateral input, the time series of the opal export from the surface water at the mooring sites were reconstructed using the upper trap data. There were two predominant characteristics in the seasonal variations of the opal export, which is nearly equal to the diatom production, in the area off Sakhalin. One is the relatively large opal flux in autumn, and the other is the southward propagation of

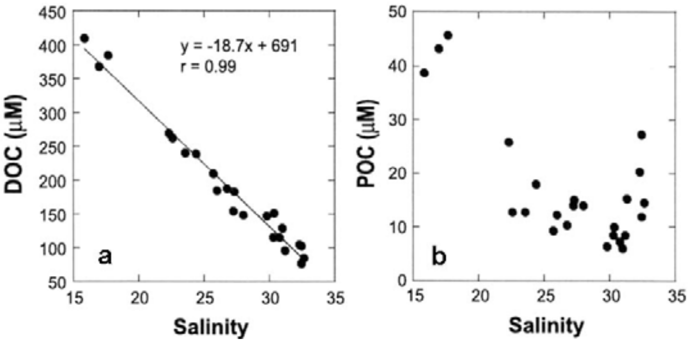

Figure 10 Relationship between Salinity and (a) DOC (Dissolved Organic Carbon) and (b) POC (Particulate Organic Carbon) in the Surface Layer (0-5 m) over the Northwestern Continental Shelf in the Sea of Okhotsk

Solid line in Figure 10a indicates the linear regression of all the data.

the spring diatom bloom, although the sea ice retreats northward every spring. Both of these characteristics suggest that the river water discharged from the Amur, together with the seasonal sea ice cover, regulates primary production in this area. Figure 10 shows the relationship between salinity and DOC (dissolved organic carbon) and POC (particulate organic carbon) in the surface layer (0-5 m) over the northwestern continental shelf of the Sea of Okhotsk, including a region near the Amur River mouth [Nakatsuka et al., 2004b]. From the very good linear correlation between salinity and DOC, it is suggested that large amounts of DOC are supplied to the shelf region from the Amur River. In contrast to the DOC, the POC has a relatively weak correlation with salinity in the surface layer. From there results, it is concluded that the Amur River discharge should increase the productivity of phytoplankton such as diatom in the Sea of Okhotsk since the Amur River water contains large amounts of nutrients, especially silicate.

5. Paleoceanography

Marine- and terrestrial-derived biomarkers (alkenones and long-chain n-alkanes etc), as well as carbonate, biogenic opal, and ice-rafted debris (IRD), were measured in two sediment cores [Seki et al., 2004]. Changes in the dominant phytoplankton species and surface hydrography as estimated from alkenone and biogenic opal records over the last 30 kyr are summarized in Figure 11. Between 30 and 15 ka the Sea of Okhotsk was covered with sea ice (Figure 11(a)). Phytoplankton productivity in the sea was low owing to light limitation and/or lowered nutrient supply, with coccolithophorid productivity being drastically depressed. During MWP (Meltwater Pulse) events 1A (14.55 ka) and 1B (10.55 ka), coccolithophorid blooms occurred in the southern sea, responding to a retreat of sea ice and increased meltwater discharge (Figure 11(b)). In contrast, diatom conductivity was low owing to a deficiency in silicate supply during the deglacial period. The input of terrestrial organic matter was enchanced as a result of rising sea level. In the early and mid-Holocene, coccolithophorid blooms spread out toward the western part of the sea, following a retreat of sea ice in this region (Figure 11(c)). Replenishment of the surface with fresh water from the Amur River resulted in stratification in the surface mixed layer and suppressed the supply of silicate from subsurface waters. In the late Holocene, diatoms became the dominant species as a result of an increased supply of silicate from the subsurface to euphotic zone that was probably caused by enhanced vertical mixing between the surface and subsurface waters in winter (Figure 11(d)) and/or by an increased supply of silicate to the subsurface water from the North Pacific. With increased nutrientsupply, coccolithophorids could not compete with diatoms and the biomass of coccolithophorids was reduced.

The mass accumulation rates of alkenones and biogenic opal also show the drastic change in phytoplankton composition from coccolithophorids in the deglacial to diatoms in the late Holocene with lower overall productivity during the glacial period.

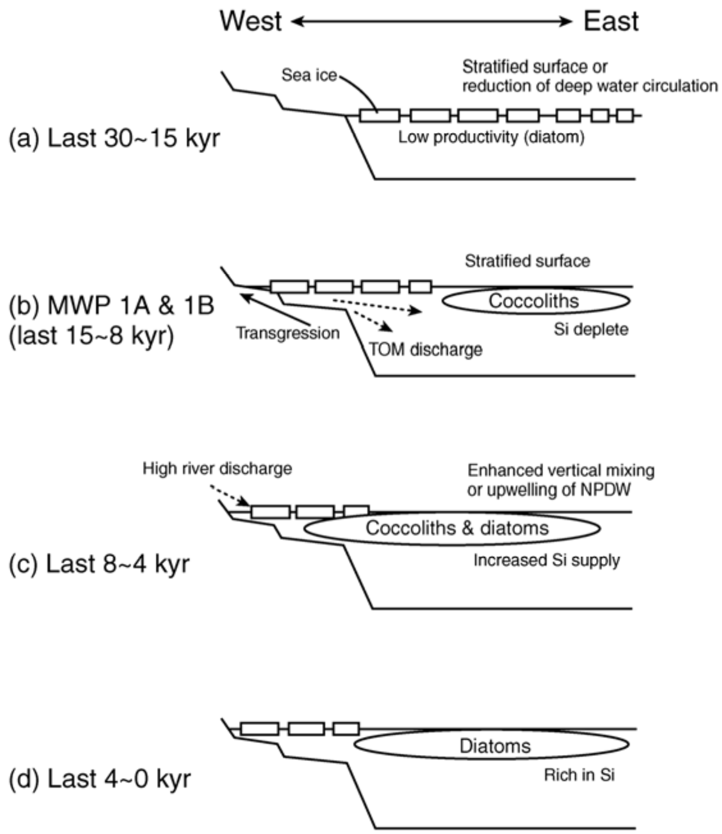

Figure 11 Reconstructed Changes in the Productivity and Hydrography of the Sea of Okhotsk from the Last Glacial Period to the Present

This phytoplankton succession should be responsive to the change of silicate supply to the surface layer. Comparisons among the three sediment cores indicate that enhanced coccolithophorid productivity in the deglacial began in the eastern region of the Sea of Okhotsk and subsequently extended to the western region. This spatial and temporal distribution of productivity is consistent with the sea ice history reconstructed by RID, suggesting that the presence of sea ice is the key factor that controls biological productivity in the sea over a glatial-interglacial cycle. In light of potential biological effects on CO_2 exchange between the ocean and atmosphere, the Sea of Okhotsk may have acted as a source of atmospheric CO_2 during MWP events 1A and 1B, in contrast to the modern Okhotsk Sea which acts as a sink for atmospheric CO_2.

6. Amur-Okhotsk Project

Base on the good results of Japan-Russia-US joint Okhotsk Sea project in 1997-2002, we started to promote a new project so-called "Amur-Okhotsk Project" (formal tytle; Human Activities in Northeastern Asia and Their Impact to the Biological Productivity in North Pacific Ocean) from April 2005, having a collaboration with Russia and China. Figure 12 schematically shows an essence of the Amur-Okhotsk Project. This project is assessing the role of Amur River on biomass production and the prediction of human impacts in the Amur River basin on the marine

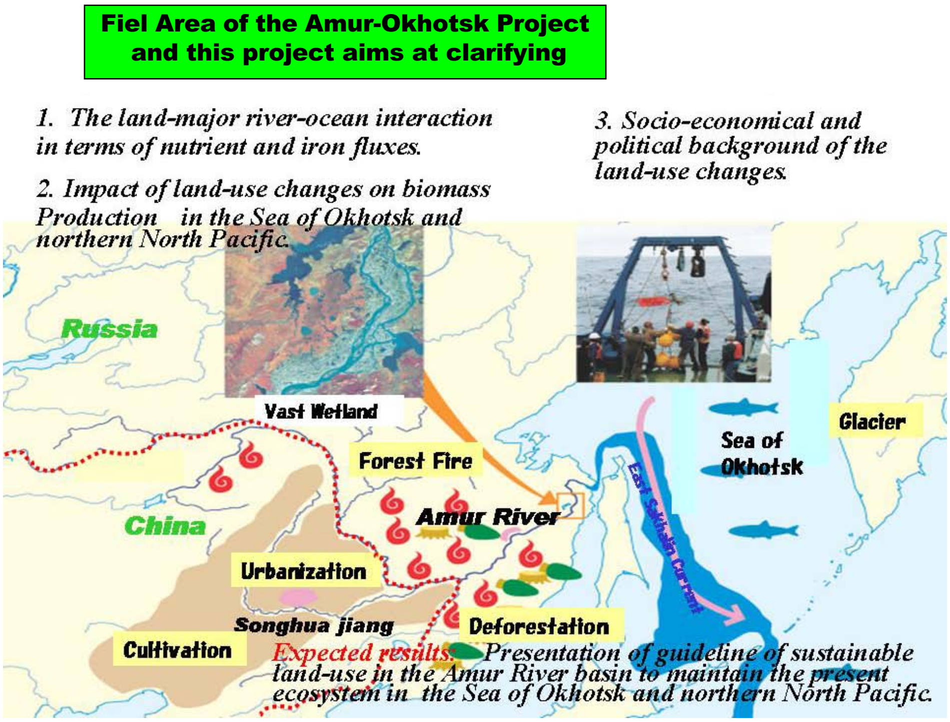

Figure 12 An Illustration Showing an Essence of Amur-Okhotsk Project

ecology in the Sea of Okhotsk and the northern North Pacific. Primary goal of the project is to elucidate the mechanism how the dissolved iron are to be formed and transported to the ocean both by the Amur River and through the atmosphere, and how the flux change of dissolved iron will affect the phytoplankton production in the Sea of Okhotsk and northern North Pacific. The second purpose is to clarify the anthropogenic impacts on flux changes of dissolved iron to the ocean. Finally, this project will present a guideline of sustainable land-use in the Amur River basin to maintain the present ecosystem in the Sea of Okhotsk and the northern North Pacific. More specially, the project will propose so-called "sustainable threshold" on the flux of dissolved iron, which can maintain the biomass production in the Sea of Okhotsk and the northern North Pacific. This will give us an ideal management of the land-use in the Amur-River basin.

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Environmental Impact Assessment Using JANSROP-GIS Data: Possibilities and Prospects

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Since the 1987 Report of the World Commission on the Environment and Development ("Our Common Future" and usually referred to as the "Brundtland Report") defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (UN World Commission on Environment and Development, 1987), the problems of how to maintain quality of life, how to continue access to natural resources and how to avoid lasting environmental damage, have attracted increasing research interest from various fields all over the world. As an approach to the solution of these kinds of problems, Environmental Impact Assessment (EIA) evaluates the impact of planned activities on the environment in advance, thereby enabling better management of current development activities in harmony with the environment and allowing avoidance measures to be taken. Therefore, compared with many other mechanisms for environmental protection, the emphasis of EIA is on prevention. In this paper, the principles and procedures of EIA will be firstly reviewed; several practices will be introduced to illustrate the EIA process; a methodology of executing EIA based on the Geographical Information System (GIS) will then be presented; and finally the possibilities and prospects of EIA using JANSROP-GIS data will be discussed.

1. EIA: Principles and Procedures

EIA was formally established by the US National Environmental Policy Act (NEPA) in the United States in 1969. From then on, it has spread worldwide and become an important tool in project planning. Although there are many definitions of EIA, it is essentially a systematic process that investigates, predicts and evaluates the influences of a development on the environment. During the several decades' history of EIA development, various guidelines for its process and procedures have been documented (e.g. J. Glasson et al., 1994; World Bank, 1999). In general, the process involves several stages including a number of steps (Figure 1), although a certain practice could omit some of them depending on local legislation. It should be noted that the process is not linear, but a cyclical activity with feedback and interaction between the various steps.

The keyword of the initial stage of the EIA process is "investigation." First, *project screening* examines the planned project according to relative legislation and

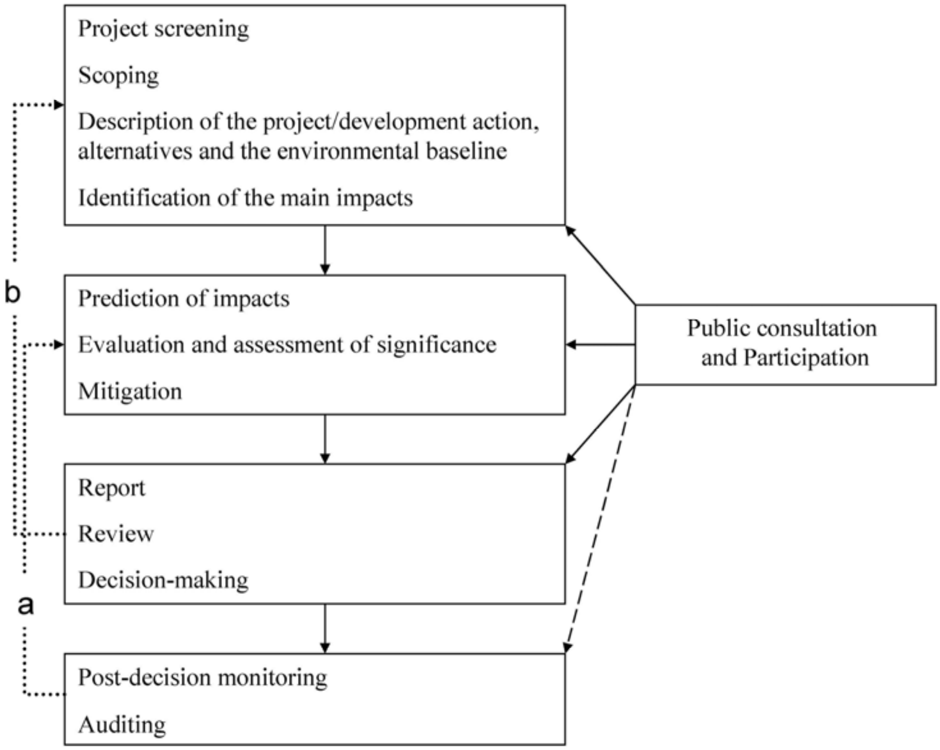

Figure 1 Main steps in the current and reliable EIA process (Modified from J. Glasson et al., 1994). The solid lines show the current action flow; the dotted lines indicate the reliable procedures that are not exactly for impact assessment, but for project assessment (a) and plan assessment (b); and the broken line suggests future issues that can take account of the public will in further development actions/plans.

determines if EIA is needed. After the necessity of EIA is confirmed, *scoping* will investigate the planned project carefully and list all of the possible environmental impacts and alternatives, which include project locations, scales, processes, layouts, operating conditions and the "no action" option. Following this measure, *the description of the project/development action, alternatives and the environmental baseline* is compiled based on data collection and surveys. The final step in the initial stage is *the identification of the main impacts*, where through the integration of previous actions, all significant environmental impacts are identified and taken into account in the EIA process.

The second stage of the EIA process concentrates on analysis. *The prediction of impacts* attempts to identify the environmental changes caused by a project or an action, in comparison with the current situation. During this step, care should be taken to select the methods utilized to ensure the precision of the impact estimations. *The* *evaluation and assessment of significance* assesses the relative significance of predicted impacts and determines the relative weighting of each. *Mitigation* then introduces possible measures to avoid, reduce and offset any adverse impacts.

The third stage of the EIA process focuses on presentation. *The environmental impact report (EIR),* also called the *environmental impact statement (EIS)*, is the main outcome of the EIA process and documents the entire procedure and the results including a non-technical summary. This is a vital step of the EIA process, because a bad presentation may cause a great deal of good work to be negated. After *the review*, which is a systematic appraisal of the quality of the EIR, the relevant authority will carry out *decision-making* on the project, combining the environmental effects together with other considerations.

The final stage of the EIA process is performed after the execution of the project. *Post-decision monitoring* is necessary to examine the actual outcomes associated with the project actions and based on the monitoring, *auditing* compares the reality with the predicted outcomes to assess the quality of the predictions and the effectiveness of mitigation, thereby providing experience for future EIA.

Besides the steps mentioned above, *public consultation and participation* aims to obtain public understanding of EIA, and to ensure that the public's views are adequately taken into consideration. It is not limited to any one stage, but repeated over the course of the entire process before a decision is made.

EIA is a process with several important purposes. Firstly, it is an aid to decision-making. It provides a systematic examination of the environmental implications of a proposed action and some alternatives before a decision is made. It helps to clarify some of the trade-offs, and can thereby be considered by the decision-maker along with other documents related to the planned activity. It has the potential to be a basis for negotiation between the developer, public interest groups and the planning regulator. Secondly, EIA can be of great benefit to the formulation of development actions, since it can provide a framework for considering location and design and environmental issues in parallel. It helps developers to improve relations with planning authorities and local communities, and leads to a smoother planning permission process. Finally, the central and ultimate purpose of EIA is to be an instrument for sustainable development. It is not a negative barrier for project developers, but a positive process that seeks a harmonious relationship between development and the environment.

Up until the 1980s, EIA was mainly carried out at an individual project level. With the awareness of protecting the sustainability of the environment itself instead of simply avoiding environmental destruction however, EIA expands to the policy, planning and program levels. This type of EIA, otherwise known as a strategic environmental assessment (SEA), has been formalized in some countries, mainly in Europe and North America, and is spreading worldwide.

2. EIA Practices: Lessons Learned

There are several features in previous EIA practices: 1) They vary case by case, from country to country. Neither standard international processes nor standard international criteria exist; 2) EIA is not an independent scientific process, because political will and public interest have to be taken into account. This is mainly reflected in the establishment of alternatives and the determination of impact significance; 3) EIA is normally wide in scope, but less quantitative than other techniques, such as simple cost-benefit analysis since integration between different categories of impacts, such as environmental destruction versus economic income, is very difficult; 4) EIA practices were mainly conducted at an individual project level as mentioned before; and 5) EIA practices concentrated on land areas and few applications for ocean areas were reported. This is partially because the ocean is not immediately related to daily life as with land or air. Another reason is the deficiency of methodology and assessment criteria to perform EIA on ocean areas.

Considering that the region of interest to this project is the Sea of Okhotsk, and the target is to benefit policy-making and planning, we hereby present two examples selected from the few previous practices of this type.

2.1 Second National Plan on Mineral Resources of The Netherlands

This case study concerns the national mineral resources plan of The Netherlands (the Netherlands EIA Commission, 2001). The plan is to determine zones and amounts for the extraction of gravel, course sand, find sand and shells both on land and in ocean areas.

2.1.1 Background

Mineral resources such as sand, gravel and clay are essential for the multitude of construction projects that take place in The Netherlands. The extraction of these resources, however, leads to many spatial and environmental problems in densely populated regions. Problems include loss of valuable nature areas, landscapes and historical elements. Also, the amount of available minerals is limited. On the other hand, positive impacts may be gained by giving new functions, such as a nature or recreation area, to depleted extraction locations. Toward this end, extraction sites should be situated in locations suitable for nature or recreation purposes.

For this plan, and as an experiment, it was decided to carry out a voluntary EIA in an early stage, i.e. before the formulation of the draft plan. The results of the EIA were integrated into the draft plan itself. Informal public participation took place during the preparation of the draft plan while formal public participation took place after its publication in July 2001.

2.1.2 Information and Alternatives

The assessment was carried out on the basis of existing information. For information that was lacking, a research program was developed to make sure that sufficient information would be available for a new plan in the future.

The EIA Commission advised to specifically compare the environmental performance of the following alternatives:

1) Use of scarce resources
2) Use of gravel
   Extraction in The Netherlands
   Imports from Germany
   Imports from the UK
   Imports from Scotland
   Re-use of construction and demolition waste
   Artificial gravel from dredge spoil
3) Use of sand
   Land locations: shallow and deep extraction
   Lakes: shallow and deep extraction
   North Sea: shallow and deep extraction

2.1.3 Impact Analysis and Comparisons

To analyze the alternatives for scarce mineral resources, a search was made for all minerals to find out which alternatives existed for the use of gravel, sand and shells. For example, reference was made to an already existing study about sustainable alternatives for non-renewable mineral resources. In this study, the use of sustainably produced wood for construction purposes is specifically mentioned as a viable option. For mineral resources, estimates were also made as to how much material would become available in the future that could be an alternative to mineral extraction, such as through the re-use of waste material.

For the use of gravel, six alternatives were analyzed by using a simplified form of Life Cycle Analysis. They were compared according to four themes: use of energy, use of space, emissions and hindrances.

The use of energy was assessed quantitatively. However, a complication was that in existing literature, substantially differing amounts of energy needed are mentioned for the extraction of a ton of gravel. This meant that the end results had a high degree of uncertainty.

The use of space was also assessed quantitatively in square meterage. It was acknowledged, however, that this in fact is an inappropriate indicator for assessment since extraction does not only have an effect on the amount of surface that is lost, but may also affect the quality of the surrounding area. It was also concluded that too little information nor an appropriate methodology exists to assess these effects by Life Cycle Analysis.

Emissions were considered to be caused mainly by the leaching of toxics from re-used construction material. This effect was assessed qualitatively, because of insufficient knowledge of how many toxins are emitted from these materials. In the qualitative assessment, the final score of each material was calculated by the equation $Z \times (A+B+C)$, where Z is the pollution of the material (from 0 (not polluted) to 4 (heavily polluted)); A indicates the degradation of organic pollution (from 0 (total degradation) to 4 (no degradation)); B indicates reduced leaching due to physical isolation or chemical immobilization (from 0 (reduction as in natural materials) to 4 (no reduction)); and C is the chance of increased leaching due to human influence (from 0 (no chance) to 4 (significant chance)).

Hindrances were estimated mainly by the area (in square meterage) influenced by noise and dust. A population density (20 for Norway and Scotland, 0 for the North Sea and 400 for The Netherlands and Germany) was then multiplied to the dataset.

The impacts of the choice of location and depth for sand extraction were assessed qualitatively according to the following aspects:

1) Non-biotic aspects
   Geology
   Geomorphology: coastline and sea
   Quality of the sea bottom
   Ground water
   Surface water
2) Biotic aspects
   Flora: phytoplankton, algae, sea weed, water plants
   Fauna: bottom fauna, fish, birds, mammals
   Ecosystem
3) Visual and historical aspects
   Landscape
   Culture and history
   Archaeology
4) Environmental aspects
   Noise
   Air emissions
   Use of energy and water
   Use of space

The assessment was carried out on the basis of expert judgment that in turn was based on a large number of previous studies. For each indicator, the impact was discussed on order, spatial and time scales, and was assigned a numerical value accordingly. The classifications were:

Order: 1 point for limited impact, 2 points for a significant effect
Spatial scale: 1 point for local impact, 2 points for a wider effect
Time scale of ecosystem recovery: 0.5 point for a quick recovery, 1 point for a delayed recovery, 2 for irreversible damage

The assessment resulted in a matrix giving scores for each of the alternatives per aspect. These scores were then multiplied using four sets of weighted factors, each set reflecting a different preference: no preference, human preference, nature preference and conservation preference. After multiplication, scores were then added to achieve a final score per alternative, at which time all alternatives could be ranked.

2.1.4 Public Participation

Public participation took place as part of the mandatory planning process, but only in a later stage of the process. In an earlier stage, NGOs and regional authorities were consulted for their opinions on the content of the new plan. Five discussion meetings were organized with groups of approximately 15 people from government, industry, environmental NGOs and universities. During the same stage everybody was able to submit written opinions.

2.1.5 Contribution to Decision-making

The EIA report was fully integrated into the draft plan for further discussion and all of the alternatives were evaluated in the report. However a caveat was inserted that the results contain a high level of uncertainty. More definite conclusions may only be drawn when the exact extraction locations are known, which means EIA at a project level.

2.1.6 Monitoring and Follow up

In the draft plan, it is concluded that extensive development of new knowledge is necessary to support the implementation of the final plan. In the plan, an overview of necessary research projects and state-of-the-art research is given. Five types of necessary knowledge development were identified and under each of them a large number of specific studies and monitoring plans were mentioned. Those are:

Research to support general policy development of mineral resources
Research aimed at the efficient use of mineral resources
Research on primary resources
Research on secondary resources
Research on renewable resources

2.1.7 Conclusions

It proved to be ineffective to perform EIA on all decisions made in this plan. An important role of EIA was to determine the decisions for which it would have the most added value. Three criteria were used for this: 1) choices that limit or steer follow up decisions on plans at a lower level or on projects; 2) decisions for which alternatives exist that from an environmental viewpoint are potentially better; and 3) decisions for which environmental effects can in some way be estimated, qualitatively or quantitatively.

An important and additional beneficial effect of this EIA was that it generated a great deal of information that will be very useful in EIA for follow up plans or at the project level. In this sense, the JANSROP-GIS data might be used for such purposes as the database contained wide spatial and field coverage in spite of sparse resolution.

2.2 Biogeographic Assessment off North/Central California, USA

This case study comes from the National Centers for Coastal Ocean Science (NCCOS) of NOAA (NCCOS, 2003). It is not a complete EIA process, but an early stage of an environmental management system (Figure 2).

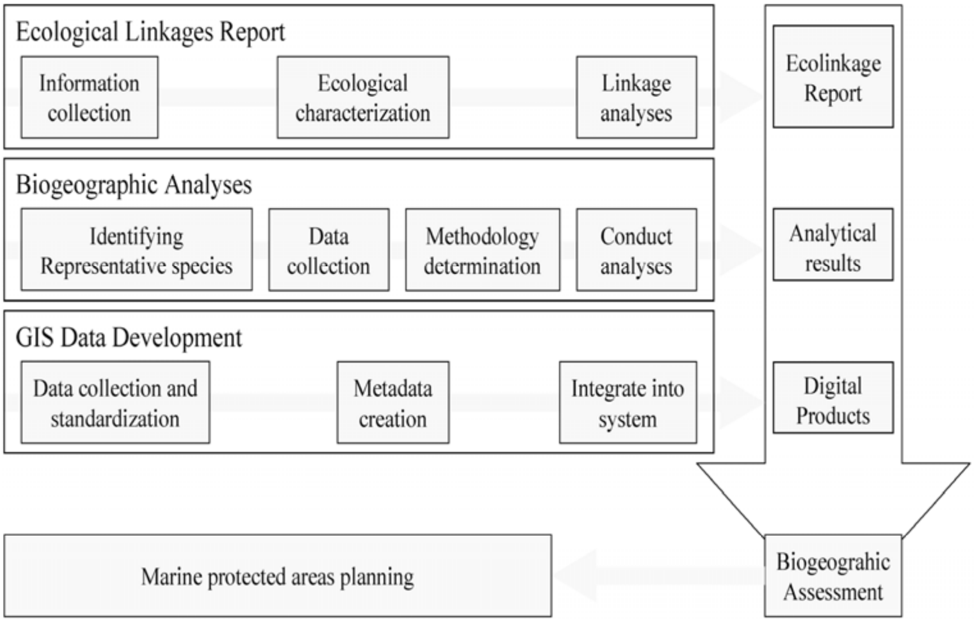

Figure 2 Project Position and Process of the Case Study (Modified from NCCOS, 2003)

2.2.1 Background

For the purpose of updating a sanctuary management plan, the biogeographic assessments were carried out within and adjacent to the boundaries of three west coast National Marine Sanctuaries (Figures 3). Since their establishment, many of the sanctuaries have witnessed increased pressure on marine resources from natural and anthropogenic phenomena, including climatic variation and the degradation of habitats. In order to increase management capabilities, it is imperative that the spatial and temporal distributions of biota and habitats within sanctuaries be delineated. Biogeography provides a framework to integrate species distribution and life history data with information on the habitats of the region to characterize marine resources in a sanctuary. When biogeographic data is integrated into a Geographic Information System (GIS), it enables users to visualize species' spatial and temporal distributions and to conduct ecological forecasts to assess potential changes in those distributions that may result from a variety of natural and anthropogenic perturbations. In addition, based on specific ecological metrics (e.g., diversity), biologically significant areas can be delineated.

Figure 3 Map of the Study Area (NCCOS, 2003)

2.2.2 Methodologies

Ideally, biogeographic assessments utilize significant amounts of data that have been collected over the entire spatial extent of the study area over a long period of time. However, such wealth of data is rarely available. In many instances, little information exists to accurately characterize the study area or associated living marine resources. This paucity of comprehensive data can limit the efficacy of biogeographic assessments, but additional analytical methods can be employed to complement the assessment. In addition to analysis of databases, two additional tasks were used to conduct the assessment. Firstly, a synthesis of existing information was compiled to incorporate qualitative information about species, habitats and ecological characterization of marine ecosystems and linkages within the study area. Secondly, species habitat suitability modeling efforts were conducted for fishes to define potential species' distributions based on known habitat affinities and physiological limitations.

2.2.3 Analyses

There are many different ways to analyze and organize biogeographic information, however to efficiently support the management plan process, only a limited number of analytical options were invoked. These analyses were selected based on reviewers' comments on the Interim Product, feedback from technical review meetings and peer review workshops. Thus, a very difficult step in the project was to select and rely on the most appropriate data and analyses to characterize the various components of the marine ecosystem that existed in the study area. The inclusion of the GIS-based products will enable NOAA staff, advisory councils and research partners to query data and information relevant to questions and issues that are not specifically addressed here.

The first analyses focused on a suite of assemblage analyses to assess the biogeography of fishes and a few macro invertebrates. Primary data included fisheries-independent data such as that collected by researchers from the National Marine Fisheries Service (NMFS), and fisheries-dependent data such as that collected by the California Department of Fish and Game (CDF&G) for recreational fisheries. These data sets, although not spatially or temporally comprehensive, are the most robust data sets that exist for the entire region and provide considerable information on the distribution of several hundred fish and invertebrate species.

The second analyses delineated rectangular no-take areas that cover 20-50 km of the coast and extend west to the edge of the continental shelf. From a biogeographic viewpoint, the results of the spatial analyses coincided with that recommendation and also identified that deep-slope communities significantly contribute to groundfish biogeographic patterns. Because assemblages follow bathymetry for the scale of this analysis, setting aside an area from the coast through to the continental slope could protect all demersal species assemblages identified in this study.

Map overlays of all species' Habitat Suitability Index (HSI) models resulted in the delineation of a broad range of important areas that cover the majority of the continental shelf within and adjacent to the three sanctuary boundaries.

Many possible combinations of the data layers could be integrated for the biogeographic assessment. Because of differences in sampling design, it was not appropriate to combine data from different taxa (e.g. birds and fish) in order to calculate community metrics. Therefore, to minimize confounding results and to focus on the "protection of biodiversity" component of the National Marine Sanctuary Program (NMSP) mission, diversity and density were calculated separately for each taxon and the resulting patterns were overlaid to identify biologically important areas across species groups. Spatial interpolation methods were applied to survey data to provide a clearer picture of the distribution of diversity and density within the study area. Hot spots were defined as regions in which diversity or density was estimated to be in the top 20% for a particular taxon. These hot spots were individually mapped for fish and birds and then combined to show areas of overlap. These areas of significant biological importance contributed to defining and assessing biogeographic patterns within the study area and are discussed in the context of known oceanographic features and sanctuary boundaries.

2.2.4 Data Sources and Gaps

Recognizing that any analysis is only as good as the data upon which it is based, the project team undertook a qualitative evaluation of the data used in this project and identified relevant data gaps. This information was used to aid in the interpretation of the biogeographic analyses to minimize the confounding of results due to information gaps. Also provided are recommendations for future research activities that would enhance biogeographic assessment products.

2.2.5 Conclusion

This spatially explicit assessment provides a robust set of analytical results and GIS data to strengthen the sustainable management of marine resources within and adjacent to the sanctuaries. A primary use of the biogeographic assessment will be to support the NMSP as it continues to conduct the joint management plan review for the three sanctuaries. In addition, the Biogeography Program will assist the NMSP in further analyses and presentations of the data and analytical results to address specific research and management questions. This study provides the foundation to continue the development of a biogeographic assessment capability to support the Cordell Bank, Gulf of the Farallones and Monterey Bay National Marine Sanctuaries.

2.3 Lessons Learned

As indicated by the International Association for Impact Assessment Board of Directors, a good quality EIA process is integrated, sustainability-led, focused, accountable, participative and iterative (IAIA, 2002). It should begin as early as practicable in the process of policy or plan formulation, keeping in mind that the purpose is to inform decisions, not to produce a study; to provide the right information at the right time for decision-making; to focus on the comparison of major alternatives; to carry out an appropriate form of analysis-impact assessment or policy appraisal; to use the simplest procedures and methods consistent with the task; to look to gain environmental benefits as well as avoid adverse impacts; and to review and document the outcome of the process (Sadler, 2001).

From the case studies, several lessons can be learned:

1) A sufficient database is the basis of EIA
2) A correct analysis method can improve the credibility of EIA results
3) Significant amounts of data need a powerful processing tool such as GIS

3. EIA Using JANSROP-GIS: Methodology and Attempts

JANSROP-GIS provides a valuable database for Eastern Russia and its related sea areas, including the entire Sea of Okhotsk for the first time, and makes it possible to perform preliminary EIA that will be helpful for designing a regional sustainable development plan with a harmonious relationship with the environment.

3.1 Methodology

In order to carry out the EIA process more sufficiently, an integrated GIS system was developed. The proposed system employed and integrated some of the internal functions of GIS to analyze and visualize base data. Besides the accurate baseline data, the key issues of the EIA process are impact estimation and assessment method selection. Thus, the proposed system introduced several new external functions to perform these EIA procedures.

Firstly, numerical and statistical models were introduced to estimate the physical and biological changes caused by proposed actions, respectively. For physical changes, a numerical ice-ocean coupled model was included and a population variability analysis (PVA) model (M. S. Boyce, 1992) was employed to predict biological changes. These models were linked to GIS as external programs. Users could start the computations on the GIS interface and the results would appear on the same interface automatically.

As mentioned before, there is almost no established assessment method for EIA of ocean areas. Based on the examination of a number of previous studies, several proposed methods for biological and economic impact assessment were introduced into the system. Referenced to the previous applications for watersheds, six widely used assessment methods were examined. The method of Index of Biological Integrity (IBI) (B.L. Kerans and J.R. Karr, 1994) was selected to be incorporated into the proposed system for two main reasons: the appropriateness of application to ocean areas and the pertinence for evaluating development actions. During the IBI assessment of an area, firstly some representative species are selected as subjects; some aspects are then determined as categories; referring to standard conditions, each category for each species is given a grade; and finally the grades are integrated into a value using a weighting system to indicate the biological condition in the area. In the proposed system, the representative species are set to be selective and the assessment categories have been modified for application to the Sea of Okhotsk. As for the economic impact assessment method, a replacement cost method (RCM) was selected because of its feasibility. The RCM assessment is to estimate the value of an impact by calculating the cost of restoring the environment or finding a replacement for it. These assessment procedures were compiled as semi-automatic GIS functions.

Using this proposed EIA GIS system, we performed several sample EIAs based on the JANSROP-GIS database.

3.2 Attempt 1: Preliminary Assessment of Biological Resources Management

There are two components in this preliminary assessment. One is the biological assessment of fishery resources near Hokkaido and the other is the biological impact assessment of possible development actions.

The ecosystem in the Sea of Okhotsk is a very unique and delicate one influenced by the natural environment, especially sea ice. During winter, vertical circulation of seawater caused by the process of freezing takes nutrients from the sea bottom to the surface layer. An amount of phytoplankton is thereby produced on the underside of sea ice, upon which zooplankton feed. When the ice melts in spring, these phytoplankton drop into the ocean's surface layer, contributing to the spring bloom. This kind of primary production further influences fishery stocks and thus it is necessary for regional fishery resources management to carefully examine the linkage between ecosystems and sea ice conditions. The JANSROP-GIS database involves a time-series fishery dataset near Hokkaido. Although a paucity of plankton data leaves a gap in the food chain, it still enables us to perform the linkage analyses statistically. Time-series datasets of sea ice extent, the timing of retreat and patterns of retreat were compiled to compare with the fishery dataset. The key analysis results are:

1) sea ice extent has a slight influence on fishery stocks;
2) the timing of sea ice retreat has a relatively large influence on fishery stocks. A late retreat contributes to large fishery stocks and vice versa; and
3) the pattern of sea ice retreat fundamentally influences fishery stocks. A northward retreat produces much larger fishery stocks - especially that of shellfish - than a westward retreat.

The biological impact assessment for possible development was performed on the platform for exploiting oil and gas designed for the Sakhalin II Project (T. Murakami, 2002) (Figure 4).

Within the surrounding area of the locations where the platforms were designed, assessment was performed using the IBI method. Based on the JANSROP-GIS database, representative species in the area were selected: one endangered species

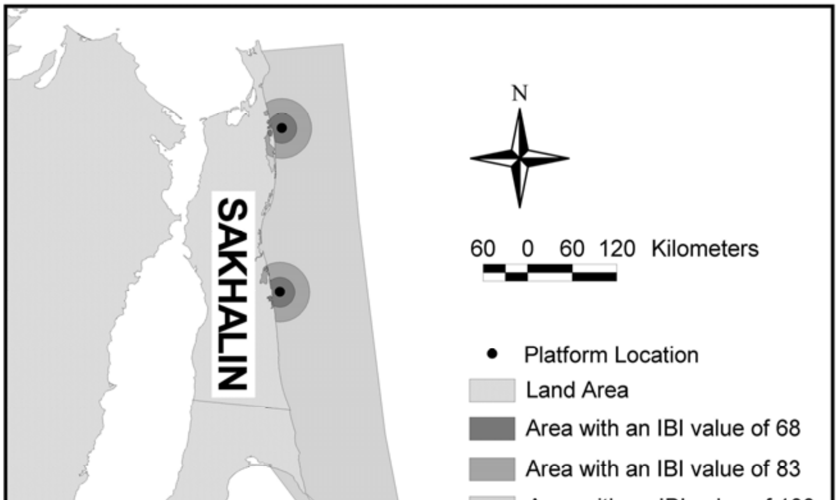

Figure 4 Biological Impact Assessments for Designed Platforms:
The IBI value under current conditions (uninfluenced) was set to be the standard level (100). The IBI values in the slightly and heavily influenced area of the platforms were estimated as 83 and 68 respectively, thirty years after development.

(Gray Whale) and four abundant species (Largha Seal, Ringet Seal, Ribbon Seal and Bearded Seal). The IBI value under current conditions was set to be the standard level (100). The influenced area of the platform was set according to two levels, heavily influenced and slightly influenced. For each influenced area, the degradation of ocean conditions was examined and the biological condition of each species in each area was then estimated using a PVA model. The results were fed into the IBI procedure to calculate the IBI values for the two influenced areas. As a result, illustrated in Figure 4, thirty years after development the IBI value would be reduced to 83 and 68 for the slightly and heavily influenced areas, respectively. It should be clarified here that this assessment is a sample to suggest a method of utilizing the JANSROP-GIS database and to evaluate the performance of the proposed EIA system. Because the JANSROP-GIS database does not include enough comprehensive data, several assumptions were incorporated into the IBI estimation procedure. The migration of the representative species selected was neglected, while the weighting system by which the grades of assessment categories were integrated into the IBI value was assumed. Therefore, the assessment results cannot be recommended for evaluating the design or plan of the Sakhalin II Project.

3.3 Attempt 2: Oil Spill Risk Assessment

According to the Sakhalin II Project plan (T. Murakami, 2002), the produced oil and gas will be transported to the southernmost area of Sakhalin island by pipeline, and then to Japan by oil tanker. Therefore, it is necessary to consider and evaluate the risk of oil spills over the ice-covered sea in order to identify measures to protect the regional environment. Here we present an assessment of an assumed accident.

The oil spill accident was assumed to have occurred between the Sakhalin and Hokkaido islands during February (ice-covered season) (Figure 5A). Based on the transportation plan of the Sakhalin II Project (T. Murakami, 2002) and the severe conditions of the area in winter, the volume of spilled oil was determined to be 100 thousand KL, approximately 16 times that of the Nakhodka Accident in the Japan Sea and around 2.7 times that of the famous Valdez Accident in the Prince William Sound (USA). Indeed it would rank in the Top 10 in terms of scale since 1967 (International Tanker Owners Pollution Federation Limited, URL: http://www.itopf.com/stats.html). A numerical simulation was carried out using an oil spill model (Rheem and Yamaguchi, 2004; Rheem et al., 2005), based on the annual meteorological and sea ice data provided by the JANSROP-GIS database (Figure 5B). The speed of the oil spill was set at 1 cubic meter per second, and the time period was set at 1 million seconds. The predicted distribution of spilled oil after one, two and three weeks is shown in Figures 5C, 5D and 5E, respectively. Based on these simulation results and the volume of spilled oil, a sample assessment of biological and economic impacts was carried out.

Firstly, the cost of oil recovery and cleaning the ocean area was estimated according to the volume of spilled oil referring to data from previous accidents. The estimation reached US$1.72 billion. Secondly, the cost of oil recovery and cleaning the shore was estimated based on the Environmental Sensitivity Index (ESI) map (Figure 5A), which was compiled based on the geological, topographical and ecological conditions of the shore. Each condition was classified into several grades according to their sensitivity to environmental pollution. An ESI rank of a section of the shore was then evaluated by integrating the three grades of the section. The estimations for one, two and three weeks later were calculated to be US$0, US$1.54 and US$3.2 billion, respectively. Finally, a partial biological impact was evaluated based on the influenced fraction of fishing grounds and annual catch data within these fishing grounds (Table 1). The influenced fractions were estimated by the overlay between the simulated oil distribution areas and the fishing ground areas. Several assumptions were also made in this sample assessment due to a lack of data. Catches within the fishing grounds were set to be homogeneous. The average annual catch for each species was calculated using data since 2000 and applied to the estimation. The estimation results suggest that the biological impact could be moderate to slight if the rescue for the assumed accident and the recovery of the spilled oil could be carried out in a timely manner. If the rescue and recovery efforts were delayed however, the biological damage would be very large. If the spilled oil was present on the sea surface for more than two weeks, it would spread to a size double that of its original area and would move to the shore, driven by wind and ocean currents. Furthermore, if the situation lasted for three weeks, the majority of fishery species would lose more than half the area of their fishing grounds.

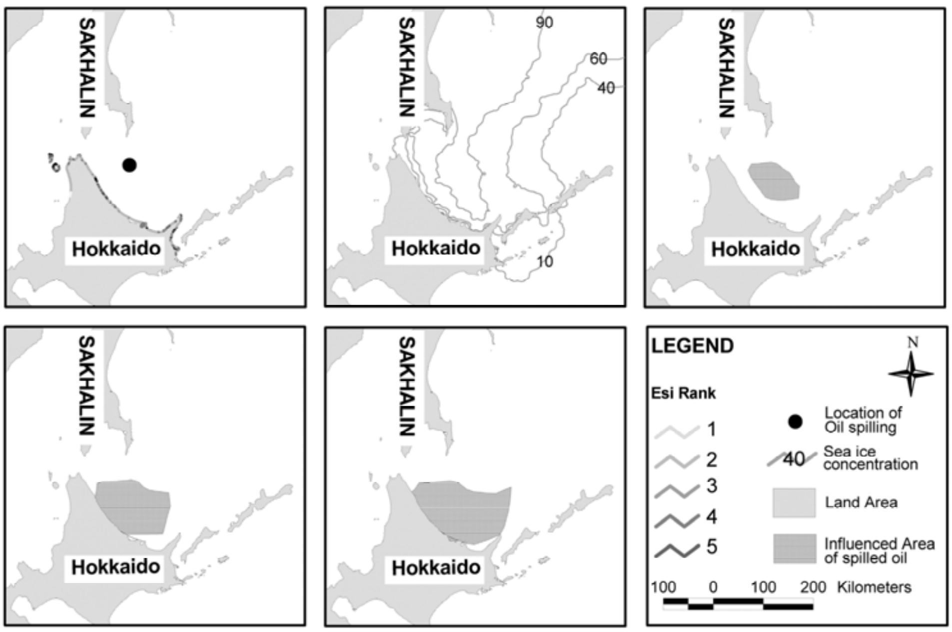

Figure 5 Predicted Oil Spill Distribution (A: ESI Map of the northern shore of Hokkaido and the assumed spilling point; B: sea ice distribution; C, D and E: the influenced area of spilled oil one, two and three weeks after the assumed accident, respectively)

Table 1 Estimated Fractions of Fishing Grounds Influenced by the Assumed Oil Spill and Annual Catches in those Grounds

Fishery species	Fraction after 1 week (%)	Fraction after 2 weeks (%)	Fraction after 3 weeks (%)	Annual catch (ton)
Arabesque Greenling	-	10	25	130,000
Walleye Pollock	30	65	80	14,000
Pacific Cod	10	15	25	2,000
Saury	4	6	8	200,000
Herring	25	40	50	4,000
Pointhead Flounder	-	30	50	2,500
Brown Sole	-	25	25	2,000
Kichiji Rockfish	15	50	80	500
Snow Crab	50	80	95	1,000
Hair Crab	10	20	50	2,000
Spear Loliginid Squid	-	10	10	500
Giant Ezo Scallop	-	30	35	400,000
Weighted average	1.87	20.93	27.21	Total: 758,500

The fraction here is defined as the ratio of the fishing ground area influenced by the oil spill to the total fishing ground area.
If the oil pollution could not be cleaned sufficiently, a significant influence may extend into following seasons. Thus, the worst result would be that more than a quarter of the annual fishing catch in the Sea of Okhotsk in Japan would be lost.

4. Concluding Comments: Necessities and Prospects

The Sea of Okhotsk plays an important role in various ways. Firstly, the dense shelf water formed by surface freezing in the northwestern region contributes to the formation of Pacific Intermediate Water, thereby influencing global ocean circulation and stratification. Secondly, the existence of sea ice in this area during the winter season dominates the interaction between ocean and air, thereby influencing atmospheric circulation and the climate over the North Pacific and adjacent areas. Finally, sea ice variability within the Sea of Okhotsk causes changes in the local natural and biological environments, thereby influencing the industrial development of surrounding regions. Thus, human activities in this area should be carefully examined to ensure local environmental sustainability. In addition, the fact that abundant natural and biological resources, especially energy resources, exist in the area provides the potential for surrounding areas to form an actively productive economic zone. Because of this, economic development in this area has been eagerly discussed by the relevant authorities. In this situation, it is obvious that a strategic EIA should and would be a key technology to lead the local communities in harmonious, environmentally-sound development.

Due to some natural, historical and political reasons, the establishment of legislation, especially international conventions on the ocean environment of the Sea of Okhotsk is far from perfect. Compared to others, this ocean area is only included in the International Convention for the Prevention of Pollution from Ships, which is also known as MARPOL. International cooperation efforts should be made to complete the legislative system for this area. To achieve this target, as demonstrated in case study 1, a strategic EIA would be extremely helpful for the establishment of not only the constraints, but also the directions of development policies, plans and programs.

The JANSROP-GIS compiled the datasets of general geography, natural environment and resources in the Sea of Okhotsk for the first time. It provided a relatively valuable database that made it possible to perform strategic EIA for the area to some extent. Several attempts, including impact assessment for influenced areas of action and risk analysis have been primarily made. Although the sample assessments could not obtain practically useful results due to the inclusion of many assumptions resulting from the paucity of data, they are still expected to lead to practical EIA which could provide useful information to follow-up EIAs.

As indicated in case study 2, although the paucity of comprehensive data limits the efficacy of EIA, additional methodologies can be employed to complete the assessment. In this paper, an attempt at looking for the linkage between sea ice variability and fish resources was conducted. The findings are expected to be examined in follow-up studies, and together with other natural and biological mechanisms, to assist in establishing local resource management policies.

However, the quality and quantity of the baseline data essentially influences the accuracy and credibility of an EIA. Ideally, good EIAs utilize significant amounts of data that have been collected over the entire spatial extent of the study area over a long period of time. Therefore, follow-up investigations, data collection and data evaluation are necessary to provide supplementary data to the JANSROP-GIS. Several suggestions can be offered.

1) Monitoring and data collection for oceanography to obtain quantitative data instead of the current qualitative data in the JANSROP-GIS.
2) Monitoring and data collection for local primary production should be carried out to fill in the data gaps in the JANSROP-GIS.
3) Further efforts should be made to perform time-series and linkage analyses to clarify the interactive mechanism between natural environmental conditions and the ecosystem.

In addition to database construction, several other issues related to the execution of the EIA process should also be taken into account (H. Yamaguchi, 2003) (Figure 6).

1) To ensure sufficient utilization, a virtual data center (VDC) linking all existing databases including the JANSROP-GIS is necessary. A VDC would constantly

compile a dynamic environmental atlas and provide the necessary data processing tools to carry out tasks demanded by users.
2) To ensure the EIA process is executed smoothly and transparently, a public participation system is necessary. This system should function to deliver the EIA results at every level to the public and to obtain feedback in real time.
3) To ensure the accuracy of impact prediction, multi-scale numerical simulation techniques should be developed for the Sea of Okhotsk.
4) As the data processing system, the GIS should be improved to be able to manage and analyze tempo-spatial data in 4-dimensions.

The suggested EIA system could assist local authorities in sufficiently executing the plan-do-check-action (PDCA) cycle for extensive development.
Essentially the best protection is preventing destruction, and with the completion of the baseline database and assessment methodology, strategic EIA will play an important role in the development of the Sea of Okhotsk.

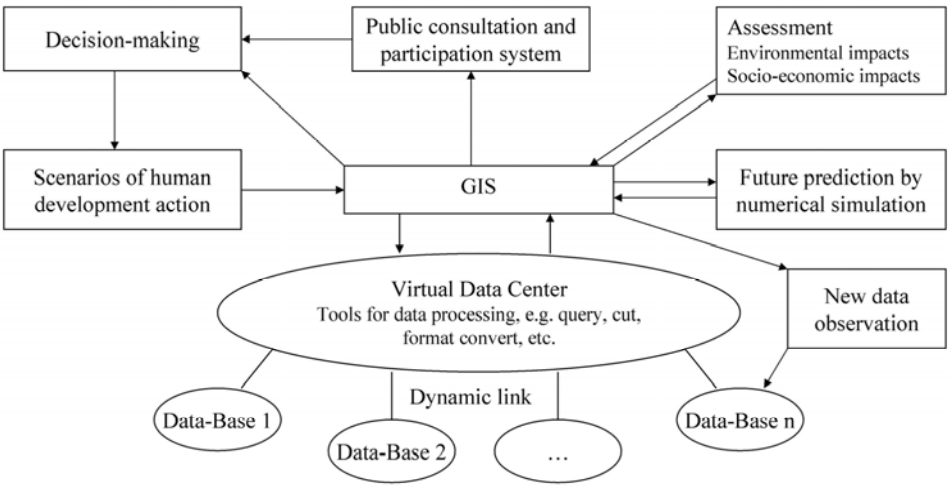

Figure 6 Conceptual Map for an Ideal Strategic EIA System (Modified from H. Yamaguchi, 2003)

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Oceanic Environmental Protection in Russia

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Russian Exclusive Economic Zones in the Okhotsk and Bering Seas are the main source of bioresources and oil in the Far East. The Russian Federation Environmental Doctrine adopted in 2002 notes the following: the sustainable development of the high quality of Russian life and the health of its people, as well as national security, can only be ensured when the quality of the environment is properly preserved and maintained. For this purpose, a consolidated state environmental policy should be developed and steadily pursued, aimed at environmental protection and the rational management of natural resources. The preservation and restoration of natural systems should be one of the priorities of state and societal activities. Before considering this problem in more detail, it is firstly necessary to briefly review the main factors affecting the environment of the Okhotsk and Bering Seas.

It is well known that sea transport and oil production on the continental shelf are the main polluting factors in the seas. Starting from the 1920s of the last century, oil has been produced in offshore oil fields. In 1999, oil production began on the shelf of the Sakhalin islands under the “Sakhalin-2” project operated by the “Sakhalin Energy Investment Company.” Oil is exported by shuttle tankers and the volume of production is around 2 million tons. That volume will shortly reach 12,000 tons per day and the annual volume of gas production more than half a billion cubic meters.

In the near future, other offshore oil production projects will also be initiated. The biggest of these are the Sakhalin 1 and Sakhalin 5 projects. As a result, oil traffic will increase dramatically in the area.

Far East oil traffic was roughly 15 million tons in 2004 and about 2 million tons were from Sakhalin (Tables 1 and 2). For example, oil traffic in 2002 was only 5 million tons. According to expectations, it will be about 20 million tons within two years and more than 80 million tons by 2010 after the construction of the new Perevoznaja oil terminal near Vladivostock.

The probability of an oil spill in the case of a shipping accident depends on a number of factors, the most important being the ship’s construction, navigational conditions, density of traffic, the quantity of transported oil and oil products. The majority of ship accidents are collisions with other ships, ice and groundings.

According to statistics of tanker accidents, the highest risk of an accident is primarily when a tanker is approaching or leaving a port or oil terminal, and such accidents mainly occur due to operator error (human factor).

The most frequent cause of pollution at terminals is from overflow during loading operations. The volumes of such spills are not large, but the number of accidents is

Table 1 Far East Oil Traffic in 2004

Marine administration	Handled oil and oil products (thousand tons)
Vanino	2,790.1
Vladivostok	2,372.0
Magadan	275.4
Nakhodka	6,937.8
P-Kamchatsky	644.2
Sakhalin	1,884.7
Total	14,904.2

Table 2 Volumes of Oil and Oil Products Transported via the Ports of the Sakhalin Oblast

Company	Handled oil (thousand tons)	
	2003	2004
Sakhenergy- Sakhalin 2	1,361	1,583
Petrosakh	140.6	89.3
Korsakov	131.8	145.0
Sakhalinmorneftegas	123.7	-
Others	65.7	67.4
Total	1,882.8	1,884.7

high and, consequently, they present a risk to the environment no less significant than that of oil spills following tanker accidents. Probability assessments of oil spills are made by the methods used by HELCOM. [1]

Table 3 shows the results of the assessment of probable oil pollution volumes in the high sea and Fig. 1 shows the estimated sizes of oil slicks in cases of more probable oil spills when response measures cannot be applied.

1. The Concept of Sustainable Development

The sustainable development of a region is considered to be an activity which is not followed by significant negative effects on the quality of the environment and living marine resources and that does not compromise future use. [2]

- Sustainability is an approach that must be continually developed and adjusted to different subjects and situations;
- Sustainability is a political concept and its application means that social, economic and ecological choices have to be made; choices that are often controversial.

The Okhotsk and Barents Seas belonging to the Arctic region are of essential importance to adjacent communities and nations. Historically, the use of Arctic marine resources has been limited to fishing, whaling, hunting and mining. More recently however, oil and gas offshore production, hydroelectricity and infrastructure such as

Table 3 Assessment of Probable Oil Spill Size in the Sakhalin Islands Area

■	Risk factor per 1000 voyages -	0.05
■	Spill number per year -	0.009
■	Quantity of spilled oil, t/year -	1.9
■	Average oil spill size, t -	198.8

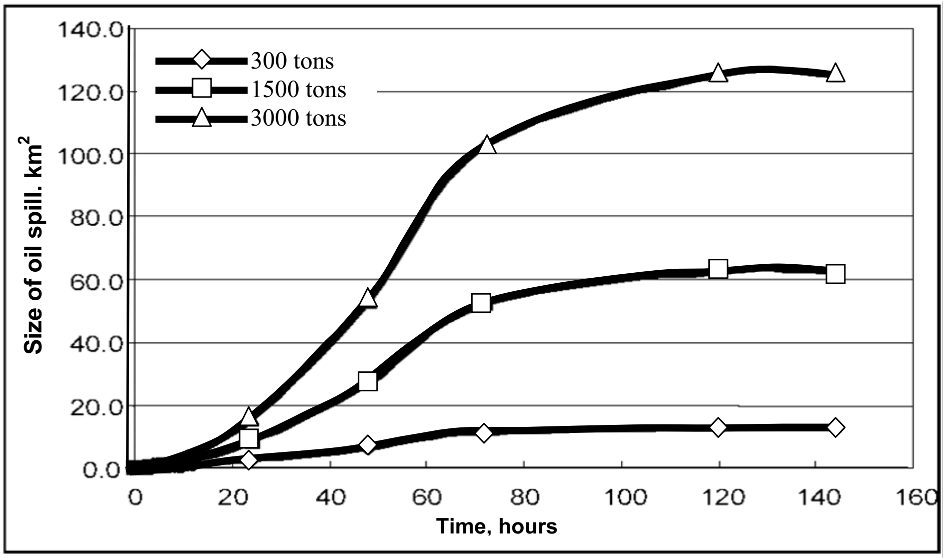

Figure 1 Oil Slick Sizes in Cases of Oil Spills (1500 and 3000 t. of crude oil and 300 t of HFO)

roads, harbours, oil rigs, pipelines and electric transmission lines have become important. The effects of these activities on the Arctic marine environment can be profound, particularly in marine areas and the coastal zone. These new activities pose new risks for society and the living marine resources of the region.

Marine conservation will require diverse strategies for management purposes. In addition, collaboration among various interests is necessary to achieve a unified direction in marine conservation.[2] Among these interests are:

- Offshore oil production
- Tourism
- Shipping Operators
- Coastal Development Interests
- Northern Cultures and Traditions

Any approach applied to marine conservation efforts in the Arctic needs to recognise that multifarious and sometimes conflicting uses of marine resources may occur and that specific resources are components of larger ecological systems that may contain a number of resources of economic and social value. Ideally, a protection system employing a multi-faceted approach should be implemented for marine conservation. Marine species protection focuses on the conservation of marine stocks. Often the habitats of rare or endangered species are protected by restricting activities in sensitive sites. Network and systemic approaches to marine conservation have numerous benefits and can facilitate collaboration.

2. Regional Agreements and Projects

Regional agreements and projects concerning certain seas are very important for environmental safety. Examples of such activities are regional programs of the UNEP/IMO, the Arctic Council, North Forum, North Council, North States Council of Ministers and the Barents Region Program of actions.[3]

A major part of the regional agreements are connected with the Barents Sea, while the Arctic Council programs cover both the Barents Sea and part of the Okhotsk Sea (Shelekhova gulf). Regional UNEP/IMO programs named the North West Pacific Action Plan (NOWPAP) now only cover the NOWPAP sea area. Inclusion of the Okhotsk Sea in its sphere is now being considered. Within the framework of regional agreements, a number of guidelines have been developed, including "Arctic Waters Oil Transfer Guidelines," "Arctic Offshore Oil and Gas Guidelines," "Circumpolar Map of Resources at Risk from Oil Spills in the Arctic", "Guidelines for Arctic Oil Spill Response" and the NOWPAP oil spill contingency plan.

The principle of sustainable development is acquiring fundamental importance in Russian policy. Several documents concerning the protection of the environment and the sustainable development of Russia have been adopted and are being implemented. Russia is an active member of international agreements covering the Arctic and Far East regions and principally of all Arctic Council programs and the NOWPAP.

3. Federal Dedicated Programs

Federal dedicated programs are an important instrument for sustainable development. Among the Russian national programs for the regions in question, the major ones are the Environmental Doctrine and the federal dedicated programs, "The Environment and Natural Resources of Russia (2002 – 2010)," "World Oceans," "The Economic and Social Development of the Far East and Baikal Region, 1996 – 2005 and up to 2010," as well as the "National Plan of Action for the Protection of Marine Environments from Anthropogenic Pollution of the Arctic Region of the Russian Federation." [3]

3.1 The Russian Federation's Environmental Doctrine

This doctrine was adopted in 2002 and the document noted the following:

- The sustainable development of the Russian Federation's high quality of life and of the health of its people, as well as national security, can only be ensured when the quality of the environment is properly preserved and maintained. For this purpose, a consolidated state environmental policy should be developed and steadily pursued, aimed at environmental protection and the rational management of natural resources. The preservation and restoration of natural systems should be one of the priorities of state and societal activities.

- Russia plays a key role in maintaining the global functions of the biosphere as a considerable part of the earth's biological diversion is represented in the vast territories of Russia with its array of natural ecosystems. The scope of natural resources and the intellectual and economic potential of Russia underscores the important role it plays in solving global and regional environmental problems.

The doctrine states the main factors contributing to environmental degradation in both Russia and the world. These factors should be taken into consideration by the Russian Federation in pursuing a consolidated state environmental policy.

The environmental doctrine of Russia is defined in the goals, objectives, tasks and principles of the consolidated long-term state environmental policy of the Russian Federation.

The doctrine is based on:

- Fundamental scientific knowledge in the field of environmental and interdisciplinary sciences;
- Assessment of up-to-date environmental conditions and the resultant effects on the quality of human life in Russia;
- Recognition of the important role of the natural systems of the Russian Federation in global biosphere processes;
- Consideration of specific global and regional features of human-nature interaction.

The document also takes into account the recommendations of the UN Conference on the environment and development (Rio de Janeiro, 1992) and other international forums on environmental and sustainable development issues.

The strategic objective of state environmental policy is the preservation of natural systems, sustenance of their integrity and life-supporting functions for the sustainable development of society, the enhancement of people's health, quality of life and demographic situation, and ensuring the environmental safety of the state.

Ensuring sustainable environmental management

The main objectives in this respect are the inexhaustible use of reproductive resources and the rational use of non-reproductive resources. The doctrine states appropriate measures to be taken.

Environmental preservation and restoration

The main objectives in this respect are the preservation and restoration of landscapes and biological diversion sufficient for maintaining the self-regulating abilities of ecosystems and compensating for anthropogenic activities.

Priority activities for ensuring environmental safety in Russia.

Ensuring the safety of potentially dangerous activities and the prevention and minimization of the consequences of disasters.

The main objective in this respect is ensuring the environmental safety of potentially dangerous activities and the rehabilitation of territories and water areas that have suffered in cases of natural or technical disasters by identifying and minimizing environmental risks and any risks to human health.

State environmental policy implementation

The doctrine is provided as a basis for the development of a state environmental and nature management control system. The main objective in this respect is ensuring effective state control over environmental preservation and nature management appropriate to a democratic organization and market economy. The doctrine is comprised of the following issues:

- Normative legal support and execution
- Economic and financial mechanisms
- Environmental monitoring and information
- Scientific support
- Environmental education and enlightenment
- Development of a civil society as a precondition of state environmental policy implementation
- Regional environmental policy
- International cooperation

3.2. "The National Plan of Action for Anthropogenic Pollution in the Russian Federation" (NPA-Arctic)

This plan was developed during the period from 1996 to 1999 as a joint effort of the government of the Russian Federation and the Advisory Committee on Protection of the Sea (ACOPS). It is part of the federal program, "World Oceans."

The overall management objective of the NPA-Arctic is to reduce pollution and habitat damage to the Arctic environment in such a manner as to permit the conservation and sustainable development of its natural resources and the removal of threats to the health of its human population from anthropogenic sources of pollution.

The NPA-Arctic concept is based on global considerations of the significance of the Arctic region and its sustainable development:

- The state of the environment (past, present and future);
- Components of the environment: atmosphere, lithosphere, hydrosphere and technosphere. Impact of the technosphere on environmental components: contamination of the atmosphere; global warming; ozone layer destruction; contamination of soils and rocks; permafrost; acidification; disruption of the heat and water balance; reduction in biodiversity, reproductivity and the composition of species, etc.; and the contamination of seas, ocean, rivers, lakes and groundwater;
- Knowledge of processes of climatic changes in the past is conducive to understanding current processes and allows the prediction of climatic changes 100 years into the future and beyond;
- Study of the contamination sources (hot-spots) and processes of destruction of

natural resources, and the zoning and ranking of impact scales (global, regional, local);

- Study, parameterisation and modelling of processes influencing changes in the environment;
- Environmental monitoring;
- Development of indicators of the sustainable development of regions, the management of the environment to return it to the path of sustainable development and the development of a legal framework for environmental protection; and
- Socio-economic aspects of sustainable development of the region.

3.3 The Environment and Natural Resources of Russia (2002-2010)

For environmental protection, the program is prescribed inter alia:

- Reduction of emissions of hazardous substances into the atmosphere, discharge of sewage into water and the amount of waste storage, and the development of a state system of complex monitoring of natural resources and environment conditions.
- Development of a state system of industrial and domestic waste management and putting facilities into operation to process and disinfect various wastes with a capacity of 70 million tons per year.
- Development of natural reserves and a parks system with a growth of 11.7 million hectares.
- Preservation of rare and endangered species of flora and fauna

The program is to be implemented during the period from 2002 to 2010. The first stage (2002-2004) involves measures for environmental protection for stabilizing existing pollution levels in environmentally adverse towns and regions, and for the protection and reproduction of minerals, forests, water, water biology and other natural resources for the purpose of meeting the current demands of the state's economy and population.

The second stage (2005-2010) involves measures for reducing environmental pollution levels and improving environmental conditions and measures for ensuring the steady reproduction of natural and raw material resources in volumes which will satisfy medium and long-term domestic and export demands.

The program comprises 12 subprograms, among them: Mineral and raw material resources; Forests; Water resources and water objects; Water biology resources and aviculture; Environmental quality regulations; Waste; Support of priority protected areas; Preservation of rare and endangered flora and fauna species; and others.

3.4. Economic and Social Development of the Far East and Zabaikal Area between 1996-2005 and up to 2010

This program was adopted in 1996 and the preamble contains an outline of its scope:

The territory of the Russian Federation in the Far East and Zabaikal area is some 40% of Russia's territory (6.5% of the total population) and the volume of regional produce is about 6% of gross national produce. The area has an extensive border with China and Mongolia, non-freezing seaports in the east and major transport routes such as the Trans-Siberian and Baikal-Amur railways. The region is rich in natural resources and according to expert assessments, the Far East Sea shelf contains 30 billion tons of hydrocarbons. Over 60% of fish and sea products in Russia come from this region.

In March 2002, the government analyzed the implementation of the program and decided that it was practical to prolong the program until 2010 with some amendments.

The goals of the program are:

- Development of economic conditions for sustainable development in the Far East and Zabaikal area taking into account the geo-strategic interests and security of the Russian Federation;
- Creation of the required infrastructure and a favourable investment climate for development of the priority branches of the economy in the Far East and Zabaikal area and the promotion of international and trans-border cooperation programs and projects;
- A complex of measures to relax social tensions in the region;
- Promotion of the effective implementation of federal ecologically-dedicated programs in the region.

The main objectives of the program are:

- Development of a transport corridor system for better international cooperation and enhancement of the Russian Federation's position in the world transport system;
- Development of an oil production base and extension of the pipeline network;
- Reproduction and preservation of marine biological resources in the basins of the Far East seas;
- Modernization of the structure and development of the key sectors of the economy – fuel and power, transport and fisheries;
- Creation of conditions for the development of small and medium businesses;
- Development of a social infrastructure and encouragement of local populations to stay in the southern areas of the region.

4. Guiding Principles for the Marine Environment Security Concept for the Sea of Okhotsk

A review of existing different regulatory systems has indicated that none of these can be regarded as 'ideal,' especially for conditions in the Sea of Okhotsk. The abundant natural and living marine resources in the sea require special approaches to fulfil the sustainable development concept.[5] Nomination of the Sea of Okhotsk as a "special area" (SA) or "particularly sensitive sea area" (PSSA) will be appreciated by "greens," but opposed by industry. A compromise should be found between them and it can be achieved if the problems are solved on a step-by-step basis. The following measures should be considered and implemented:

- Updating existing regulations containing requirements for shipping and offshore

oil production activities. The activities should be based on BEST AVAILABLE TECHNIQUES (BAT) and BEST ENVIRONMENTAL PRACTICE (BEP);
- Carrying out Formal Safety Assessments (FSA) for the Sea of Okhotsk;
- Evaluating the results of FSAs and the need for additional special preventative pollution measures as required by IMO Guidelines (e.g. traffic separation schemes, winter navigation in the Sea of Okhotsk, increasing oil spill response capabilities and others);
- Considering the necessity of nominating the Sea of Okhotsk as an SA or PSSA according to the requirements of IMO Guidelines.

BEST AVAILABLE TECHNIQUES (BAT) [4, 6]*:*
1. The use of the best available techniques shall emphasise the use of non-waste technologies, if available.
2. The term “best available techniques” means the latest stage of development (state-of-the-art) of processes, facilities or of methods of operation which indicate the practical suitability of a particular measure for limiting discharges, emissions and waste. In determining whether a set of processes, facilities and methods of operation constitute the best available techniques in general or individual cases, special consideration shall be given to:
    - Comparable processes, facilities or methods of operation which have recently been successfully tried out;
    - Technological advances and changes in scientific knowledge and understanding;
    - The economic feasibility of such techniques;
    - Time constraints for installation in both new and existing plants;
    - The nature and volume of the discharges and emissions concerned.
3. It therefore follows that what are “best available techniques” for a particular process will change over time in light of technological advances, economic and social factors, as well as changes in scientific knowledge and understanding.
4. If the reduction of discharges and emissions resulting from the use of best available techniques does not lead to environmentally acceptable results, additional measures have to be adopted.
5. “Techniques” include both the technology used and the way in which the installation is designed, built, maintained, operated and dismantled.

BEST ENVIRONMENTAL PRACTICE (BEP)[4]*:*
1. The term “best environmental practice” means the application of the most appropriate combination of environmental control measures and strategies. In making a selection for individual cases, at least the following range of measures should be considered:
    - The provision of information and education to the public and to users about the environmental consequences of a choice of particular activities and a choice of products, their use and ultimate disposal;
    - The development and application of codes of good environmental practice

which cover all aspects of activity in the product's life;

- The mandatory application of labels informing users of the environmental risks associated with a product, its use and ultimate disposal;
- Saving resources, including energy;
- Making collection and disposal systems available to the public;
- Avoiding the use of hazardous substances or products and the generation of hazardous waste;
- Recycling, recovery and re-use;
- The application of economic instruments to activities, products or groups of products;
- Establishing a system of licensing, involving a range of restrictions or a ban.

2. When determining what combinations of measures constitute best environmental practice in both general and individual cases, particular consideration should be given to:
    - The environmental hazards of the product and its production, use and ultimate disposal;
    - Substitution with less polluting activities or substances;
    - The scale of use;
    - The potential environmental benefits or drawbacks of substitute materials or activities;
    - Advances and changes in scientific knowledge and understanding;
    - Time constraints for implementation;
    - Social and economic implications.
3. It therefore follows that best environmental practice for a particular source will change over time in light of technological advances, economic and social factors, as well as changes in scientific knowledge and understanding.
4. If the reduction of inputs resulting from the use of best environmental practice does not lead to environmentally acceptable results, additional measures have to be adopted and best environmental practice redefined.

Recommendations

1. It is obvious that using the experience of the IMO and broader cooperation under the Arctic Environmental Protection Strategy (AEPS) of the Arctic Council and within NOWPAP and their various sub-programs, will be one of the ways to implement the sustainable development concept for the Okhotsk and Bering Seas.
2. All measures outlined above deserve consideration as areas for future work. The highest priorities for the Sea of Okhotsk may lie in the establishment of a special marine regime for navigation and regulations for offshore oil production. These are not easy matters to solve and the joint efforts of politicians and scientists will be required.

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Proposals for a Marine Regime in the Sea of Okhotsk and Russian-Japanese Cooperation in this Field

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The Sea of Okhotsk is located in the north-western part of the Pacific Ocean near the Asian coast and is separated from the ocean by the Kuril Islands range and the Kamchatka Peninsula.

The Sea of Okhotsk is a semi-enclosed sea of the Pacific Ocean between the Eurasian continent and the Sakhalin, Hokkaido and Kuril Islands.

1. General Description

To the south and west, the Sea is bound by the coast of Hokkaido Island, the eastern coast of Sakhalin Island and the coast of the Asian continent. It is long and elongated in a south-west to north-east direction in the shape of trapezium. The maximum length of the aquatic area in this direction is equal to 2,463 km and its width reaches 1,500 km. According to some estimations, the water plane is equal to from 1,583 to 1,603 thousand km^2, the length of the coastline (10,460 km) and the total volume of sea water (1,316 thousand km^3).

According to its geographical location, the Sea is classified as an adjacent sea of the mixed continental-adjacent type. The Sea of Okhotsk is connected to the Pacific Ocean by numerous straits in the Kuril Islands ridge, with the Sea of Japan by the La Perouse Strait and with the Amurskiy estuary by the Nevelskiy and Tatar straits.

The dividing line[1] between the Sea of Okhotsk and the Sea of Japan is located in the area of the Tatar and Nevelskiy Straits. Nevelskiy Strait is a part of the Amurskiy estuary system and is considered to belong to the Sea of Okhotsk. Tatar Strait is a part of the system of the Sea of Japan.

The average depth of the Sea is 821 m and the maximum depth is over 3,350 m (in the Kuril depression).

The Gulf of Shelikhov is located in the north-east, while the gulfs of Aniva, Terpeniya (near Sakhalin) and Sakhalinskiy, etc., are located in the southern part.

The Amur River flows into the Sea, which is almost completely covered with ice from October to June.

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1 Limits of Application of Territorial Jurisdiction of States in the World Ocean: Brief Reference Book. #9001. Saint-Petersburg: Head Department of Navigation and Oceanography of the Ministry of Defence of the Russian Federation, 1995.

Fish varieties: salmon, herring, pollack, flounder, codfish, Sakhalin taimen, etc.

Main ports: Magadan, Okhotsk; Korsakov (Sakhalin Island); Severo-Kurilsk (Kuril Islands).

The basic morphologic zones in the sea bed relief are: the shelf (the continental and insular bank of Sakhalin Is.) and the continental slope where some underwater elevations, depressions, islands and an abyssal depression exist. The shelf zone (0-200 m) is 180-250 km wide and covers roughly 20% of the Sea area. The continental slope (200-2,000 m) is wide and flat in the central part of the basin and covers about 65% and the deepest depression (more than 2,500 m) is located in the southern part of the Sea and covers 8%. Within the area of the continental slope, there are several elevations and depressions where depths substantially differ. The bed of the abyssal depression is flat, while the Kuril ridge forms a natural threshold separating the Sea depression from the ocean.

Straits joining the Sea of Okhotsk with the adjacent areas of the Sea of Japan and the Pacific Ocean make the exchange of water between the basins possible which, in turn, significantly influences the distribution of hydrological characteristics. The Nevelskiy and La Perouse Straits are relatively narrow and shallow, and this results in a relatively small amount of water exchange with the Sea of Japan. The straits of the Kuril ridge, which stretches for about 1,200 km, on the contrary, are deeper and their total width is equal to 500 km. The Bussol (2,318 m) and Krusenstern Straits (1,920 m) are the deepest.

The Sea of Okhotsk is located in the monsoon climatic zone, however, in the northern part of the Sea, the Gulf of Shelekhov, which plunges deeply into the Asian continent, also has some features of a Subarctic and an Arctic area.

The internal water regime in the Sea of Okhotsk is Subarctic.

The monsoon climate, due to changed location and the character of interaction between baric formations, as well as the location of the sea at the border of the Asian continent and the Pacific Ocean, are the main determining factors of the climate and hydrological sea regime. The main baric formations, governing the conditions of atmospheric circulation and the character of the transfer of air mass, are the Aleut Minimum, North-Pacific Maximum, Siberian anticyclone (in winter), as well as the Far East depression and Okhotsk anticyclone (in summer). The general monsoonal character of the circulation and wind regime is often disturbed by strong cyclones, which pass in a north-easterly direction. Winters here, especially in the northern part of the Sea, are long and severe with frequent storms and snowstorms. Summers are chilly, with ample precipitation and thick fogs. Springs and autumns are short, cold and cloudy. The coldest time of year lasts between 120-130 days in the south and 210-220 days in the north of the Sea. The influence of cooling factors is stronger than those of warming and the resulting heat exchange on the surface is negative. In general, the Sea of Okhotsk is the coldest among the Far East seas.

From May to September, low winds (2-5 m/sec) prevail in the southern quarter of the Sea area. Occurrences of wind gusts (20 m/sec and more) result from cyclones and typhoons entering the Sea, peaking in August-September. Usually one or two, and occasionally three or four typhoons are observed each year. During the cold periods, strong winds prevail in the northern quarter of the Sea with a typical velocity of 5-10 m/sec (in some months up to 10-15 m/sec). The probability of winds with velocities above 15 m/sec is roughly 10% a year and this figure, the velocities and directions of winds significantly vary in different parts of the Sea. The maximum velocities of winds reach 25-30 m/sec in the north-eastern and western parts of the Sea, 30-35 m/sec in the central and eastern parts and above 40 m/sec in the south. Autumn and winter storms are stronger and longer than summer storms. The southern and south-eastern parts of the Sea are the choppiest. The vast horizontal width of the Sea and the frequent strong winds in the area facilitate strong wind-driven swells (waves of 4-6 m and up to 10-11m high) and the composite of hydrometeorological conditions creates the prerequisites for dangerous ice accretion on ships and structures located in the Sea.

Average annual temperatures in the Sea of Okhotsk gradually decrease from South to North from +5°C down to -4 ~ -5°C. The spread of average monthly fluctuations of temperatures in this direction, in opposite, grows from 15-18°C up to 30-36°C. The coldest month is January, while August is the warmest. The minimum actual readings of air temperatures, recorded by onshore stations, are -36 ~ -51°C in the north and -12 ~ -16°C in the southern areas of the Sea. The maximum readings (31-36°C) were observed in the south-western part of the Sea. During cold periods when synoptic situations change, sharp fluctuations in air temperatures are observed over the entire aquatic area and the temperature spread may exceed 20°C.

The Sea of Okhotsk, along with the Bering Sea, is a highly productive marine ecological system and it is of primary commercial importance to Russia.[2]

2. The Legal Status of Sea Areas in the Sea of Okhotsk and Their Delimitation

The legal status of sea areas in the Sea of Okhotsk conforms to the commonly accepted principles and regulations of international maritime law, as stated in the UN Convention on the Law of the Sea (UNCLOS), 1982, effective from 1994 (ratified by Japan in 1996 and by Russia in 1997). The map in Figure 1 was drawn by the author using data from the Head Department of Navigation and Oceanography.[3]

Similar to practically the whole Pacific Subarctic zone, many of the categories of sea areas defined by the Convention exist in the Sea of Okhotsk:

- internal waters,
- territorial sea,
- contiguous zone,
- exclusive economic zones,
- continental shelf,
- islands,

[2] Data here and elsewhere based on: V.I. Ilichev. Oceanographic Atlas of the Bering, Okhotsk and Japan Seas (Russian version) and Russian navigational charts. Pacific Oceanological Institute, 2003.

[3] Decree of the USSR Minister Council, 7 February 1984 and 15 January 1985. List of geographical positions of points, determining positions of baselines. Published in: Maritime Law of the Russian Federation (two volumes, three additional volumes). Saint-Petersburg: Head Department of Navigation and Oceanography of the Ministry of Defence of the Russian Federation. 1994-2002 with correction materials.

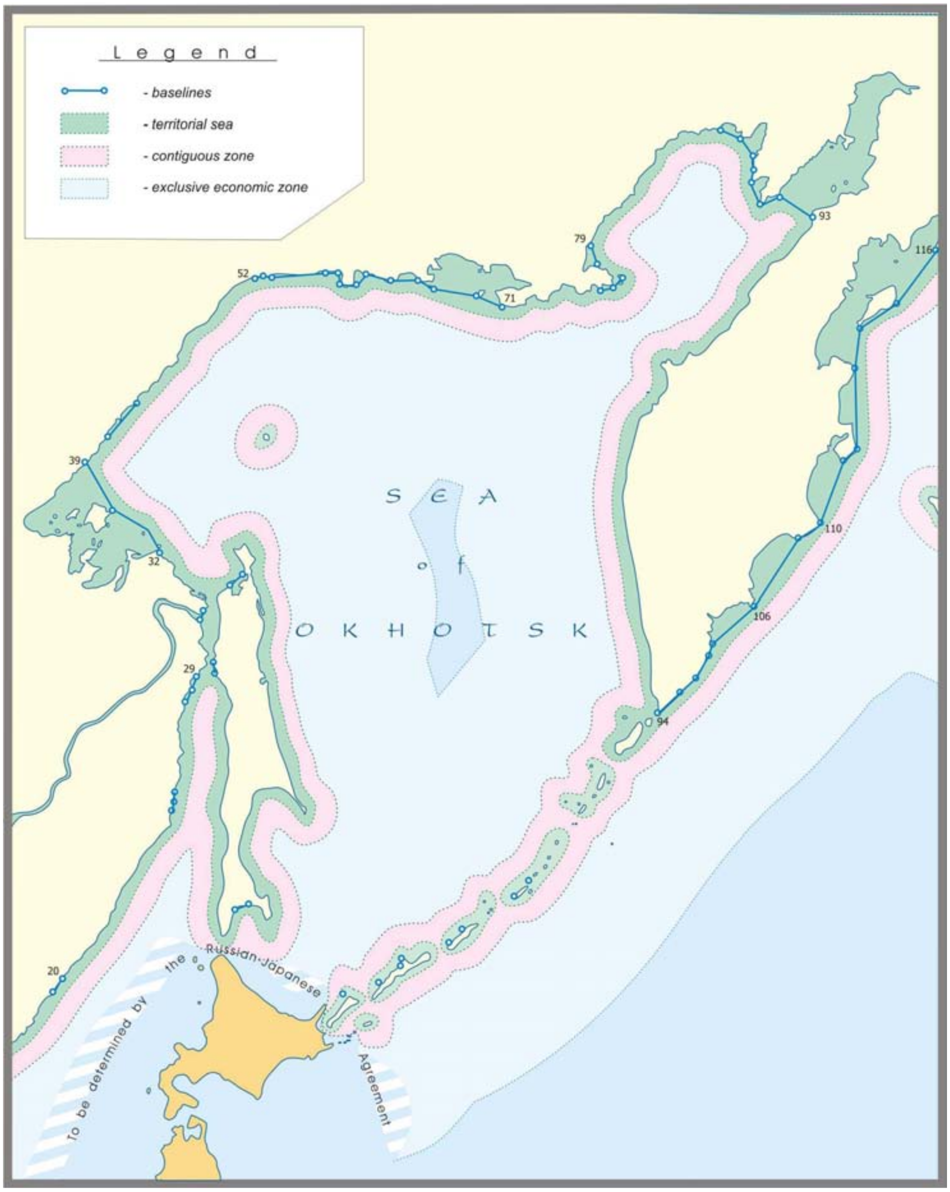

Figure 1 Baselines, Territorial Sea, Contiguous Zone and Exclusive Economic Zone of the Russain Federation in the Sea of Okhotsk

- semi-enclosed sea,
- sea bed areas located outside the continental shelf,
- high seas,
- fishing zones.

Definitions of sea territories and zones are subject to the above-mentioned Convention and various inter-state and national regulations.

A unique area, which is completely encircled by the Russian economic zone, is located in the central part of the Sea of Okhotsk. According to the UNCLOS it is a high sea area, but there has been a lot of discussion in Russia, started by some politicians, to extend Russian sovereignty over this zone by extending, for example, the Russian EEZ to 250 miles from the baseline. The government of Russia, however, acts only according to laws and international obligations, so the sole limitation is that foreign vessels fishing inside this area are not accepted for any services at Russian ports.[4]

The part of the Sea of Okhotsk, specifically Penzhinsakya Guba,[5] historically belongs to the internal waters of the RF.

Civil vessels of other states, which have established authorisation or notification procedures for Russian vessels entering their home ports, enter Russian ports and harbours with the authorisation of the appropriate authorities or by sending notification according to the principle of reciprocality.

Navigation in the Sea of Okhotsk is conducted in compliance with the principles of international maritime law beginning with the UNCLOS and conforming to the regime of navigation[6] established by RF authorities[7] relating to freedom of navigation on the high seas including the 200-mile exclusive economic zone and innocent passage through the territorial sea, etc.

The actual legal regime in the Sea of Okhotsk, both in international legal and national interpretations, has a number of specific features with regard to both territorial limits of the international legal regime, the national regulations on navigation in waters of the Sea of Okhotsk and its ports, and its actual essence.

The existing details of the international legal environment in the area of the Sea of Okhotsk are determined by factors of territorial supremacy and authority of the Russian Federation over the majority of the maritime area of the Sea of Okhotsk.

Russian researchers and pioneers have made a significant contribution to geographic surveys and to the development of land and sea areas in the region. The Russian State for many centuries has had sovereign authority over the territories of the Sea of Okhotsk and its coastal areas. This imposes special legal obligations on pioneers and affords privileges to the state. Some states may use their rights not only in compliance with international law, but also in consideration of the traditions formed in

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4 Decree of the Russian Government #962, 22 Sept. 1993, as amended on 2 November 1995. "On additional measures for preservation of biological resource and protection of fishery interests of the Russian Federation in the Sea of Okhotsk."

5 The north-eastern part of the Gulf of Shelekhov in the Sea of Okhotsk is 300 km long and on average 65 km wide, with a depth of 62 m. It is covered with ice six months of the year.

6 Here and elsewhere, when referring to Russian rules and regulations, the author means in the Russian part of the Sea, not extending to Japanese areas.

7 The Ministry of Defence of the Russian Federation.

the process of the development of such territories based on national laws.

There are areas which are attributed to different types according to legal classifications, determined by provisions in the UN Convention on the Law of the Sea.

The legal environment of the Russian coastal areas and their borders are also regulated by the Law "On the State Border of the Russian Federation" promulgated on April 1, 1993, the Federal Law "On the Continental Shelf of the Russian Federation" promulgated on December 7, 1995, the Federal Law "On Internal Waters, the Territorial Sea and the Contiguous Zone of the Russian Federation" promulgated on July 17, 1998 and the Federal Law "On the Exclusive Economic Zone of the Russian Federation" promulgated on December 17, 1998.

In the remaining part of the Sea of Okhotsk, the general rule is to attribute waters of all bays and gulfs with entrance widths not exceeding 24 miles to Russian internal waters. The status of internal sea waters is entirely determined by the sovereignty of the Russian Federation, which establishes rules regulating access of foreign military ships into these waters, navigational rules and other issues related to their presence in internal waters of the Russian Federation.

The Russian territorial sea is 12 miles wide. The Russian Federation has similar sovereignty over this area as other coastal states and is obliged to comply with the right to innocent passage by foreign vessels (granted under the Convention to vessels of all states). The Law "On the Exclusive Economic Zone of the Russian Federation" presumes the institution of the 200-mile zone, within which the appropriate authorities are able to establish special obligatory measures for prevention of pollution of the sea by vessels with regard to areas subject to Article 234 of the Convention. Article 234 empowers coastal states with authority over the protection and preservation of marine environments from pollution within exclusive economic zones. According to this Article "Coastal States have the right to adopt and enforce non-discriminatory laws and regulations for the prevention, reduction and control of marine pollution from vessels in ice-covered areas within the limits of the exclusive economic zone, where particularly severe climatic conditions and the presence of ice covering such areas for most of the year create obstructions or exceptional hazards to navigation, and pollution of the marine environment could cause major harm to or irreversible disturbance of the ecological balance." In other words, laws applicable to not all, but to the areas in question, may be stricter than those adopted at the international level. And not only with regard to discharging, dumping and the practice of navigation, but they must be applicable to other sorts of issues including projecting, construction, manning and equipment of vessels.

Currently, the Russian Ministry of Natural Resources is continuing its activities to defend the application and determination of the external boundaries of its continental shelf. Between June 24-29, 2002, the 11th Session of the Commission of the United Nations (UN) on Boundaries of the Continental Shelf took place in New York at the Headquarters of the UN. The Russian delegation that participated in the session was led by I. F. Glumov, the Deputy Minister of Natural Resources. The main topic that was discussed was consideration of the recommendations prepared by the special subcommittee with regard to the applications concerning the external boundaries of the

Russian continental shelf beyond the 200-mile zone, submitted by Russia in December 2001.[8] Regarding the Sea of Okhotsk, the Commission recommended that Russian make a well-documented partial submission for its extended continental shelf in the northern part of that sea. The Commission stated that this partial submission shall not prejudice questions relating to the delimitation of boundaries between states in the south for which a submission might subsequently be made, notwithstanding the provisions regarding the 10-year time limit established by Article 4 of annex II to the Convention. In order to make this partial submission, the Commission also recommended that Russia make its best efforts to effect an agreement with Japan in accordance with the Rules of Procedure of the Commission.[9]

It must be pointed out that the basic limitations and restrictions on navigation are stipulated in the national document “The Regime of Navigation of Vessels in Waters of the Pacific Coast of the Russian Federation.”[10]

Special areas have been established in the international La Perouse Strait between Sakhalin Is. (RF) and Hokkaido Is. (Japan), where territorial waters are from 3 to 12 miles wide.

3. Foreign Policy of Russia in the Maritime Field and Its Possible Application to the Sea of Okhotsk

Among the priorities of our external political activities in the maritime field in the immediate future, is the delineation of maritime spaces with neighbouring countries, responses to our national interests in terms of shipping safety, responsible fishing and scientific research activities in the world’s oceans in combination with measures to protect the maritime environment, the fight against terrorism, the suppression of the sea transport of weapons of mass destruction and materials connected with them as well as other kinds of weapons and drugs, the assertion of Russian interests in the activities of the organs of the system of the UN Convention on the Law of the Sea and other relevant international organizations.

The completion of the delineation of maritime spaces – territorial waters, the economic zone and continental shelf – with neighbouring countries will allow spatial boundaries of sovereignty to be defined and the legal and sovereign rights of our country along her sea coast to be established. As a result of the delineation of these regions, a clear legal regime will be created which will enable the safety and economic interests of Russia, her citizens and legal entities, to be ensured.

Negotiations with neighbouring countries are underway. The delineation of maritime spaces with Japan will become possible after the agreed formulation of the

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8 Statement made by the Deputy Minister for Natural Resources of the Russian Federation during the presentation of the submission made by the Russian Federation to the Commission on 28 March 2002. United Nations CLCS/31, Tenth session New York, 25 March-12 April 2002.

9 United Nations A/57/57/Add.1, Oceans and the Law of the Sea, Report of the Secretary-General. Distr.: General, 8 October 2002.

10 The Regime of Navigation of Vessels in Waters of the Pacific Coast of the Russian Federation (Summary #4440), as amended. Hydrographic Service of Pacific Ocean Fleet, 1996.

physical line of the border between our countries.[11]

Regardless of the fact that we formally talk about 'delineation' with contiguous states, in actual fact our aim is not division, but the creation of clear legal conditions for mutually profitable cooperation with our closest neighbours.

We cannot avoid problems arising in connection with the toughening of fishing rules in seas under the jurisdiction of coastal states, as well as in open waters beyond national jurisdiction which are within the scope of international agreements and organizations. The most important universal international agreement in this sphere is the agreement, signed on 4 December 1995, concerning the realization of the conditions of the UNCLOS, which concerns the preservation of transborder sea resources and stocks of far-migrating fish. The leading theme of the agreement was the idea of the impossibility of unregulated fisheries which could lead to a serious violation of balance in the sea's ecosystems, and the exhaustion of certain species of sea creatures. An innovation in international law was the condition making it possible to inspect foreign boats in open seas for this very purpose.

A serious problem for us has become the destructive trade of bioresources in the Russian economic zone. Of course, considerable harm is caused by domestic poachers, but at the same time, for example in the Far East, considerable contributions to illegal activities in the economic zone are financed by fishermen from other countries. This problem has become a constant topic of discussion with our neighbours.

The dynamics of the development of the modern world are more advanced than ever before. New realities are appearing which require timely and adequate reflection, including the norms of international law. Maritime law, as well as international law in general, is in a constant state of flux. The revision and updating of the regime set up by the Geneva Conventions of 1958 started approximately 12-15 years after they were enacted. Meanwhile, more than 20 years have passed since the UNCLOS was signed. This period has been full of large-scale technological and political changes. Our task therefore, is to update foreign affairs and positions on international law in a timely manner in order to achieve the security of Russia's interests.

The main idea in progressing with a maritime regime for the Sea of Okhotsk is to engage in as much cooperation as possible. We realize now that, as Mr. S. Lavrov, Russian Foreign Affairs Minister said in a press conference after negotiations with his Japanese colleague, "the positions of the parties are quite opposite," so we cannot expect the determination of the physical line of the border between our countries in the near future.

That does not mean that we have to stop joint activities in the maritime and fishery fields. The more local or partial agreements we achieve, the closer we come to global solutions.

As an example, I would like to refer in brief to the cooperation between states in the Baltic Sea with Russia, Finland and Estonia successfully cooperating in the Gulf of Finland. The delimitation of sea areas with Estonia has now almost been solved and

[11] "The priorities of the external policy of Russia with regard to the sea." S. Lavrov, Magazine External Economic Relations #4, 2005.

was to be legally concluded after the signing and coming into force of the Agreement of the Delineation of the Continental Shelf and the Economic Zone. The process was cancelled however, and has been postponed due to political problems. And although a marine border hasn't been established, we have already cooperated a great deal in maritime affairs. That cooperation was considered to be of significant importance by the President and the government of the Russian Federation.

With success like this, an agreement can be made between Russia and Japan in the future. Agreement should form the basis for the further development of mutually acceptable accords for all aspects of use of the waters of the Sea of Okhotsk and joint activities between Russia and Japan in them. The Agreement should be made only after the settlement of all existing disputes.

The Agreement should set forth the main directions of joint activities in aquatic areas. First of all, this means maintaining Russian and Japanese interests in the area of navigation, fishing and exploitation of the shelf, as well as preservation of the already established practice of interaction with other states.

The Agreement should be based on effective international laws, namely UNCLOS-82 and Russian and Japanese laws related to internal sea waters, the territorial sea, the adjacent zone and the continental shelf. We hope that this Agreement is not a fantasy, but a future of our direct descendants. A draft of such an Agreement is proposed by the author below.

The author has heard many proposals for the use of the Sea of Okhotsk and the concept of the Particularly Sensitive Sea Area (PSSA), according to IMO Guidelines. A very important issue is the Russian point of view on the designation of vast marine areas as PSSAs, such as with the entire Baltic Sea (excluding waters of Russian sovereignty), for example. The Russian Federation was unable to support the designation and would not support such a move in the future for several reasons.

Firstly, we believe that the idea of designating a PSSA and adopting associated protective measures is justified only in respect to special maritime areas, which are restricted by their natural geographical limits.

When talking about the PSSA designation of the Baltic Sea, our Minister of Foreign Affairs, Mr. Lavrov, stressed that the Baltic Sea has been named a PSSA according to a decision of the IMO, even though the system of shipping in its waters has not yet been toughened.[12]

Speaking about vast areas, such as the Sea of Okhotsk, it is more reasonable to use Special Area status in the context of MARPOL 73/78. Our argument is supported by the fact that all associated protective measures can be implemented within routine IMO procedures, and thus no further adoption of special mechanisms (such as PSSA) is required.

As for environmental protection, we believe that rather than the PSSA mechanism, the resources available under the UN Convention on Biological Diversity are sufficient. We believe that an approach of this kind, aimed at establishing

[12] "The priorities of the external policy of Russia with regard to the sea." S. Lavrov, Magazine External Economic Relations #4, 2005.

protective measures for entire sea regions (such as the Baltic and Okhotsk Seas) would be all-embracing and multilateral, and not simply politically inspired and is therefore completely reasonable.

That does not mean that we are against any associated protective measures, Russia supports reasonable measures even if they are announced as "associative." Thus Russia wholeheartedly supported the proposal of the Baltic States to implement new traffic separation schemes in Bornholmsgat and in the north of Rügen, amendments to the traffic separation schemes off Gotland Island and in the south of Gedser, as well as new areas to be avoided in the Baltic.[13]

The IMO approved on 13 December 2002, a joint application from Finland, Estonia and Russia for the establishment of a mandatory Ship Reporting System. According to IMO resolution MSC.139(76), Finland, Estonia and Russia require that all ships of 300 GT and over participate in GOFREP while sailing in international waters in the Gulf of Finland. The GOFREP went into initial operation on 1 July 2004, and an official ceremony was held in Helsinki last October. The agreement covers the international waters of the Gulf of Finland in a joint effort between Finland, Estonia and Russia. I would once again like to draw reader attention to the fact that we still have not established the border between Russia and Estonia in the Baltic, which makes this similar to the Sea of Okhotsk, but that this was not an obstacle to effective cooperation.

4. The Agreement on International Cooperation for the Use of the Sea of Okhotsk

Since the Sea of Okhotsk is bound by Russian lands – the coast of the Asian continent, Sakhalin Island, Kamchatka peninsula, the Kuril Islands —and Japan's Hokkaido Island, the Agreement can be made between the Russian Federation and Japan. Agreement should form the basis for the further development of mutually acceptable accords for all aspects of use of the waters of the Sea of Okhotsk and joint activities between Russia and Japan in them. The Agreement should be made only after the settlement of all existing disputes.

The Agreement should set forth the main directions of joint activities in aquatic areas. First of all, this means maintaining Russian and Japanese interests in the area of navigation, fishing and exploitation of the shelf, as well as the preservation of the already established practice of interaction with other states.

The Agreement should be based on effective international laws, namely UNCLOS and Russian and Japanese laws related to internal sea waters, the territorial sea, the adjacent zone and the continental shelf.

In the opinion of the author, implementation of the Agreement should not require additional expenses from Russia from the federal budget. Below is a draft of a possible Agreement by the author in a form it could initially take and so it is effectively a declaration of intent.

[13] Sub-committee on Safety of Navigation (NAV) 52 report to the MSC. IMO, 2005.

AGREEMENT
Between the Russian Federation and Japan
on Cooperation for the Use of the Sea of Okhotsk

The Russian Federation and Japan, hereinafter referred to as the Parties,

being governed by the interests of preservation of the environment and the stable development of the region;

recognizing the importance of the Sea of Okhotsk for the stable development of the region:

being convinced that all issues related to the Sea of Okhotsk shall be settled by peaceful means only and in cooperation or as agreed by the Parties to the Agreement;

proceeding from the necessity of preserving the Sea of Okhotsk as an indivisible ecosystem, used in the interests of Russia, Japan and the whole of humankind;

have agreed as follows:

Article 1

The majority of the Sea of Okhotsk historically comprises the internal sea waters, the adjacent zone and the exclusive economic zone of the Russian Federation, as well as the internal sea waters, the territorial sea and the adjacent zone of Japan. Additionally, there is the area of the high sea in the Sea of Okhotsk which is surrounded by the exclusive economic zone of the Russian Federation.
[Further, the complete description of all waters of the Sea of Okhotsk, both international and national, should follow.]

All issues related to the status of waters in the Sea of Okhotsk have been settled.

Article 2

1. Merchant vessels, fishing vessels, military ships and state vessels in the Sea of Okhotsk shall be granted navigational freedom within the limits determined by the status of waters and specified by the UNCLOS-82 and the respective national laws of the Parties.
2. Merchant vessels, fishing vessels, military ships and state vessels in the Sea of Okhotsk shall be granted the right of innocent passage and other inalienable rights, specified by the UNCLOS-82 and the respective national laws of the Parties.

Article 3

International cooperation, and specifically joint activities in the area of fishing, including its regulation and navigational-hydrographic support, protection of the sea environment, ecological safety and also searching and salvation in the Sea of Okhotsk, shall be supported by both existing agreements and making, when appropriate, new agreements.

Article 4

Disputes between the Parties related to interpretation and application of this agreement hereof, shall be settled through consultations and negotiations, and also by other peaceful means as determined by the Parties.

Article 5

1. This Agreement shall be subject to ratification and shall take effect from the date when the Parties exchange Letters of Ratification.
2. Amendments and addenda hereto shall be formalized by separate protocols which shall take effect according to the procedure described in Paragraph 1 of this Article.

5. Conclusion and Tasks for Future Solutions in the Sea of Okhotsk

The global and national importance of the Sea of Okhotsk is mainly determined, but not limited to the following factors:

- The Sea of Okhotsk is a source of fishing stocks;
- The Sea of Okhotsk is a source of crabs;
- The Sea of Okhotsk is a source of caviar;
- The Sea of Okhotsk is a source of mineral reserves;
- The Sea of Okhotsk is a source of oil and gas;
- The Sea of Okhotsk is an area of merchant navigation.

Russia has made a significant contribution to the investigation and development of the area of the Sea of Okhotsk and Russians were the first to discover many lands and islands in the Sea of Okhotsk and the Pacific Ocean.

The suggested regime for the Sea of Okhotsk, made with the cooperation of Russia and Japan, shall include the following actions:

- development of a special legal and ecological status for the area of the high sea in the Sea of Okhotsk;
- development of a map of precise legal borders for the differing status of regimes of navigation and ecological importance and their comparison with the purpose of facilitation of activities related to the protection of the environment and ecology in the area of the Sea of Okhotsk;
- adjustment of regimes in fishing zones, areas for dumping and discharge of hazardous substances, especially when issuing licenses for new oil extraction facilities and other transportation and extraction activities.
- development of shipping routes and areas for extraction of natural resources.
- consideration of issues related to the extension of the area of marine reservation areas, areas for habitation of marine mammals and other zones for the protection of nature;
- consideration of the issues related to control and monitoring in areas for the discharge of hazardous substances and dumping, especially in locations of planned and recently begun oil extraction;
- consideration of quotas of marine resources for all areas and the surface of the

Sea of Okhotsk;

- consideration of issues related to the legal status, economic feasibility and environmental safety of the development of international and Russian technical systems and aids for control, monitoring and informational support in special zones and areas of protection of the environment in the Sea of Okhotsk;
- creation of a map of the precise nature of legal status, regimes, fishing zones, environmental protection and areas of habitation of sea mammals with the purpose of developing international and national plans for the Sea of Okhotsk, which will ensure as far as possible the preservation of its biological diversity, living resources, natural resources and mineral wealth.

We hope all of these measures can be achieved through mutual cooperation between Russia and Japan in the near future.

Ice Certificate

The safety of the ice navigation ensured by the ship's hull as well as by her propulsion and steering means, is regulated by classification societies with assignment to the ship of the respective ice class depending upon the operating conditions and the function of the ship. At the same time, in practice, the safety of the ice navigation can be increased if the ship is complying with requirements of the Ice Certificate issued by a competent body that specifies the safe ice operating conditions depending upon the category of the ice strengthening, ice conditions and icebreaker escorting. If the expertise of ice and strength performances of the ship shows that under certain limitations the ship is capable to operate in given ice conditions, than the icebreaker escorting of the same will be carried out at lower speeds which ensures the increased navigation in ice.

Limited, i.e. safe escorting speeds are defined by calculation depending upon the specific design of the ship, her bodylines, displacement and power plant output. Results of the calculation constituting graphical dependencies of allowed save ship's movement speeds upon ice conditions and icebreaker escorting performances (channel width, broken ice form and concentration in the channel) are documented in the form of the document stipulating the ship's speed while navigating in ice, which is called the Ice Certificate.

The feasibility of development of Ice Certificates for ships operating in ice conditions has been recognized by the Russian Maritime Register of Shipping (RS) and the Northern Sea Route Administration (NSRA). Recommendations on usage of the Ice Certificate developed by a competent body are included in the RS Classification Rules for sea-going ships and the NSRA Guide for ships navigating along the Northern Sea Route.

These Regulations have been developed in order to increase the safety of the navigation in ice conditions. Depending upon specific ice conditions the Harbour Master can allow the ships navigation provided that these ships comply with the operation requirements at low ambient temperatures, their propulsion plant ensures their steady motion after the icebreaker and their possible safe operation in ice conditions is confirmed by the Ice Certificate or Provisional recommendations on the ice safety. The report on fitness of the ship for her operation in winter conditions as well as the Ice Certificate or Provisional recommendations on the ice safety, are issued by a competent Russian body authorized by the Ministry of Transport of the Russian Federation. Such competent body to do the following:

- Examination of sufficiency of the power plant output and the propeller thrust for ensuring the safe ship's navigation in the channel after the icebreaker.
- Examination of compliance of the ship with the operating conditions at low temperatures in the given area, including the reliability of operation of ship's systems, deck machinery and gears, and also hull structures.
- Development of recommendations for safe modes of the ship's motion in ice after

the icebreaker in the form of regulating document called the Ice Certificate, or Provisional recommendations on the ice safety for ships occasionally calling at the port. Such ships are to be provided with the mandatory icebreaker escort, the routing and keeping of sufficiently wide channel in the ice (the channel width by 20-30% to exceed the ship's beam).

The use of the Ice Certificate while operating in ice conditions allows the reasonable assignment of main parameters of safe ships motion modes in ice (safe speed of the ship motion, safe distances during the icebreaker escorting) depending upon the ice conditions in the area of the ship's operation (broken ice thickness, strength and concentration in the channel), icebreaker consorts and the technical state of the ship in question.

The Ice Certificate is valid for 10 years. Upon expiry of this term it is subject to renewal basing upon results of survey of the ship's grade of wear and tear. The Ice Certificate is also subject to renewal in case of inadequate replacement of main engines, propulsion plant as well as structural changes.

Ice Certificate Structure

The Ice Certificate includes the following:

- concise information about the ship and her ice performances (including her ice class), obtained from the design documentation, delivery trials and results of operation of ships of the given type;
- ice performance curves, diagrams of safe speeds, distances and circular motion radiuses in the channel after the icebreaker, are the main working document allowing to define the safe ship's motion modes in ice;
- assessment of the shipside compression strength.

Two categories of diagrams constitute the basis of the Ice Certificate:

a) diagrams for definition of the safe allowed motion speeds in ice;
b) diagrams for definition of the safe distance between the icebreaker and the escorted ship.

(Dr. Loly Tsoy, Head of Laboratory of Icebreaking Technology, Central Marine Research & Design Institute, Russia)

Original in Russian

TRANSPORT MINISTRY OF THE RUSSIAN FEDERATION

INSTRUCTION

17.02.2003	Moscow	№ ВР-30-р

"On measures ensuring the safety of navigation of cargo ships calling at freezing ports of the Russian Federation"

Safety of the navigation of ships in ice ensured by the strength of hull and propeller-rudder system is regulated by classification societies through the assignment to ship of an appropriate ice class depending on operational conditions and ship's purpose. A the same time, in practice the safety of navigation of ship in ice may be improved when meeting requirements of the Ice Certificate developed by a competent institution and defining conditions of the safe operation in ice in dependence on the category of ice strengthening, ice conditions and icebreaker support. If expert examination of the ice performance and strength characteristics of ship shows that she under certain limits is able of operating in given ice conditions, her escorting by icebreaker at lower speeds is carried out thus providing for higher safety of navigation in ice.

Results of the expert examination and relevant calculations representing graphic dependences of admissible safe speeds of ship on ice conditions and parameters of icebreaker escorting (channel width, configuration and concentration of ice in the channel) are presented as a document regulating speeds of the movement of ship in ice and called Ice Certificate. The advisability to develop Ice Certificates for ships operating in ice is acknowledged by the **Russian Maritime Register of Shipping** (**RS**) and by the **Northern Sea Route Administration** (**NSRA**). Recommendations on the use of the Ice Certificate developed by a competent institution are included into the Rules of the classification and construction of sea-going ships of **RS** and into the Guide for the ships sailing along the Northern Sea Route of **NSRA**.

Bearing in mind the above stated I am ordering:

1. in the icebreaker escorting of ships to ports to follow the attached *Regulations on the assessment of the suitability of ships to sail to freezing ports of the Russian Federation*;
2. to entrust the **Central Marine Research and Design Institute** (**CNIIMF**), leading under the Transport Ministry, with the functions of expert of the ice performance of ships proceeding to port and of being the author of ***Ice Certificate*** and ***Interim Recommendations on Ice Safety***;
3. captains of ports to take into account conclusions and documents developed by **CNIIMF** when determining the possibility of ship to call at port in winter.

Annex is attached

The First Deputy Minister V.V. Ruksha

Annex to Decree No. BP-30-p
of 17.02.03

AGREED	APPROVED
The Head of Northern Sea Route Administration	The Head of Department for Safety Navigation of the Ministry of Transport of the Russian Federation
________________ A.G. Gorshkovskiy	____________________ M.I. Suslin
14 February 2003	14 February 2003

REGULATIONS ON ASSESSMENT OF THE FITNESS OF SHIPS FOR WINTER NAVIGATION TO THE FREEZING PORTS OF THE RUSSIAN FEDERATION

General Director of CNIIMF, D. Sc. V.I. Peresypkin

Moscow

2003

Canadian Experience in Arctic Development and Regulating Shipping in Ice

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Abstract

This report comprises the Canadian contribution to the third year of JANSROP Phase II. It is an extension of earlier work done for the programme. The first part presents the status of development projects in the Canadian Arctic. The second part describes Canadian experience with an arctic marine regulatory system, proposes two options for a marine regulatory system for the Sea of Okhotsk, and outlines the requirements for an ice routing system.

1. Introduction

The International Northern Sea Route Programme (INSROP), which ran from 1993 to 1998, produced results leading to the conclusion that the Northern Sea Route (NSR) has the potential of being utilized as an international shipping route. To promote the use of NSR, the Development and Operation Programme for Environmental Sustainability has been implemented by the Ship and Ocean Foundation (SOF) as a project called JANSROP (Japanese Northern Sea Route Programme) Phase II. The purpose of JANSROP Phase II is to raise international interest in the NSR through the exploitation of natural resources, especially along the eastern half of the NSR by proposing developmental schemes, working out scenarios for the construction of cost-effective infrastructure, transport complex and ports and harbours along the NSR, and the establishment of a marine operation regime in the sub-arctic region based on the principle of the environmental sustainability with a particular emphasis on the Sea of Okhotsk as a typical example.

This paper comprises the Canadian contribution to the third year of JANSROP Phase II. It is an extension of earlier work done for the programme. The first part covers the status of developments projects in the Canadian Arctic and the second part expands upon regulatory and other aspects of winter shipping in the Sea of Okhotsk.

2. Canadian Arctic Development of Resources

Early development (1974-2002) can be characterized as a tidewater Canadian Arctic resource economy. Development of Arctic resources began with lead/zinc mines and oilfields in the Canadian Arctic; for example Nanisivik Mine, Baffin Island (1974-2002), Polaris Mine, Little Cornwallis Island (1982-2002), and Bent Horn Oil Terminal Cameron Island (1985-1997). In all three cases the resource was located at the coast or within a few kilometers of the coast, with good marine access. These lead/zinc mines and oil fields are now closed, with the resulting significant reduction of commercial marine traffic in the Canadian North.

The shipping experience gained as a result of these developments forms the backbone of present day Canadian Polar shipping expertise. The experience has contributed significantly to the development of the Arctic Ice Regime Shipping System (AIRSS) component of the Arctic Shipping Pollution Prevention Regulations (ASPPR).

Past development was dominated by commodities; zinc/lead and oil, which required marine transportation as the means of export. Future resources include nickel, diamonds, gold and gas for example;

Nickel: Raglan & Voisey's Bay
Diamonds: Diavik, Ekati, Snap Lake, Kennedy, Jericho and others
Gold: Lupen, Boston, Meadowbank, George Lake and others
Gas: Mackenzie Delta

Thus the future, in contrast with the resource economy of 1970 through 2000 (which has seen all lead/zinc mines north of 60°N now closed, and the absence of any oil exploration for decades) lies in nickel, diamonds, gold and natural gas spread over a wider area. More developments are expected.

2.1 Current Developments

2.1.1 Nickel

Nickel development is being driven by prices at near historic highs. Development is concentrated on the Quebec/Labrador Peninsula. The Raglan mine started production in 1997, and Voisey's Bay will start in 2005. Both these developments require year-round marine transportation in ice-covered waters. The Arctic Ice Regime Shipping System and the future Polar Rules are the basis for managing this marine transportation.

Falconbridge's Raglan Nickel Mine, located in Northern Quebec near the south shore of Hudson Strait, entered production in 1997 and now produces 150,000 tonnes of nickel concentrate a year with an expected mine life of 20 years. Marine transport to Raglan fully complies with the ASPPR and the AIRSS, as the Port lies within Zone 15 of the Shipping Control Zones. The Raglan Mine relies completely on marine transportation through ice-covered waters to transport all the annual production of nickel concentrate as well as to receive all mine supplies. The shipping season extends from June 15 to March 15 each year. The shipping season closes from March 15 to June 15 for environmental reasons to minimize the impact of the marine operation on aboriginal hunting and wildlife populations. The MV Arctic, an icebreaking OBO constructed to Canadian Arctic Class 3 (CAC3) and given AIRSS numerals equivalent to a CAC4/3 hybrid, completes all marine operations. The vessel transits in mid-winter to the mine through the heavy pack ice of Hudson Strait without icebreaker support.

Voisey's Bay Nickel Mine is being developed by Inco Ltd. on the Labrador coast. It is one of the largest Nickel/Copper deposits in the world. Voisey's Bay will produce

350,000 tonnes of nickel concentrate and 300,000 tonnes of copper concentrate per year for an expected mine life from 19 to 29 years. Presently the mine and port are under construction, with completion in the fall of 2005. First shipment is expected in November 2005 (ahead of schedule). Like Raglan, it will have year-round navigation in ice-covered waters with the following schedule:

shipping open: 25 May to 15 December & 25 January to 15 April
shipping closed: 16 December to 24 January & 16 April to 24 May

The reason for the closure periods is to minimize the impact of the shipping operation on aboriginal hunting activities in the region. The location is south of 60°N and outside of ASPPR Control Zones, however Inco has committed to using the Ice Regime System (and associated Canadian Arctic Classes) as the basis for the management of marine operations.

2.1.2 Diamonds and Gold

The Barren Lands comprise a large area of the central Canadian Arctic bounded by the Queen Elizabeth Islands to the north and 60°N to the south, Hudson Bay to the east and the Mackenzie River to the west. The area presently accounts for all of Canada's annual diamond production and 10% of the world's. Many more diamond deposits are under development and exploration. In addition, the region is the most intensively explored region for gold in Canada.

All mine and exploration supplies must be brought in from the south on winter ice roads, an extreme cost that greatly limits the economic viability of the region. A proposed answer to solve the transportation problem for the Barren Lands is to build a Port in Bathurst Inlet along the Arctic Ocean coast. A port in Bathurst Inlet would allow icebreaking cargo vessels direct access to the region, greatly reducing the cost of both inbound supplies as well as the future export of base-metal commodities. This marine answer to the transportation problems of the Barren Lands is presently up for consideration by all levels of Government in the region and signifies the important role played by marine transportation in the Canadian Arctic.

2.1.3 Mackenzie Gas and Pipeline

Although the development of the significant gas fields found in the western Canadian Arctic has been planned for many decades, difficulties with resolving native land claims issues and the world price for gas have delayed development until now. The present development plan centres on three onshore gas fields located in the Mackenzie River delta (called Niglintgak, Taglu and Parsons Lake) and a pipeline to bring gas to the South. The pipeline proponents include Imperial Oil, ConocoPhillips, Shell Canada, ExxonMobil, and the Aboriginal Pipeline Group. It is significant that an aboriginal group is a participant in the undertaking. The schedule envisioned completion of First Nations negotiations, funding and permits in 2005, and the pipeline going into service in 2010.

Initial gas fields are onshore but will be expanded to offshore gas fields in future (including possible Alaska fields) as the service life of the pipeline will exceed the life of the existing on-shore gas fields. The future of offshore gas in the Beaufort looks very encouraging. It is seen as the next major source of gas for North America with reserves of at least 64 TcF.

2.2 Marine Transportation in Development

Marine transportation has played, and will continue to play, an increasingly vital role in northern resource development in Canada. Government, Industry, and the people of Canada have benefited from a mature marine regulatory environment where the rules are clear and well-described. Developers even use the rules to plan developments when the regulations do not apply (e.g. Voisey's Bay). The addition of International Maritime Organization/International Association of Classification Societies (IMO/IACS) Polar Rules to ASPPR will further enhance the strength of the Canadian Arctic regulatory regime.

The following can be concluded from Canadian Arctic experience in the development and transportation of natural resources:

- Marine Transportation has played a critical role in Canadian Arctic resource development
- Although we have recently seen a retraction in marine shipping activity, the future looks bright – being led by nickel, diamond, gold and natural gas developments
- A mature, strong, clear and stable regulatory regime contributes to sustainable development.

3. Update of Okhotsk Regime for Winter Shipping

3.1 Summary of Canadian Experiences with an Arctic Marine Regulator System

3.1.1 Overview

With the introduction of the Arctic Waters Pollution Prevention Act (AWPPA) in 1970, the Canadian Government enacted legislation to control the potential for pollution from marine transportation in Canadian Arctic waters. The impetus for the enactment of the regulations was the transit of the Canadian portion of the Northwest Passage by the American tanker *Manhattan* in 1969. Oil field development in the Beaufort Sea and Alaska was increasing in the late 1960's and concern was expressed that Canada did not have the regulatory means to control pollution from future icebreaking oil tankers transiting the Northwest Passage. The AWPPA was enacted to give Canada the regulatory authority to control pollution from land (to sea), from offshore activities, and from shipping in Canadian Arctic navigable waterways.

The application of the AWPPA to shipping, inside and outside its baselines and territorial seas is in line with Clause 234 of United Nations Law of the Sea (UNCLOS) which states:

Coastal States have the right to adopt and enforce non-discriminatory laws and regulations for the prevention, reduction and control of marine pollution from vessels in ice-covered areas within the limits of the exclusive economic zone, where particularly severe climatic conditions and the presence of ice covering such areas for most of the year create obstructions or exceptional hazards to navigation, and *pollution of the marine environment could cause major harm to or irreversible disturbance of the ecological balance. Such laws and regulations shall have due regard to navigation and the protection and preservation of the marine environment based on the best available scientific evidence.*

The Arctic Shipping Pollution Prevention Regulations (ASPPR, 1989) control shipping under the AWPPA. There are two aspects to the shipping control provisions of the ASPPR: the Zone/Date system of the original 1970 regulations and the Arctic Ice Regime Shipping System (AIRSS, 1996) of the 1996 amendment to the regulations. Details on the Zone/Date system and AIRSS can be found in the Transport Canada contribution to the JANSROP Phase II report (Santos-Pedro, 2003). Included in the AWPPR are specifications for the construction of Arctic-Class ships, crew qualifications, and reporting procedures. The original 1970 regulations specified 10 Arctic Classes while the AIRSS 1996 amendment specified four ice classes termed Canadian Arctic Class (CAC). In both cases, equivalencies to the Swedish-Finnish Baltic rules were also included for the lower ice-class (type) vessels. The Canadian Government will replace the existing Arctic Classes with the new IMO/IACS Polar Classes, once these have been adopted.

Also covered in the Arctic Waters Pollution Prevention Act are provisions for liability responsibility. The AWPPR provides for absolute liability in the event of an oil spill in the Canadian Arctic. In line with provisions of the Civil Liability Convention, the Canada Shipping Act has been amended and now extends strict liability coverage for all waters, including the Canadian Arctic.

3.1.2 Canadian Experience with the AWPPA 1970-2004

There is a wide body of experience gained in the application of the AWPPR by Canada over the past 34 years. Remarkably, the original 15 zone boundaries, as well as the entry and exit dates for each ice class applied to each zone, have remained little changed during that time. The definition of the boundaries, and entry and exist dates, for the 15 Zones of ASPPR was based on the best available knowledge of ice distribution in the Canadian Arctic and vessel performance in ice that existed in Canada in 1970. Ice distribution knowledge came from the then Ice Branch of Transport Canada, the organization responsible for the provision of ice information to marine interests operating in Canadian ice-covered waters (Ice Branch transferred to Environment Canada in 1972 and is now known as the Canadian Ice Service). This definition of zones was determined prior to the widespread use of satellite images for ice reconnaissance and an estimation of the performance of Arctic Class vessels, none of which had yet been built.

The original drafters of the Zone/Date component of the ASPPR relied heavily on the experiences from the existing shipping operations that occurred in the Canadian Arctic, namely, the annual community sealift. It is apparent from an analysis of the Zones/Dates that an accommodation was made to the sealift operators to ensure that the requirements of the sealift would not be unduly compromised by the new Zone/Date system. Evidence of this appears in two zones. Zone 3 was created to cover the marine access to the Eureka weather station on Ellesmere Island. Zone 3 allows access for a Type B vessel from August 20 to September 5 (but no access for the much higher ice class Arctic Class 1). This period happens to correspond to the timing of the sea lift to the weather station and it is clear that these dates were implemented to ensure that the sealift vessels (which at that time tended to be Type B ice class) could reach Eureka. However, experience over the years has demonstrated that the ice conditions in the Norwegian Bay portion of Zone 3 are too severe for the Type ice classes (A and B). The sealift is now undertaken by Coast Guard icebreakers alone, yet the Zone 3 dates remain in place in the regulations. Another example of an accommodation to the community sealift in the Zone/Date is the placement of the community of Resolute Bay in Zone 13 when ice conditions along the access route are more suited to Zone 6, which is more restrictive.

Experience with the Zone/Date system over the years has highlighted the fact that the inter-annual variability of ice conditions found in the Canadian Arctic were not well described by a rigid Zone/Date system. The practical application of the Zone/Date system resulted in vessels accessing areas regardless of the actual safety of the prevailing ice conditions in the area. For example, the Zone/Date system allows a Type C vessel access through the entire Northwest Passage from August 25 to September 25, despite the fact that such an ice class has a less than one in ten chance of making it through in any given year. To counter this problem, in 1996 Transport Canada introduced the Arctic Ice Regime Shipping System (AIRSS), described in Santos-Pedro (2003). AIRSS calculates the accessibility of a region to all ice classes based on the actual ice conditions in the region. The original intent was to supplement the Zone/Date system of the ASPPR with the AIRSS in its entirety. However, there was strong opposition from the commercial shipping industry to AIRSS: it was a system that was based on the highly variable ice conditions of the Canadian Arctic, hence removed the apparent certainty of vessel access dates and scheduling afforded by the Zone/Date system. In response, as an interim measure, the Canadian Government implemented AIRSS for vessels wishing to access the Zones outside of the allowable dates for the vessel. Consequently, the Zone/Date and AIRSS systems operate side by side under the ASPPR.

The history described above shows that the opposition to the ASPPR came from the commercial shipping industry. The Canadian Government has modified the regulations to accommodate those interests and gain experience with new operational systems. Although potential international challenges on the issue of innocent passage of the Canadian Arctic Archipelago are well publicized in the popular press, there has never been a legal challenge of the regulations, either in Canada or abroad. Canada has never been challenged in the World Court on the validity of the AWPPA, and no challenge is expected, since Canada's application of its Arctic shipping regulations conforms with Clause 234 of UNCLOS and, also by extension, clause 76.

3.2 Discussion on Proposed Marine Regulatory System for the Sea of Okhotsk

3.2.1 Overview

The February 2003 Canadian JANSROP report (Santos Pedro, 2003) provided a description of the various shipping regulations enacted by governments around the northern hemisphere to control shipping in ice-covered waters. These include the Arctic Shipping Pollution Prevention Regulations (ASPPR) enacted by the Canadian Government to cover shipping in Canadian Arctic waters, the Baltic Fairway System that maintains winter shipping to Finnish and Swedish ports in the Baltic and the Russian Passport System designed for the Northern Sea Route of Russia.

A summary of the strengths and weakness of each system is provided below:

ASPPR Zone/Date System

Strengths

- Provides shippers with predictable dates of access based on historical data
- Separates areas of historically lighter and heavier ice conditions

Weaknesses

- Does not take into account inter-annual variability of ice conditions, resulting in vessels potentially accessing areas with unsafe ice conditions or, conversely not being able to access areas even though conditions may be safe for navigation
- Original specification of construction standards for Arctic vessels deficient in several areas

ASPPR/AIRSS

Strengths

- Access to an area based on actual ice conditions present
- System has a scientific basis, having been extensively tested in field trials
- There is a reporting requirement
- Ice regime described by simple formula
- Requires more diligent ice observations (implies better safety)
- Identifies more hazardous ice conditions (low Ice Numeral)
- System development includes hull loading for different ice types
- Can use AIRSS for strategic planning by using ice charts

Weaknesses

- No pre-defined areas to act as a guide for vessel access
- Requires a well established infrastructure of ice information and regulatory support
- Seems complicated for operators to learn and apply
- The heavily ridged ice found in many areas of the Sea of Okhotsk may not be well described by AIRSS
- No predictability provided to operators as to where and when vessels will be allowed access into a region, since it depends on actual ice conditions

Baltic Fairway System

Strengths

- Access to ports based on actual ice conditions, preventing ships of inadequate power and ice class from venturing into unsafe conditions
- Demonstrates the effectiveness of multi-national co-operation in the application

and administration of a unified set of marine regulations for ice navigation

- Specification of the construction standards for the Baltic classes well suited for the region

Weaknesses

- Fairway regions not based on ice conditions rather unrelated marine traffic zones and coordinated assistance by icebreakers
- Little predictability in when fairways will open and close to ice classes each winter, due to the highly inter-annual variability of ice conditions in the Baltic

Russian Ice Passport

Strengths

- Provides for a booklet of safe speed for each vessel
- Provides for independent travel based on actual ice conditions

Weaknesses

- Existing system lacks theoretical justifications and experimental validation
- Issued by several different Russian agencies which may provide different results
- There are no reporting requirements

3.2.2 Marine Regulatory System for the Sea of Okhotsk (Option I)

A marine regulatory system for the Sea of Okhotsk that builds on the strengths noted above, while at the same time avoiding the weaknesses, would be the most effective in preventing marine pollution in the Sea of Okhotsk. The proposed system would have the following characteristics:

Bi-national Marine Navigation Committee

Russia and Japan establish a bi-national committee (likely made of each country's respective maritime Administrations) to administer the Marine Regulatory System (similar to the co-operation between Sweden and Finland in the Baltic).

Sea of Ohkotsk Ice Zones

As described in Santos-Pedro (2003), there is a wide range of ice conditions that occur in the Sea of Ohkotsk and adjacent areas. As a basis for a shipping control system, a series of Zones could be defined, outlining regions of similar ice conditions.

Flexible Table of Entry and Exit Dates

Using the Baltic and Polar Classes, create a table of access for each ice class based on the average or nominal ice conditions. Each year, allowance is to be made to lengthening or reducing the access dates based on the prevailing ice conditions in that given year, as determined by the Navigation Committee.

Book of Navigation

The vessels could have an optional navigation book that combines the attributes of the Russian Passport and the AIRSS numeral system. Ice information that is sent to the vessel could be used to calculate a numeral of ice safety that could be compared against the known or expected performance of the vessel in the calculated conditions. Such a system could ensure both increased safety of navigation, as well as vessel performance in ice.

3.2.3 Marine Regulatory System for the Sea of Okhotsk (Option II)

A more detailed analysis and consultation with all stakeholders would provide the optimum system, which may be a combination of the characteristics of OPTION I.

3.3 Ice Routing System

Providing requirements for safety have been satisfied, performance, both in terms of time and fuel consumption, is a priority in route selection when transiting through ice-covered waters. There are three main components to a routing system: ice information, knowledge of ship performance, and a routing model for predicting performance. A routing model could either provide a prediction of transit time and fuel consumption for a chosen route or use an optimization function to select a route. In its simplest form a routing system utilizes some sort of descriptive imagery of the ice and the experience of the master or ice navigator and crew. More sophisticated routing systems can process digital information on ice conditions and use information about the performance characteristics of a ship to indicate routing. Developing a functional routing system is a very demanding task. Within the context of this project only an outline of such a system will be described.

3.3.1 Ice Information

The starting point of a routing system is having information about current ice conditions and ideally forecasts of likely changes. Typically, national ice services provide charts of ice conditions using the WMO "egg code", or some modification of it, to quantitatively describe the ice. The WMO "egg code" quantitatively describes partial concentrations, stage of development (age or thickness) of each partial concentration and floe size. There are some shortcomings to the WMO classification. Each stage of development characterizes a range of ice thickness. For thicker ice these ranges are so large that they are not particularly helpful. In the Baltic, supplementary information specifies ice thickness to the nearest 10 cm. In Russian practice the degree of ridging and pressure are indicated quantitatively. There are other approaches to describe ice conditions that more directly relate to ice navigation. Keinonen et al. (1991, 1996) and Riska et al. (2001) have assumed that there are five ice conditions that can be encountered: (i) level, (ii) channel, (iii) ridges, (iv) ice floes or (v) open water. This approach requires very detailed ice information in terms of properties and their spatial distributions. To simplify, Keinonen proposed an "equivalent ice thickness" to combine each of these components in an ice regime. Riska's approach is more complex, maintaining each ice condition. Another approach was an adaptation of the Canadian Arctic Ice Regime Shipping System (AIRSS) to operational ice navigation (Frederking, 1999), developing a set of "Transit Multipliers" related to WMO ice categories with adjustments to the multipliers for decay, ridging and floe size. An Ice Index developed by Kamesaki et al. (1999) quantified ice conditions with a modified AIRSS, supplanted by adjustments for ridging severity and ice strength. None of the approaches mentioned here takes into account directionality in ice conditions. In practice leads may be oriented, providing avenues of lighter ice conditions.

The ice charts, from whatever authority they are provided, describe current ice conditions or predicted ice conditions for the near future. Ice conditions, however, are not static. In some circumstances they may change rapidly. A forecast model that can predict evolving ice conditions would be a useful attribute in a complete description of conditions.

The following factors concerning ice information would be required for a routing system:

- Digital (quantitative numerical) ice information, as a minimum based on the WMO "egg code", i.e. partial concentrations, stage of development (age or thickness) of each partial concentration and floe size. Ideally this information should be supplemented by more precise ice thickness, ridge size and frequency, pressure, and directionality of leads.
- Digital ice information spatially represented in a GIS system.
- A high resolution forecast model that can produce digital ice information at appropriate time intervals into the future.

3.3.2 Ship Performance

There are a number approaches for predicting ship transit performance in ice. The approach of Keinonen et al (1991), while empirically based, allows consideration of ship size, bow form, form, type of propulsion, friction, and snow and ice conditions. Patey and Riska (1999) have described an approach that takes into account 16 ship parameters and five ice conditions (open water, channel ice, level ice, ridged ice and floe ice). The ship performance model predicts velocity as a function of ice conditions, ship characteristics and power setting. Determining the speed is an iterative process involving a balance of thrust and resistance. Fuel consumption rate is a function of the power (from which the fuel consumption can be determined).

Ship performance would be determined using the following factors:

- A performance model for a ship to predict resistance as a function of velocity, equivalent ice thickness and strength, snow depth, ship particulars including bow form, and hull condition.
- Power, thrust and fuel consumption as a function of velocity for the ship.
- A calculation algorithm to balance thrust and resistance for a particular power setting to give steady-state transit speed and fuel consumption.

3.3.3 Routing Model

A routing model is the means by which the GIS based information on ice conditions is combined with ship performance to determine the transit time and fuel consumption for a voyage between two selected points. Patey and Riska (1999) have developed a transit simulation program NEWSIM, that was subsequently extended (Riska et al., 2001) to use the Kamesaki el al. (1999) Ice Index to make probabilistic predictions of transit times for strategic planning purposes. Frederking (2003) described a routing model that could be used to determine transit times and fuel consumption for specific routes through ice regimes.

A routing model should include the following features:

- Windows-based visual presentation of ice chart information derived from digital ice data in a GIS format. This ice information could be fixed in time, or time stepped at appropriate intervals, to represent evolving ice conditions.
- The ability to lay out various routes on the GIS ice charts and use the ship performance model to predict transit times and fuel consumption for a number of alternative routes.
- For evolving ice conditions, a time stepping method using updated ice conditions could be used to calculate transit times and fuel consumption for pre-selected routes.
- An optimization methodology could be used to determine a route given the start and the end points.
- A model running on-board ship with input from on-board marine radar plus ice information communicated to the ship would be particularly useful for tactical navigation.

3.3.4 Summary

The primary components of a routing system have been outlined. The technology for supplying digital ice information to a GIS platform is available, however there is still a requirement for a better quantitative description of the ice. There are adequate equations for describing ship performance in ice. Routing models for strategic planning, as well as more tactical operations, have been identified. There are no technical barriers to implementing ice routing systems for the Sea of Okhotsk.

3.4 Review of Historical and Current Ice Information Available

The best sources of ice information are the NOAA Satellite Active Archive (SAA) as well as MODIS archive. These Archives Include detailed satellite imagery dating back to the early 1990's over the region. Imagery for earlier dates is available from the DMSP archive. Although there are limited data and they are very hard to retrieve, some data for the Sakhalin Island region is archived at Enfotec.

For an operational service, a direct-receive MODIS and NOAA-AVHRR receiving station in the region would allow direct access to real-time data from these satellites. In addition, there are a number of synthetic aperture radar satellites in operation (RADARSAT-1 and ENVISAT) as well as planned for launch in the near future (RADARSAT-2 launch late 2005 and Terra-SAR-X launch 2006) that can provide near-real time imagery of ice in the region. An ice analysis centre combined with shipboard ice navigation systems (such as Enfotec's IceNav system) can provide state-of-the-art information for vessel navigation in the region.

3.5 Identification of Problems Still to be Solved

- Adequate description of the historical variability of the ice in the region not yet acquired.
- Modification to the WMO "egg code" to provide improved information about ice ridges.
- Many outstanding environmental issues (such as the impact of development on

the western population of the Pacific Grey Whale) arevstill unknown.

3.6 Acknowledgements and Disclaimer

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Developments in Environmental Protection - the Barents Sea and European Union Waters

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1. Introduction

The marine environmental measures noted in *Suggestions for a Conceptual Design of an Okhotsk Sea Environmental Regime - Comparison with the Barents Sea* (*Suggestions for Okhotsk Sea*) under traditional international law also govern for the European Union (E.U.) (and Norway), since almost all States have ratified the central IMO treaties governing international shipping.[1] However, due to a number of devastating oil tanker accidents, involving the *Patmos* in 1985, the *Haven* in 1991, the *Evoikos* in 1997, the *Erika* in 1999, and the *Prestige* in 2002, where it appeared that existing legal regimes, including MARPOL 73/78, were functioning less than optionally to control marine vessel-source pollution,[2] the E.U. appears to be challenging the International Maritime Organisation (IMO) regimes.

2. New International Developments

There is presently strong development surrounding marine protected areas including particularly sensitive sea areas (PSSA), especially in Europe.[3] Up until the late 1990's PSSA's were seldom utilised; Australia's Great Barrier Reef was designated by the IMO in 1990 as a 'particular sensitive sea area' within an extended territorial sea where compulsory pilotage was required.[4] However, in 1998 Cuba's Sabana-Camagüey Archipelago was designated, and two PSSA's were formally designated in March 2002, marine areas around the Florida Keys and the waters surrounding Colombia's Malpelo Island. The Wadden Sea north of continental Europe was recently PSSA designated, the first in Europe waters; and a sixth and a seventh area, off the coast of Peru, Paracas National Reserve, was recently designated in 2003, and Western European Waters in 2004.[5] Discussions in the IMO surrounding the

1 Norwegian environmental measures governing both international shipping and offshore hydrocarbon developments including the anticipated Barents Sea Management Plan have been enumerated in *Suggestions for Okhotsk Sea.*

2 See Mason, M., 'Civil liability for oil pollution damage: examining the evolving scope for environmental compensation in the international regime, *Marine Policy*, Vol. 27, (2003), 1-13.

3 The E.U. is aligning with Australia and New Zealand on marine protected areas under the Convention on Biodiversity (CBD).

4 See Birnie P., and A. Boyle, *International Law & the Environment*, p. 276 who note that the U.S. designation, however, of the Florida Keys as an 'area to be avoided' and the prohibition of tankers in this area appeared at that time to be an unilateral act and thus in breach.

5 See http://www.imo.org/Newsroom/mainframe.asp?topic_id=848&doc_id=4009, and WWW Briefing p. 1.

Baltic Sea in Europe, the Canary Islands and the Galapagos Islands and IMO designation 'in principle', resulted in complaints raised by several States including Russia and several shipping organisations.

2.1 PSSA's

Looking more specifically at the European areas, the *Wadden Sea* met the criteria for designation as a PSSA in terms of *ecological sensitivity, social, cultural and economic importance,* as well as *its importance scientifically and educationally.* It is Europe's largest coastal wetland, and one of Europe's last natural areas of this type.[6] It is a shallow sea extending from Den Helder in the Netherlands, along the entire north-west coast of Germany to Esbjerg in Denmark. Around 260,000 vessel movements take place per year. The designation is for the purpose of increasing the awareness of seafarers of the vulnerability of the area, and 'appropriate protective measures' are already in place.[7] These include four traffic separation schemes 'off Friesland'[8], 'off Texel,[9]' 'off Vlieland, Vlieland North and Vlieland Junction,[10]' 'Terschelling-German Bight,'[11] and 'German Bight Western Approach'[12], and the deep-water routes forming parts of the routing system 'off Friesland'.[13]

The *Baltic Sea* area with the exception of the Russian territorial sea; the *Galapagos Archipelago* (Ecuador); and *the waters of the Canary Isles archipelago extending 12 nautical miles (nm.)* (Spain) were approved 'in principle' by the IMO Marine Environmental Policy Committee (MEPC) 51 in March and April 2004 for designation as three new PSSA's.[14] The proponents of the three PSSA's stated that they would submit detailed proposals for 'associated protective measures' linked to the PSSA's to the Sub-Committee on Safety of Navigation (NAV) in 2005 for subsequent consideration by the MEPC.[15] The Baltic States, except for Russia, proposed that the Baltic Sea, minus the Russian territorial sea, be designated 'in principle'. No new 'associated protective measures' were proposed, but the States suggested that they

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6 This description is taken from Pullen, S., K. Gjerde, A. Mäkinen, J Lamp, J. Varas, and A. Tveteraas, 'Particularly Sensitive Sea Areas (PSSA's) in the North-East Atlantic and Baltic,' *WWF Briefing*, 2003 (WWF Briefing), p. 2. For further information, Stephan Lutter, WWF North-East Atlantic Program, Am Gütpohl 11, D-28757 Bremen, Germany. World Wildlife Foundation (WWF).

7 See Roach, J. Ashley, 'Particularly Sensitive Sea Areas: Current Developments', (Eds. Nordquist, M., J.N. Moore, and S. Mahmoudi), *The Stockholm Declaration and Law of the Marine Environment*, (The Hague, Martinus Nijhoff Publishers, 2003), p. 314. IMO citations are included. J. Ashley Roach is Captain, Judge Advocate General Corps, United States Navy (Retired), now at the Office of the Legal Advisor, United States Department of State. A disclaimer appears in the first note that the views expressed are solely the responsibility of the author and are not intended to reflect the positions of the Department of State or any other agency of the United States Government., p. 316; MEPC 47/20, § 8.11.

8 Roach, J., Ashley, 'Particularly Sensitive Sea Areas: Current Developments', p. 316; IMO Ships' Routing, Part B II/9-1 – II/9-3.

9 Roach, J., Ashley, 'Particularly Sensitive Sea Areas: Current Developments', p. 316; IMO Ships' Routing, Part B, II/11.

10 Roach, J., Ashley, 'Particularly Sensitive Sea Areas: Current Developments', p. 316; IMO Ships' Routing, Part B, II/12-1 – II/12-2.

11 Roach, J., Ashley, 'Particularly Sensitive Sea Areas: Current Developments', p. 316; IMO Ships' Routing, Part B, II/13-1.

12 Roach, J., Ashley, 'Particularly Sensitive Sea Areas: Current Developments', p. 316; IMO Ships' Routing, Part B, II/14-1 – II/14-3.

13 Roach, J., Ashley, 'Particularly Sensitive Sea Areas: Current Developments', p. 316; IMO Ship's Routing, Part C, II/3-1 – II/3-3..

14 See http://www.imo.org/Newsroom/mainframe.asp?topic_id=848&doc_id=3551.

15 See www.uscg.mil/hq/g-m/mso/ docs/MEPC_51_Delegation_Report.doc from which the following is taken.

would do so at NAV in 2005, likely seeking approval of additional traffic separation schemes in high traffic density areas in the Baltic.

Western European Waters were designated 'in principle' at MEPC 49 in 2001 as a PSSA. MEPC 52 agreed to the final designation of this PSSA[16] In the October 2004 MEPC meeting Western European Waters were finally designated, with a new mandatory yet free, without charge, vessel reporting system as an 'associated protective measure' under SOLAS Regulation V/11 which entered into force in June 2005.[17] NAV had approved a mandatory ship reporting system which was proposed by Belgium, France, Ireland, Portugal, Spain and the U.K. to serve as a 'appropriate protective measure' for this area. This PSSA covers the Western coasts of the United Kingdom, Ireland, Belgium, France, Spain and Portugal, from the Shetland Islands in the North to Cape S. Vicente in the South, and the English Channel and its approaches.[18] Sensitive areas include a very high species diversity of both macro-fauna and flora, including seabirds. Offshore waters of Ireland contain some of the richest fishing grounds in Europe. Various specially protected areas already exist off the coasts of Ireland, Belgium, Spain and Portugal. Off the coasts of Belgium lie areas known for fishing, and off France lie areas known for great biodiversity and biological wealth. Spain and Portugal enjoy coastlines with areas containing species of fauna and flora with a high degree of endemicity. The marine and shore environment of the Belgian, French, Irish, Portuguese, Spanish and U.K. coasts, the English Channel and its approaches are thus particularly vulnerable to the risks of vessel transport. This area is also one of the most international significant sea routes due to the number of ships and quantities of dangerous or polluting goods transport. 25% of the world's commercial traffic converge on the English Channel, on the way to the industrial areas and harbours of northern Europe. Additionally significant cross channel commercial traffic exists between Ireland and the U.K., between Ireland, the U.K. and the European mainland, and North European traffic bound for Western Atlantic ports. Other 'associated protective measures' already in place and adopted by the IMO under SOLAS include traffic separation schemes, deep-water routes, areas to be avoided, routing measures, mandatory ship reporting systems, and coastal vessel traffic services (VTS).[19]

At the same time, and perhaps because of the rapid development of the PSSA concept, unusual under international law, controversy exists. This includes within the IMO itself, and yet another revised set of Guidelines were to be voted upon in July 2005, centred upon a proposal by the U.S. and its measures taken in the Florida Keys. These, if approved, will require a stricter use of descriptive language of the necessary

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16 See http://imo.amsa.gov.au/public/resolution-titles/res-mepc.html (subscription) and www.uscg.mil/hq/g-m/mso/docs/MEPC_52_Delegation_Report.doc.

17 See MEPC 52/24 p. 47 citing MEPC121(52) and SOLAS Regulation V/11. See MEPC 52/24/Add.1, Annex 10, (Annex 3) for specifics regarding the new mandatory ship reporting system for the Western European PSSA. Detailed descriptions of the characteristics of the maritime traffic, the transport of harmful substances, and the threats from disasters, including a description of the meteorological, oceanographic and geographical conditions is found in MEPC 49/8/1, MEPC 49/8/1 add.1 and MEPC 49/8/1 Corr.1.

18 See MEPC 52/24/Add.1, Annex 10 for the following description. See MEPC 49/8/1 for detailed descriptions of the ecological, socio-economic and cultural, scientific and educational criteria of this area.

19 See MEPC 52/24/Add.1, Annex 10, (Annex 2) for specifics areas and measures. See *Suggestions for Okhotsk Sea* for developments under SOLAS.

elements, require at least one 'appropriate protective measure' specified at the time of IMO designation doing away with 'designation in principle', and require one of the specified sensitive elements to international shipping, for example coral, present throughout the area proposed, although not necessarily the same element.

2.1.1 Convention on Biodiversity (CBD) and the Associated Jakarta Mandate

What the above appears to mean seen from a European perspective is the following. The objectives of the Convention on Biodiversity (CBD) and the associated Jakarta Mandate on Marine and Coastal Biological Diversity go certainly in the right direction under the five key thematic issues. These include the application of appropriate policy instruments and strategies for effective implementation of integrated marine and coastal area management, undertaking direct action to protect the marine environment, and developing guidelines. Information is to be gathered, and assimilated and provided to parties on biological diversity, and sustainable use and ecosystem approaches promoted, encompassing as well areas beyond the limits of national jurisdiction. Marine and coastal protected areas are to be established, strengthened, and managed effectively, including through proper monitoring and research. Collaboration, co-operation and harmonisation of initiatives are to be undertaken. It remains to be seen how much implementation the instruments achieve in practice.[20]

The key to international regimes probably lies in *enforcement*, and in this respect the Barents Sea[21] and European marine areas not governed by special protective regimes may experience problems viewed with respect to the CBD. Parties are generally required to ensure that activities and processes including shipping under their flags do not cause environmental damage to other States, or to areas beyond national jurisdiction. Parties must be develop strategies. At the same time, due to the use of the phrase *as far as possible and as appropriate*, used in the centrally relevant Articles containing specific measures, little appears genuinely mandatory for parties exercising questionable jurisdictional control, such as flags of convenience States. Non parties are definitely not bound. Indeed, it appears possible that the Jakarta Mandate could be argued by rather disreputable parties to be fulfilling their CBD obligations under this phrase. This could include viewed in terms of oil and gas tankers flag States that these, as far as possible and as appropriate, promote environmentally sound and sustainable development, prevent introduction of, control or eradicate alien species, and ensure sustainable use of components of biological diversity. Further, it may be possible to argue by flag States under as far as possible and as appropriate that they require environmental impact assessment of proposed projects affecting biological diversity, promote reciprocal notification, information exchange and consultation on such activities, and examine issues of liability and redress, including restoration and

[20] Convention on Biological Diversity, http://www.biodiv.org/convention/articles.asp. There are 188 Parties to the Convention, current to September 2005, including Norway which ratified on 9 September 1993, Russia which ratified on 5 April 1995, and Japan which accepted on 28 May 1993.

[21] See Figures 1 and 1a.

compensation for damage to biological diversity. Flag state jurisdiction continues to be the most crucial in attempting to control marine vessel-source pollution, particularly in States' exclusive economic zones.

Additionally, a question may be raised concerning the States that are bound by the Convention on Biodiversity, though the CBD has 188 parties. Looking first at the 5 Arctic littoral States, Canada, Denmark/Greenland, Norway, Russia and the U.S., all with the exception of the U.S. have ratified the CBD, while the U.S. has signed, and is not strictly bound.[22] Thus, with respect to coastal States, the Barents Sea is generally governed by the CBD. The same may be said with respect to European waters. An important issue arises concerning flag States that are parties and whose vessels are hence bound by CBD provisions while navigating the Barents Sea and European waters. Looking at the largest thirty five shipping States listed in order of tonnage, *89.5% of the world's top thirty eight world merchant shipping tonnage are bound by the CBD in the Barents Sea eco-system.*[23]

A caution however regarding the *flags of convenience* or 'open registry' States must be made. These require little or virtually no link between nationality of shipowner and the vessel, while normally, all or a fixed proportion of the vessels' owners and/or crew must have the nationality of the State concerned. Experts note,

> (T)hese States are often said to be lax in the qualifications required of the crews of their ships, and to be unwilling or unable to exercise effective jurisdiction over their ships in matters of pollution control and shipping safety. Their past record certainly gives some support to this point of view…[24]

At the same time the same experts note,

> It must, however, be stressed that substandard ships can be found under most, if not all, flags, they are by not means peculiar to flags of convenience. In fact, the establishment of a genuine link in the case of ships owned by companies, which can be freely incorporated in States other than the State where the majority of shareholders are resident, is difficult to determine.[25]

What is of most importance is the vigour with which the flag State exercises its jurisdiction and control over ships after registration.

22 See http://www.biodiv.org/world/parties.asp#.
23 The largest thirty five shipping States listed in order of tonnage as of 2000 are Panama, Liberia, Bahamas, Malta, Greece, Cyprus, Norway, Singapore, China, Japan, U.S., Russia, Hongkong, Italy, Philippines, Denmark, India, Germany, Netherlands, South Korea, Turkey, Bermuda, the U.K. and Northern Ireland, Taiwan, France, Iran, Brazil, Sweden, Canada, Spain, Australia, Finland, Poland, Romania, and Iceland. Table current to 2000 obtained and adapted from P. Ørebech, Fisheries College, University of Tromsø, 12 April, 2005. The Netherlands and Finland have accepted rather than ratified, but are listed as parties. See also R. Churchill and A. Lowe, *The Law of the Sea*, (Manchester, Manchester University Press, 1999), p. 256 for a table of the top 20 flag States from 1997. The earlier list adds St. Vincent, and Marshall Islands, and also mentions Vanuatu, which are also parties. Obtained and adapted from P. Ørebech, Fisheries College, University of Tromsø, 12 April, 2005. See also R. Churchill and A. Lowe, *The Law of the Sea*, (Manchester, Manchester University Press, 1999), p. 256 for a table of the top 20 flag States from 1997. From this of the 38 largest shipping States, four are not CBD parties, the U.S., Bermuda, Hongkong and Taiwan. Additionally, the E.U. is a CBD party.
24 See Churchill R., and A. Lowe, *The Law of the Sea*, (Manchester, Manchester University Press, 1999), p. 259.
25 Ibid.

The flags of convenience include *Panama with the largest merchant fleet globally*, *Liberia, Cyprus, Bahamas, Malta, St. Vincent, the Marshall Islands and Vanuatu.* Owners of these vessels are chiefly nationals of Greece, Japan, the U.K. the U.S., Hong Kong and Norway. With these at least, it could be argued that effective exercise of State jurisdiction may be wanting in pollution control or safety, due to inability or unwillingness.[26] Thus it might be argued *32% of the world's top 38 world merchant shipping tonnage are not bound or are laxly bound by the CBD in the Barents Sea eco-system.*[27]

Seen in terms tankers carrying crude oil the same comparison indicates the top 10 State flags are Bahamas, Hong Kong, Greece, India, Iran, Liberia, Malta, Marshall Islands, Panama, and Singapore. These contribute 77% to a total of 139,794,872 gross tanker tonnage world wide. Of these, non CBD ratifiers include only Hong Kong, but of the flags of convenience 5 of those include, Panama, Liberia, Bahamas, Malta and the Marshall Islands. In addition to these 10, if the top 39 tanker flag States are viewed,[28] all the CBD non ratifiers are included,[29] and 6 of the 8 flags of convenience appear, Panama, Liberia, Cyprus, Bahamas, Malta and the Marshall Islands, then *approximately 26% of the world's top thirty-nine world crude oil shipping tonnage are not bound or are laxly bound by the CBD in the Barents Sea eco-system.* Seen from the problems surrounding MARPOL 73/78 indicated in *Suggestions for Okhotsk Sea*, these findings may perhaps cast doubts upon enforcement of this regime as well in the Barents Sea and European waters. Indeed, the percentages of laxly bound States are undoubtedly greater, if viewed in relation to the expert statement above that substandard ships can be found under most, if not all, flags, and this practice is of course not restricted to the Barents Sea.

Due to the CBD vagueness where not only non parties, flags of convenience, but also other parties as well may comply less than optimally, much of enforcement would thus probably depend upon effective enforcement of the central vessel-source marine pollution treaties, MARPOL 73/78, and SOLAS, associated with 1982 United Nations Convention on the Law of the Sea (LOSC) Articles 211, 218 and 220.[30] While, the former experiences flag State enforcement problems, SOLAS allows a relatively quick establishment, accepted by the IMO, of sea lanes within a State's exclusive economic zone, which may be a way for a State to go in conjunction with or independent of a PSSA.[31] Enforcement under SOLAS would seem easier to facilitate due to the vessel

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26 See ibid.

27 This is based upon adding another 8 to the 4 States above not bound to the CBD.

28 The top 39 crude oil tanker flag States include, Australia, Belgium, Brazil, Canada, China, Taiwan, Cyprus, Denmark (DIS), Finland, French Antarctic Territory, Indonesia, Italy, Japan, South Korea, Kuwait, Malaysia, Nigeria, Norway, Norway (NIS), Portugal (MAR), Russia, Saudi Arabia, Spain (CSR),Turkey, United Kingdom, Bermuda, Cayman Islands, Isle of Man, U.S., and Venezuela. World Fleet Statistics Table, Crude Oil - Obtained from A. Gray, Lloyd's Register Fairplay, 29 April 2005. See http://www.lrfairplay.com/. The cut off criteria was set at 200,000 gross tonnage world wide with a total of 135 registers listed.

29 These are the U.S., Taiwan, and Bermuda, in addition to Hong Kong.

30 1982 United Nations Convention on the Law of the Sea (LOSC), *United Nations Treaty Series* (*UNTS*), Vol. 1833, p. 397.

31 A routing system can encompass mandatory sealanes, traffic separation systems and sailing rules in and out of a definite zone, recommended sealanes, deepwater lanes and precautionary areas, the latter which vessels must navigate with special care and through which recommended sealanes can be established. Areas to be avoided (ATBA) can also be established, where because of a particular danger or a particular sensitive ecological or

identification systems.

2.1.2 Associated Protective Measures

Enforcement problems and a vague CBD would undoubtedly count in favour of a coastal State including Norway establishing a PSSA, under the proper conditions, *since all international shipping vessels could be excluded from specific areas.*[32] *Preserving biodiversity through PSSA designation may indeed be the only way.* This is especially important to note, since controversy regarding PSSA designation continues in the IMO, in Russia and in Norway. Nevertheless, Norway could likely if necessary use an estoppel argument (reciprocity) against Russia with regards to a PSSA designation in the Barents Sea, due to the long established Russian areas to be avoided (ATBA's) and 'avant la lettre' in the Okhotsk Sea noted in *Suggestions for Okhotsk Sea*. Through no official statement from the U.S. State Department has yet been requested with respect to the Barents Sea, indications are that the U.S. appears generally somewhat reserved, since all the associated protective measures can be achieved without the use of a PSSA under SOLAS and other relevant IMO treaties.[33] Biodiversity concerns were not addressed.

The specific 'appropriate protective measures' carried out in the other designated PSSA's, could be examined, particularly such as those established for some time in Australia, the U.S. and Cuba. These already have support under international law, regardless of the unsettled Guidelines. *'Appropriate associated measures' looking cumulatively at the 10 PSSA's already designated include areas to be avoided, areas for compulsory pilotage, prohibition of discharges including ballast water, prohibition of dumping of most other wastes, installation of coastal State reception facilities, no anchoring, and enhancement of surveillance and monitoring capacities for illegal discharges.*

Looking at Australia's Great Barrier Reef, the number of different marine zones within the PSSA was increased from 6 to 9 last summer, 2004, with characteristic activities of permitted use differentiated from 13 to 16. The Florida Keys appears to have eleven differentiated areas. The developed established PSSA's have extensive management plans implementing in practice the 'appropriate protective measures'. The Florida Keys for example has a several hundred page management plan, which is renewed every 5 years. Should a PSSA in the Barents Sea be designated, the 'appropriate protective measures' and implementation of such carried out by Norway could for example be similar to or slightly less strict than the measures taken in the Great Barrier Reef, the Florida Keys and Cuba's Sabana-Camagüey Archipelago, in order to achieve less resistance from adversarial interests such as shipping. European coastal States could follow the same line.

At the same time, problems with a Barents Sea PSSA as outlined by Det Norske

environmental condition all vessel traffic or a certain type of vessels are forbidden to sail. A routing system can consist of several different of the above in combination. Mandatory or recommended vessel reporting systems are also allowed subject to application to the IMO. As part of this an automatic vessel identification (AIS) system of oil tankers is allowed, making reporting and a reporting scheme superfluous.

32 See Figure 2.

33 Roach, J., Ashley, Office of the Legal Adviser, 'Telephonic Interview' 23 February, 2005.

Veritas (DNV) north of Finnmark down to Lofoten about 50 nm. out to sea may include discrimination issues, both against Russian oil and gas tankers on the way to Europe and possibly Norwegian fishing vessels. All vessels in international shipping are subject to the measures taken by Norway. If Russia becomes a member of the World Trade Organisation (WTO) which may happen early in 2006, and oil is freighted initially solely on Russian tankers, it may be questioned whether these are discriminated under General Agreement on Trade in Services (GATS) by being required to sail 50 nm. to sea to Europe?[34] Fishing vessels though not technically regulated under the PSSA regime which governs international shipping, have in practice been strictly regulated or excluded in approximately 67% of the Australian Great Barrier Reef Marine Park - PSSA, and roughly 50%, looking at large trawlers, of the Florida Keys Sanctuary Area - PSSA.[35] What is to guarantee that Norway or other States may not establish a coincident 'Marine Park' - PSSA, containing 10 marine zones with 10 differentiated activities? A legal representative for particularly trawler organisations may with reason be concerned.

Many weighty policy arguments exist as well, possibly weighing against a Norwegian PSSA, outlined in the expert report 'Mot Nord',[36] as well as the recent Government White Paper, St.meld.nr.30.[37] These include untraditional bilateral co-operative agreements between Norway and Russia.[38] A Barents Sea management plan is expected developed by Norway by 2006, covering specific activities and dealing with the interactions between the hydrocarbon, fisheries, transport, biology and security interests.[39] Due to the balance attempting to be achieved by Norway in the Barents Sea, the legal controversy at all levels regarding PSSA designation,[40] current boundary delimitation negotiations with Russia, security concerns in relation to the U.S. and the E.U. and NATO, the influence Norwegian shipping, oil and gas, and fishing interests carry, the weight good relations with Russia carries, possible discrimination of Russian tankers sailing 50 nm. to sea, the sensitivity bilateralism with Russia entails, a thin population base in the district Finnmark on the Russian border, as well as the present controversy over Saami property rights in Finnmark

34 See http://www.wto.org/english/tratop_e/serv_e/gats_factfiction_e.htm. It appears only Russian oil tankers are permitted under the current production sharing agreements Russia has with Norway. The E.U. production sharing agreements allow other flags, which would seem to allow other flags vessels in the Barents Sea traffic should E.U. States be involved in this oil production.

35 The large ATBA in the Florida Keys applies to all vessels but only over 50 meters, and U.S. trawlers in the area are generally shorter. Many Norwegian trawlers on the other hand are over 50 meters would be excluded.

36 'Mot nord! Utfordringer og muligheter i nordområdene', (To the north! Challenges and possibilities in the northern areas) *NOU 2003:32*, pp. 25-6. This is an independent expert group's report and proposals published by the Norwegian Foreign Ministry. Translation by author. See http://odin.dep.no/ud/norsk/publ/utredninger/NOU/032001-020003/dok-bn.html.

37 See http://odin.dep.no/fkd/norsk/dok/publ/stmeld/047001-040002/dok-bn.html.

38 Norway has under the Cold War been fearful of entering bilateral agreements in most areas with the more powerful Soviet Union/Russia. Fishery administration has been the chief exception.

39 The prospect of transport of nuclear burnt fuel from Japan along the Northern Sea Route to the U.K. and France and reprocessed fuel back again has also been discussed, implicating both the Barents Sea and Western European Waters. See generally Steven G. Sawhill and Claes L. Ragner, 'Shipping nuclear cargo via the Northern Sea Route, *Polar Record,* Vol. 38, (204), January 2002,

40 PSSA designation is particularly sensitive for Russia in the Baltic Sea and sensitive for Norwegian fishing interests in the Barents Sea, the former because of a belief of breach of law of the sea rights of vessel passage and the latter because of a fear of unnecessary regulation of fisheries.

under International Labour Organisation Convention 169,[41] the Norwegian government may well decide not to proceed with PSSA designation. It may decide to achieve much the same through quicker and less controversial measures under SOLAS and other relevant IMO treaties.

For the E.U. the conflicting interests appear much the same, interactions between the hydrocarbon, fisheries, transport, biology and security interests, as well as preserving good relations with Russia, but additionally seem to be directed in all directions. The E.U. has nevertheless chosen to take a high profile.

3. E.U. Environmental Offensive

On the background of the international developments noted authorities of the International Oil Pollution Compensation Funds (IOPC Funds) associated with the IMO 1992 Protocols to the International Convention on Civil Liability for Oil Pollution Damage (CLC Protocol) and International Convention on the Establishment of an International Fund for Oil Pollution Damage, (Fund Protocol)[42] have in practice acknowledged *the necessity to meet more demanding clean-up standards in areas associated with important wildlife values* and/or tourism. From this one expert believes,

> (W)hile oil spill damage in ecologically sensitive PSSA's has so far not been an issue for the 1992 Fund Executive Committee…the committee is likely to take a more generous view of reasonableness in order to meet stringent environmental reinstatement costs. Were that to be the case the preventive environmental rationale of marine protected areas would at least prompt a sympathetic realignment in the economic compensation system for oil pollution damage, although the high biodiversity value of such areas is likely to expose more acutely the absence of recompense for eco-system damage per se.[43]

However, a strong European reaction to the oil tanker accidents with regards to *liability for damage from pollution* occurred and may perhaps be extrapolated to other areas of international environmental law. Viewed globally, the extension under the LOSC Part XII of coastal and port State jurisdiction with MARPOL 73/78 probably has not had much impact on pollution prevention, reduction and control. Various problems have been noted. Though practice may have become somewhat 'greener' in the last years, it is unlikely that dramatic changes have occurred. Therefore *the unilateral developments currently taking place in Europe as well as North America should not be underestimated.*

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[41] See http://www.ilo.org/.

[42] International Convention on Civil Liability for Oil Pollution Damage, 29 November 1969, (CLC), *New Directions*, Vol. II, (1973), p. 602; International Convention on the Establishment of an International Fund for Oil Pollution Damage 18 December 1971, (Fund Convention), *New Directions,* Vol. II, (1973), p. 611. Protocol of 1992 to Amend the CLC, in force 1996 with 91 State parties, 1 June 2003. Protocol of 1992 to Amend the Fund Convention, in force 1996 with 85 State parties, 1 June 2003. See www.imo.org. See also Gauci, G., 'Limitation of liability in maritime law: an anachronism?' *Marine Policy*, Vol. 19, No. 1, (1995), 73. See ibid. generally 65-74 for further arguments against limitation of liability.

[43] Mason, M., 'Civil liability evolving,' 7.

The 1999 *Erika* incident caused much turbulence in the liability and compensation regime governing oil pollution and was the first tanker pollution incident in which the European Commission (E.C.) has taken a strong role in proposing changes in the international IMO regime. These proposals revolve around increasing available compensation for damage available through, the limitation rights, channelling of liability and a third tier fund, and some experts believe that these may pose a serious threat to the existence of the international liability and compensation regime.[44] The E.C. argues first that limitation rights are too protective that should be broken only in cases of 'gross negligence'. This argument finds support from the U.S. OPA 1990[45] which marks a significant move and increase away from the limits of liability provided for in the IMO, 1992 Protocol to the CLC.[46] Counter arguments include that the right of limitations would be rendered very vulnerable, the determination of the existence of fault or privity (knowledge) often delays the compensation process, and with more serious consequences, different interpretation of 'actual fault or privity' by national courts would lead to disparities in compensation. It is also argued that the limits under the 1992 Protocols were planned raised by 50.37% by late 2003, unless 25% of State parties objected.

The E.C. argues secondly that by channelling, liability is imposed in a manner that may not adequately reflect the responsibilities of the parties. Counter arguments include that holding multiple parties responsible encourages litigation, thus slowing down the compensation process and wasting money on transactional costs. Such is argued to damage the negotiated balance under the 1992 Protocols, including the prompt and certain compensation to claimants, set against a financially manageable regime with predictable insurance requirements for liability parties. The current level of coverage of $1 billion is argued by the IMO to be possible because of the reassurance given to underwriters by the limitation rights. If the $1 billion were called upon, there is a real risk it would cease to be available, even at increased cost.

Concerning the third issue, a third tier fund, counter arguments include that a European third tier fund paid for by cargo owners would upset the balance achieved by the 1992 Protocols between shipowners and oil companies, and consequently undermine the regime. Financial sharing the last 10 years has been approximately 50/50 between oil companies and shipowners, with the former rarely involved but paying substantial contribution in the large spill clean-ups through the IOPC Funds.[47] If forced to contribute to a new purely European oil company-financed fund, European oil companies could put pressure on national governments to move out of the 1992 Fund Protocol, or even move themselves out of European States or pursue re-structuring to allow smaller companies to import smaller amounts below the

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44 See Wu, C., 'Liability and Compensation for Oil Pollution Damage: Some Current Threats to the International Convention System,' *Spill Science & Technology Bulletin*, Vol. 7, Nos. 1-2, 109-11 from which the following is obtained.

45 United States Oil Pollution Act of 1990 (OPA 1990), 33 *United States Code (USC)* 2701, *Public Law* 101-380, August l8, l990.

46 See www.imo.org. See also Gauci, G., 'Limitation of liability in maritime law: an anachronism?' *Marine Policy*, Vol. 19, No. 1, (1995), 73. See ibid. generally 65-74 for further arguments against limitation of liability.

47 See www.imo.org.

threshold for Fund contributions.[48]

Developments surrounding liability coverage for pollution damage associated with oil transport thus should be carefully followed both under the IMO 1992 CLC and Fund Protocols, and also the evolving E.U. base, including any interrelation between the two. Some turbulence will likely continue due to the European dissatisfaction. The area of law is crucial, both seen in a remedial perspective, as well as a preventative perspective.

Also importantly, the E.U. is currently in the process of developing anti-oil pollution measures that in the view of one expert have the potential to be even more onerous to shipping interests than those existing under the U.S. OPA 1990.[49] The E.C. and European Parliament (E.P.) Draft Directive on Ship-Source Pollution and the Introduction of Sanctions for Infringements,[50] in the Preamble states,

> The Council agrees that *fines should not be insurable* and that *the issue should be raised in the relevant international forum*.

This is not adopted, being still under hearing, yet the E.U. appears to be moving beyond what the IMO has been attempting to do, because of differences in implementation by States of MARPOL 73/78, *particularly related to the imposition of sanctions for discharges of polluting substances.* The E.U. plans to increase the scope, holding not only the shipowner or master of the ship criminally liable, but also cargo owner, the classification society or other involved persons. This is applicable in all maritime zones, for infringements in accordance with international law, committed with intent, recklessly and or by serious negligence. The E.U. plans to increase the scope as well by expanding the criminal liability to all maritime zones. Traditionally LOSC Article 230 allows for monetary penalties only for violations of national laws or applicable international law in the territorial sea and beyond, except in the case of a wilful and serious act of pollution in the territorial sea. At the same time, discharges into PSSA's and other SPMA's *other than* those outlined in MARPOL 73/78, the Mediterranean, the Baltic, the Black Sea, the Red Sea and Gulfs area, the Gulf of Aden, the Antarctic area and North-West European waters (further defined and specified), appear not covered by this draft. It would appear relevant to argue, however, that this also govern PSSA's in areas subject to heavy oil tanker traffic, perhaps the Barents Sea and Western European Waters. Developments surrounding this E.C. and E.P. Draft Directive and related ones, as well as any parallel Canadian legislation and measures, should be followed closely. Apparently the E.C. is also developing a ecosystem based management plan for the Arctic including a strategy proposal that will be sent to and worked under the Arctic

48 Gold, E., *Gard Handbook on P&I Insurance*, 5th Edition, (Arendal, Assuranceforeningen Gard-gjensidig, 2002), p. 414, notes the E.U. has already set the basis for an environmental liability regime for Europe to make polluters strictly liable for environmental damage they cause, which appears to take the E.U. towards a more U.S. oriented compensation and liability regime. This consequently has serious implications for existing IMO international regimes.

49 Gold, E., E-mail to author, 27 April 2005. Canada reportedly is also developing similar measures.

50 See Brussels, 28 Feb. 2005, Doc. No. 6614/05, MAR 24, ENV 29, CODEC 100; and Brussels, 17 Feb 2005, Doc. No. 6408/1/05 REV 1, MAR 21, ENV 73, DROIPEN 11, CODEC 93. Italics added.

Council.[51]

Along the same lines, the International Ship and Port Facility Security Code (ISPS) as noted in *Suggestions for Okhotsk Sea* was adopted in the IMO with amendments in SOLAS to increase security and measures against terrorism on board vessels and in ports.[52] The E.U. adopted Provisions 725/2004 implementing the IMO provisions, *but expanding the scope and requirements for vessels and port terminals*, and through this parts of domestic traffic are also encompassed. A new E.U. Directive may be adopted in 2005 that expands the scope, especially with respect to facilities that handle large quantities of dangerous and polluting cargoes, located near populations centres. Norway is implementing these provisions, both for vessels and ports at a substantial cost, to hold a standard with Norway's most important trade partners. These developments might be followed closely, particularly with respect to the growing E.U. legislation, as well as the U.S. OPA 1990 and related legislation. Should a PSSA in the Barents Sea not be designated, the protective measures and implementation of such taken by the E.U., the U.S. and perhaps Canada could be modelled by Norway, or other States, for example with similar or slightly less strict provisions in order to achieve less resistance from adversarial interests such as shipping.

Additionally, all the latest developments in liability and compensation, criminal liability, and vessel and port facility security, particularly carried out by the large federations which are also the large hydrocarbon markets, may have extra territorial ring effects related to anti pollution measures on tankers navigating the Barents Sea. The E.U. and U.S. requirements for vessel entry into their waters and ports would necessarily require higher quality of tankers navigating the Barents Sea or other seas on the way to these markets.

4. Conclusions

Finally, *negotiation* between actors for all the conflicting interests present is likely the only realistic solution for future management of the Barents Sea, and European waters, wherein a balance is hoped achieved. For the Barents Sea these interests include Arctic security, including Norwegian, U.S., Russian and E.U. interests; economic, trade and shipping interests including possibly nuclear; oil and gas interests; indigenous interests; environmental, biodiversity and fishing interests in all forms; and northern area political interests. For the E.U. the interests are much the same, but additionally probably directed in all directions. Because many of these are powerful interests, the chances for success are probably high, if all will listen to each other and find a middle ground.

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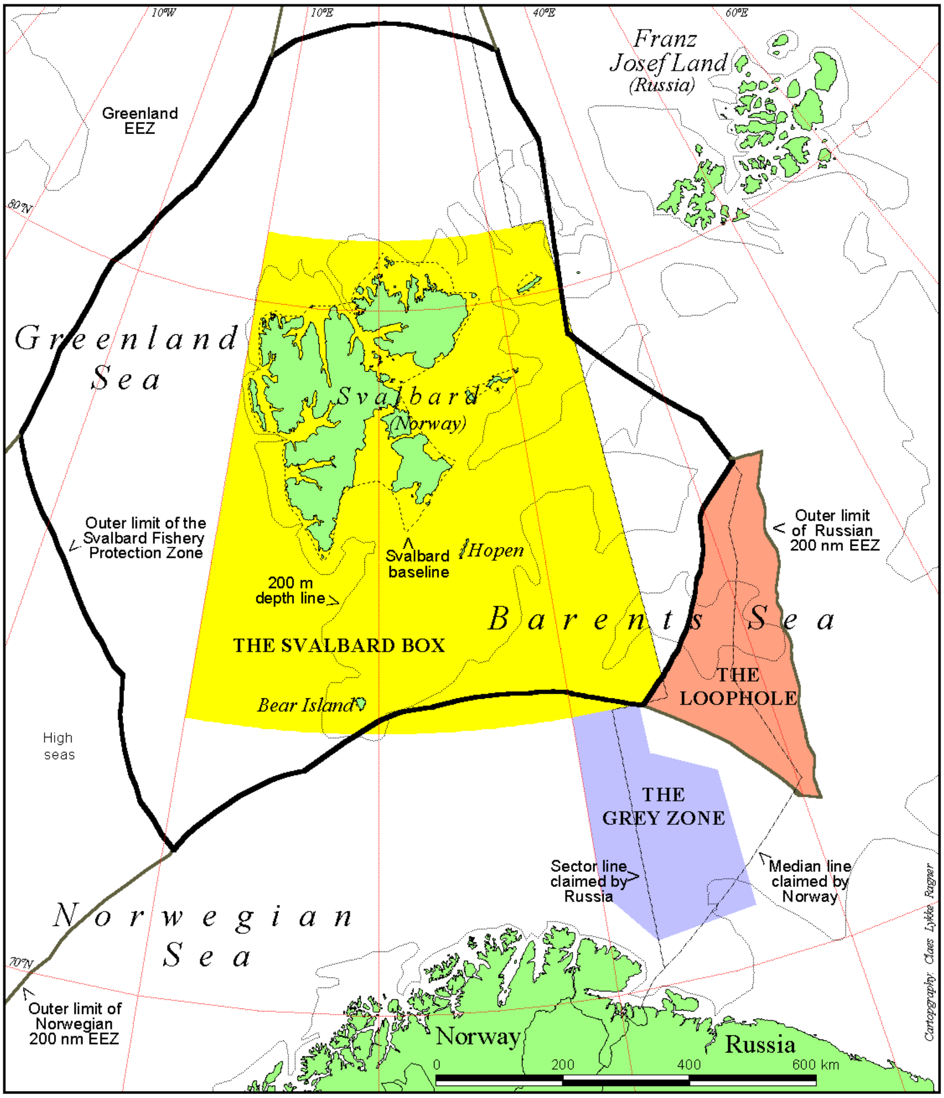
51 See Minister of the Environment Hareide's K., speech, Tromsø, 24 May, 2005, http://odin.dep.no/md/norsk/aktuelt/taler/minister/022051-090060/dok-bn.html.

52 See http://www.ilo.org/ilolex/english/convdisp1.htm



10°W
10°E
40°E
60°E
Franz Josef Land (Russia)
Greenland EEZ
80°N
Greenland Sea
Svalbard (Norway)
Outer limit of the Svalbard Fishery Protection Zone
Svalbard baseline
Hopen
200 m depth line
Outer limit of Russian 200 nm EEZ
Barents Sea
THE SVALBARD BOX
THE LOOPHOLE
Bear Island
High seas
THE GREY ZONE
Sector line claimed by Russia
Median line claimed by Norway
Norwegian Sea
70°N
Outer limit of Norwegian 200 nm EEZ
Norway
Russia
0
200
400
600 km
Cartography: Claes Lykke Ragner

Figure 1

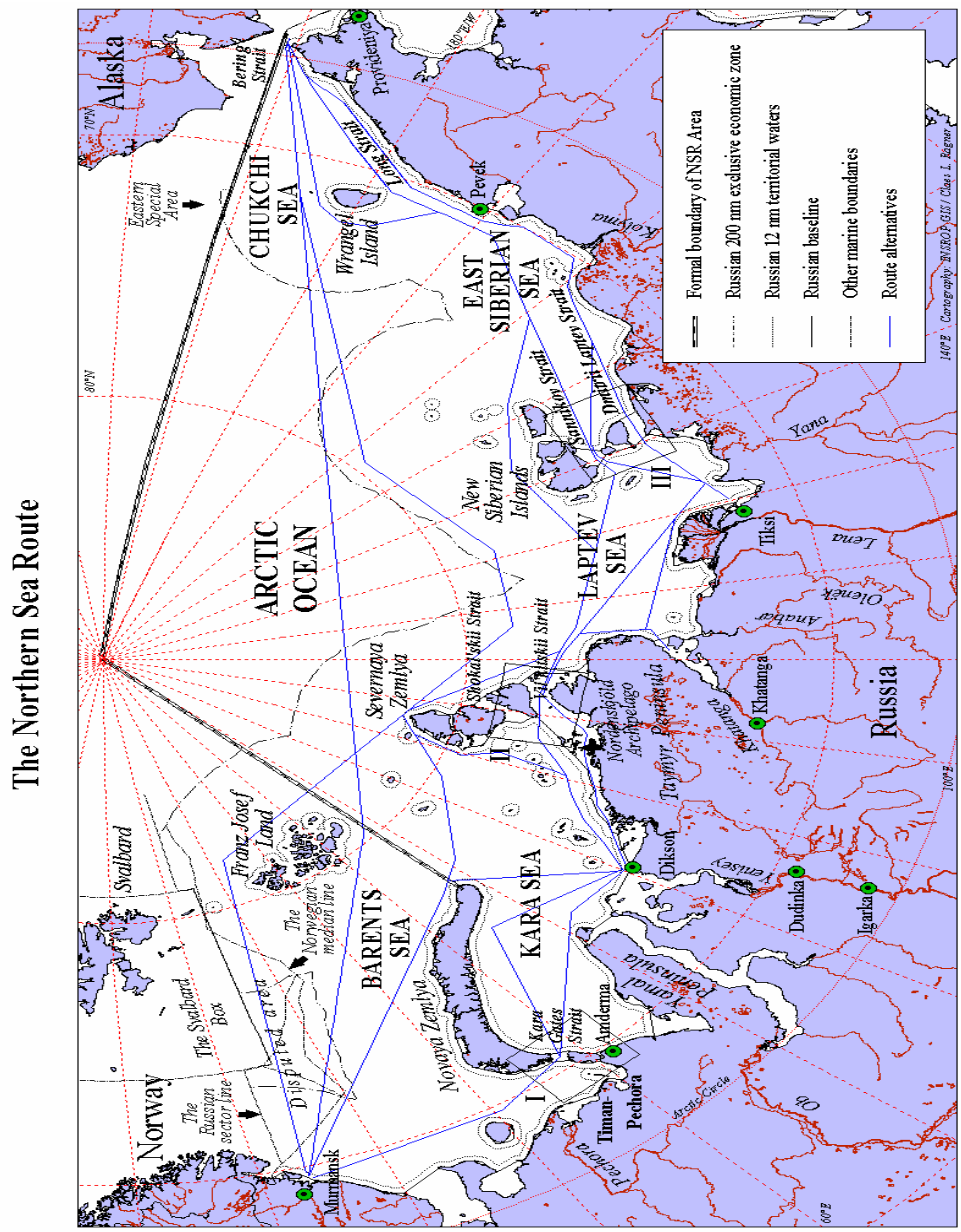

The Northern Sea Route
Formal boundary of NSR Area
Russian 200 nm exclusive economic zone
Russian 12 nm territorial waters
Russian baseline
Other marine boundaries
Route alternatives
ARCTIC OCEAN
BARENTS SEA
KARA SEA
LAPTEV SEA
EAST SIBERIAN SEA
CHUKCHI SEA
Alaska
Norway
Russia
Svalbard
Franz Josef Land
Severnaya Zemlya
Novaya Zemlya
New Siberian Islands
Wrangel Island
Bering Strait
Murmansk
Dikson
Tiksi
Pevek
Providenya
Khatanga
Dudinka
Igarka
Amderma
Timan-Pechora
Kara Gates Strait
Yamal Peninsula
Taymyr Peninsula
The Norwegian median line
The Svalbard Box
The Russian sector line
Disputed area
Eastern Special Area

Figure 1a

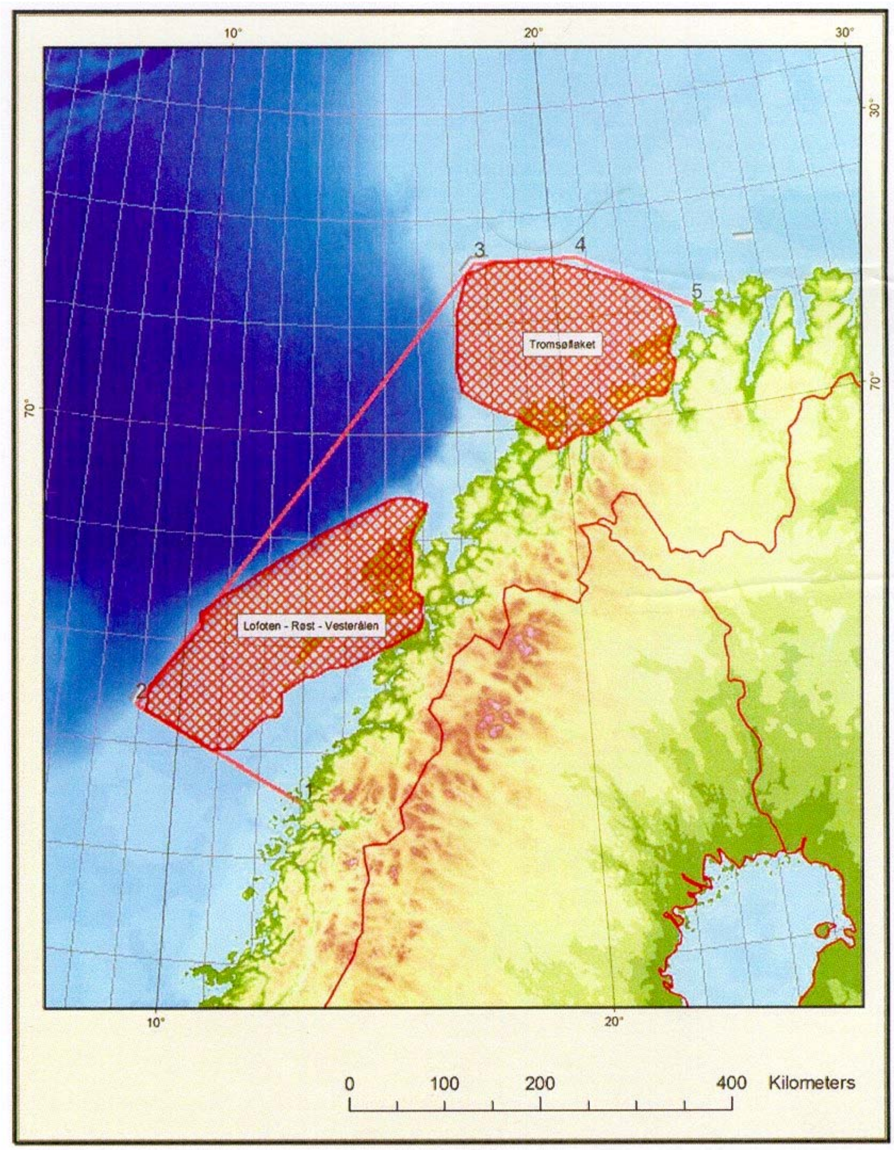


Figure 2

Area proposed designated as PSSA in northern Norwegian Sea and the Barents Sea, indicated by a red line. Areas given in red hachure are of high environmental vulnerability. Sectors indicated in grey are suggested TSS. Obtained from Figure 10.1., Det Norske Veritas, *Report No. 2002-1621*, p. 112. Please note that distances appear in kilometre (km.). *1 nm. equals 1.852 km.* Thus, 100 km. on the chart equals approximately 54 nm.

Suggestions for a Conceptual Design of an Okhotsk Sea Environmental Regime - Comparison with the Barents Sea

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1. Introduction

Increased oil and gas activities, both in the Russian north-west and the far east are planned. Developments are, however, further along on land in the north-west than in the Okhotsk Sea. In the Russian Barents Sea rich hydrocarbon resources are predicted, approximately 4,500 metric tonnes, however there is no offshore production yet. The gigantic gas field, Shtokmanovskoye, is planned to start production in 2011 or 2012. The Pechora Sea also has blocks expected to be announced in 2006, and offshore production may begin in 2006. In north-west Russia on land a pipeline may be built from large oil fields in Siberia to the Barents Sea coast, increasing dramatically vessel transport of Russian oil through the Barents Sea in the next decade. Plans also include reloading oil at sea to larger vessels due to shallow waters in these areas. In general, the entire Russian oil industry is under restructuring, including privatisation, consolidation, and responsibility transformation. There are growing environmental concerns in Norway.[1]

Looking at hydrocarbon developments in the Norwegian Barents Sea, 65 exploratory wells have been drilled on the Norwegian side since 1980. Drilling continues including 5 exploratory wells autumn 2005 east for Svalbard. Thirty new hydrocarbon exploratory blocks have been issued by the government, for the first time in 9 years, some controversial due to concern for fisheries and the marine environment. Uranus, 130 km north of North Cape, will have a well drilled autumn 2005. Areas off Lofoten and Vesterålen are geologically interesting, however, fisheries and shellfish collection may be affected, and more specific evaluation is promised. The gas field, Snøhvit, west of North Cape, will be in operation in 2006, while the Goliat oil field east for Snøhvit, has not started production yet.

In the Okhotsk Sea off the island of Sakhalin, the Royal Dutch Shell led consortium operating the US $10 billion Sakhalin-2 oil and gas project is Russia's largest in foreign investment.[2] An accident already occurred, 8 September 2004, off the west coast of Sakhalin when the dredger *Cristoforo Colombo* ran aground during a storm in an area near the port of Kholmsk characterised by strong winds and waves up

1 This relates as well to marine pollution from radioactive sources. See Figure 7.
2 See Figure 1.

to six meters. 189 tons of oil and diesel fuel were spilled from damaged tanks,[3] and the spill moved north from Kholmsk along the western coast of the island. A tentative estimate indicates damages were suffered totalling over U.S.$ 2 million. A number of international environmental organisations called upon the Shell Group to suspend oil production under the Sakhalin-2 project, and renewed criticism of the Sakhalin venture, saying the oil spill, though not expected to occur so early, was indicative of what to expect as the project goes forward.

Environmentalists have also criticised Sakhalin Energy for plans to build a seabed pipeline, two offshore platforms and a liquefied natural gas (LNG) plant. They have called upon Shell to do more to protect a group of rare, critically endangered grey whales that feed in the area where the platforms and pipeline were to be built, which forced the company to postpone its schedule a year while it conducted studies to assess the effects the project would have on whale behaviour. On 30 March 2005 Sakhalin Energy announced that the original route of the offshore pipeline, expected to pump 140,000 barrels of oil a day, would be moved 20 km. south to protect the whale.[4] The European Bank for Reconstruction and Development (EBRD), which lent money for the first phase of the project, said it would take into account the new route but would not decide finally on the loan until after a 120 day period for public consultation. Autumn 2005 the EBRD apparently is still considering. Russian environmentalists support the changes made by Sakhalin Energy, but claim that more is needed. The production platform PA-B, in Piltun-Astokhskoye field, is situated within 7 km. of the whales feeding area.[5] It is believed that the platform should be moved, since the limit of the feeding area varies depending on the oceanographic situation. The death of even one of the 23 grey whale females of reproductive age increases the danger of the entire population becoming extinct.

Another complaint includes that the extensive use of subcontractors in Sakhalin Energy is risky, due to these not being held to the same strict standards, as the lead operators such as Shell. Consequently, it is not only the environmentalists who call for more stringent environmental measures taken in the Okhotsk Sea. A legal representative for a consortium member publicly called for measures to be initiated and was positive to the media efforts taken by the environmental groups.[6] Various vessel accidents resulting in discharges have as well occurred in Onega Bay, the White Sea, September 2003; and Kola Bay, in the Murmansk region, October 2004.[7]

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3 See Bambulyak A. and B. Frantzen, *Oil transport from the Russian part of the Barents Region*, (Svanhovd, Svanhovd Environmental Centre, 2005) pp. 80-2 from which the following is obtained unless noted otherwise.

4 See 'Sakhalin Energy Move to Protect Whales Insufficient, Say Russian Environmentalists' BBC Monitoring International Reports, 1 April 2005, and J. Boxell, 'Shell Re-Routes Pipeline to Help Whale's Survival', Financial Times London, 31 March 2005 in Russian Environmental Digest Files Editor <editor@teia.org>, 28 March – 3 April 2005, Vol. 7, No. 14, pp. 1-2; and 'DJ Shell's Sakhalin Whales Issue May Harm EBRD Loan-Sources', Prime-Tass Business News Agency, 16 March 2005, in Russian Environmental Digest Files Editor <editor@teia.org>, 14-20 March 2005, Vol. 7, No. 12, p. 8.

5 See Figure 2.

6 See Dean R. and M. Barry, 'A Conflict of Interests for Russia: Offshore Oil vs. the Problems of Environmental Regulation,' International Energy Policy, the Arctic and the Law of the Sea, International Conference, St. Petersburg, Russia, 23- 26 June 2004. R. Dean is a partner in the international law firm of Coudert Brothers LLP. Washington D.C. U.S.

7 Bambulyak A. and B. Frantzen, *Oil transport from the Russian part of the Barents Region*, pp. 69-80. D. Brubaker has forwarded notification of this interest to the Indigenous Peoples of the Russian North, North

2. Environmental Measures

2.1 Traditional Regimes

Viewed environmentally the Okhotsk Sea is characterised by lying almost exclusively under Russian jurisdiction,[8] whereas the Barents Sea is more evenly divided between Norwegian and Russian jurisdiction, with other international actors playing a role on Svalbard and potentially in its extensive marine zones. Both seas have small high seas areas, ‘doughnut holes’ and disputed areas. Both are large marine ecosystems (LME’s) with biodiversity sensitive areas characterised by rich biological production and harsh environmental conditions, and both have indigenous peoples’ interests involved including culture, the environment and the natural resources such as fish, sea mammals and sea birds. Both seas will face growing conflicts between environmental, fisheries and hydrocarbon interests.

Traditional environmental law of the sea regimes which *could be more clearly implemented by both Russia and Japan* include the global vessel-source pollution treaty MARPOL 73/78,[9] which regulates discharges of oil, hazardous chemicals, containers, sewage and garbage and air pollution. Operational oily waste discharges are permitted as long as the tanker is 50 nautical miles (nm.) from land, not in a special area, with a fixed rate of mixing and vessel velocity. It is credited with reducing discharges into the seas through its various measures and technologies.[10] MARPOL 73/78 has played a significant role in Western Europe and North America,[11] but vessels registered in or flying the flag of developing countries have not been so stringently controlled.[12] Flag States, including flags of convenience, have generally avoided enforcing conventional provisions. Reporting to the IMO of enforcement by flag States under MARPOL 73/78 has not been observed, and the IMO appears not to have been interested in pressing the matter. The mediocre record of enforcement by flag States is the crux of the problem. Most of marine pollution takes place beyond a foreign territorial sea. Surveillance and monitoring of vessels at sea, which are necessary for reports to be delivered under MARPOL 73/78, are difficult to be carried

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Siberia and the Far East Organisation.

8 See Figure 3.

9 International Convention on the Prevention of Pollution from Vessels, 2 November 1973, (MARPOL 73/78), *United Nations Treaty Series (UNTS),* Vol. 1340, (1983), p. 61, as amended by the Protocol, 1 June 1978, Nordquist M. and K. Simmonds, (eds.), *New Directions in the Law of the Sea (New Directions)*, (London, Oceana Publications, 1980), Vol. IV, (1975) (MARPOL 73/78), p. 345 and *New Directions* Vol. X, (1980), p. 32. See *Yearbook of International Co-operation on Environment and Development 2003/2004 Green Globe Yearbook,* (eds. Stokke O.S. and Ø. Thommessen), (London, Earthscan Publications Ltd, 2003), pp. 144-6. With Annexes I and II State Parties represented 97% of the world’s gross tonnage. Annex I governs oil, Annex II noxious liquid substances, Annex III harmful substances in packaged form, Annex IV sewage, and Annex V garbage. The air pollution Annex VI is not in force. See http://www.imo.org. See generally Birnie P. and A. Boyle, *International Law & the Environment*, (2nd ed.) (Oxford, Oxford University Press, 2002), pp. 351-3, 367-9, 373-6, and 290-1 for the following information unless otherwise noted. The authors believe acceptance of various IMO treaties and consensus surrounding Part XII under the 1982 United Nations Convention on the Law of the Sea (LOSC), *UNTS*, Vol. 1833, p. 397 indicate a strong measure of *opinio juris*, acceptance as law, and represents in certain respects an agreed codification of existing principles which have become custom.

10 These include segregated ballast tanks (SBT’s), protection location (PL) and inert gas systems (IGS) in products tankers of more than 300,000 dwt; and SBT’s PL and IGS and crude oil washing (COW) in crude oil tankers of more than 20,000 dwt.

11 However, the largest number of vessels detained in Memorandum of Understandings (MOU) ports are apparently not oil tankers, but dry cargo and bulk carriers, which are less environmentally important. See below.

12 Birnie P. and A. Boyle, *International Law & the Environment*, p. 367-9.

out by other than developed coastal States, since it is only these which have the necessary funding for navies, coast guards and aircraft. In addition, the inadequate enforcement jurisdiction exercised by most coastal States in their exclusive economic zones, results in prosecutions remaining with the flag State for discharges in such waters. While there has been extensive referral of violations to flag States by port and coastal States, subsequent action has been reported infrequently and there is no reliable measure of flag State prosecutions or successes under MARPOL 73/78. Other issues which continue to surround MARPOL 73/78 include the following,

- the inadequacy of port reception facilities for many types of waste including oily and hazardous wastes, i.e. facilities may be absent or unsuitable, difficult to use, hard to find, or inconveniently located;
- many types of vessel often operate to very tight schedules which allow only a very limited amount of time in port to dispose of operational waste;
- low probability that illegal dumping activities will be detected and sufficient evidence collated to prosecute;
- the high cost incurred by the shipowner for the handling and disposal of waste set by some port authorities/waste contractors; and
- mariners have become accustomed over the years to discharging waste into the sea and are unaware of the effect of their actions on the marine environment.[13]

In response to the large oil tanker accidents, including *Prestige*, recently, single hull tanker phase out was accelerated, from 2007 to 2005 for pre-MARPOL tankers, and from 2015 to 2010 for MARPOL tankers and smaller tankers, with the carriage of heavy fuel oil being banned in the latter.

The International Convention for the Safety of Life at Sea,[14] (SOLAS) is another central IMO convention, which clearly *could be utilised by both Russia and Japan*, dealing with requirements for construction and building of vessels, fire preventive equipment, radio and communications equipment and cargoes. Developments have also recently taken place related to the establishment of sea lanes under SOLAS Re. V/10 and IMO Assembly Resolution A.572(14), General Provisions on Ship's Routing'.[15] These allow a relatively quick establishment, accepted by the IMO, of sea lanes within a State's exclusive economic zone. A routing system can encompass mandatory sealanes, traffic separation systems and sailing rules in and out of a definite zone, recommended sealanes, deepwater lanes and precautionary areas, the latter which vessels must navigate with special care and through which recommended sealanes can be established. Areas to be avoided (ATBA) can also be established.[16]

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13 Ball I., 'Port waste reception facilities in UK ports,' *Marine Policy*, Vol. 23, No. 4-5, 307-8. Other deficiencies under MARPOL 73/78 include inadequate training of crews in MARPOL requirements, and equipment malfunction.

14 International Convention for the Safety of Life at Sea, (1 November 1974), (SOLAS), *UNTS* Vol. 1184, (1980), p. 2. See Birnie P. and A. Boyle, *International Law & the Environment*, p. xxiv for overview of SOLAS Amendments subsequently adopted.

15 See generally http://www.imo.org/dynamic/mainframe.asp?topic_id=155

16 See 'På den sikre side – sjøsikkerhet og oljevernberedskap' (On the safe side - safety at sea and oil contingency planning), *St.meld.nr. 14*, (Oslo, The Royal Norwegian Fisheries and Coastal Ministry, 2004) Government White Paper, s. 81-2.

This is an area where because of a particular danger or a particular sensitive ecological or environmental condition all vessel traffic or a certain type of vessels are forbidden to sail. A routing system can consist of several different of the above in combination. Mandatory or recommended vessel reporting systems are also allowed subject to application to the IMO. As part of this an automatic vessel identification (AIS) system of oil tankers is permitted, making reporting and a reporting scheme superfluous. Following 11 September 2001 the IMO also adopted new provisions governing maritime security leading to amendments in SOLAS as well as the International Ship and Port Facility Security Code (ISPS) to increase security and measures against terrorism on board vessels and in ports.[17] Requirements of the Code include ship identification number to be permanently marked on vessel's hulls; continuous synopsis record (CSR) kept onboard showing vessel history; ship or port facility security assessment (SSA or PFSA), ship or port facility security plan (SSP or PFSP); ship or port facility security certificate (SSC or PFSC); ship or port facility security officer (SSO or PFSO), company security officer, continuous ship to port security communication link, training and drills, and a ship security alert system (SSAS).[18] The IMO also adopted in 2003 directions on the use of ports of haven and beaching places for vessels in distress. The Paris and Tokyo Memorandum of Understandings (MOU) may be mentioned as well, wherein respectively *25% and 50%* of vessels are examined while in port regarding their compliance with IMO ratified treaties and rules, including MARPOL 73/78, and SOLAS.[19]

Russia and Japan might also ratify the International Labour Organisation 169, Convention Concerning Indigenous and Tribal Peoples in Independent Countries (ILO 169),[20] due to the possibility that hydrocarbon developments may affect traditional lifestyles of the indigenous peoples living in the area.[21]

2.2 Specially Protected Areas

Several varieties of specially protected marine area's (SPMA's) are possible to establish under law of the sea,[22] however, special areas under MAPROL 73/76 or the other possibilities are apparently not under consideration by Norway for use in the Barents Sea. Rather, particularly sensitive sea area's (PSSA's) designated under the

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17 See http://www.ilo.org/ilolex/english/convdisp1.htm

18 See http://fleet.inmarsat.com/F77_security.htm

19 The Paris Memorandum of Understanding on Port State Control, January 26, 1982, (MOU), *International Legal Materials* (*ILM*) Vol. 21, (1982), p. 1. Under this 17 Western European States and Canada co-operate in a program of vessel inspection, implementing LOSC Article 211 and 218-220, which is to ensure that each port State inspects at least 25% of foreign vessels visiting its ports annually. The U.S. is a co-operating observer. For the Tokyo Memorandum of Understanding on Port State Control , see http://www.tokyo-mou.org/. See Birnie P. and A. Boyle, *International Law & the Environment*, p. 365-6 for other regional MOU's of varying effectiveness, including the Tokyo MOU. Gold, E. *Gard Handbook on Marine Pollution*, (2ed) (Arendal, Assuranceforeningen Gard, 1998), pp. 74-6 notes Russia became a Party to the Paris MOU in 1996 and the Tokyo MOU in 1993, which became operational in 1994.

20 International Labour Organisation 169, Convention Concerning Indigenous and Tribal Peoples in Independent Countries. See www.ilo.org.

21 See Det Norske Veritas, *Report No. 2002-1621*.

22 Examples include 'protected area' under the Convention on Biological Diversity, http://www.biodiv.org/convention/articles.asp; and 'World Heritage Sites' under the 1972 UNESCO Convention Concerning the Protection of the World Cultural and Natural Heritage, http://whc.unesco.org/world_he.htm. See Nadelson, R. 'After MOX: The Contemporary Shipment of Radioactive Substances in the Law of the Sea', *International Journal of Marine and Coastal Law*, 237-44.

IMO in conjunction with the traditional measures noted above appear to have been the policy under discussion. The reason for this is not known, though it may include that PSSA's seem the most politically expedient special area presently. *PSSA's are thus the focus, although the other alternatives of SPMA's nevertheless are certainly possible to utilise by both Russia and Japan.*[23] There are 10 such areas, PSSA's, world wide,[24] and PSSA's appear to be developing as part of larger sustainable management plans for LME's.

SPMA's or PSSA's may be the best way to deal with preserving marine biodiversity. The key to international regimes lies with *enforcement*, and in this respect the Barents Sea may experience problems viewed with respect to the Convention on Biological Diversity.[25] Parties are required under CBD provisions to generally ensure that activities and processes including shipping under their flags do not cause environmental damage to other States, or to areas beyond national jurisdiction. Parties must develop strategies. At the same time, due to the use of the phrases *as far as possible and as appropriate*, used in the centrally relevant articles containing specific measures, little appears genuinely mandatory for parties exercising questionable jurisdictional control, such as flags of convenience. Non parties are definitely not bound.

The IMO application for a proposed PSSA designation by the Marine Environmental Policy Committee (MEPC) under the 2001 Guidelines must contain a summary of the proposed objectives, location, need for protection and protective measures; a description of the area with a chart, including the significance based on the PSSA criteria and its vulnerability to damage from international shipping activities. An explanation how the proposed measures will provide the needed protection from threats of damage, as well as the possible impact of the proposed measures on the safety and efficiency of navigation is required as well. New Guidelines were to be considered July 2005 in the IMO forwarded by the U.S., which are stricter. These require at least one associated protective measure, objects requiring protection throughout the area, and abolish 'PSSA in principle'. The 2001 Guidelines also require further information concerning risks from shipping. Information should be supplied on vessel traffic characteristics including operational factors, vessel types, traffic characteristics and harmful substances carried, and natural factors including, hydrographic, meteorological and oceanographic. Information is suggested provided comprising, evidence of damage from international shipping; history of groundings, collisions and their consequences; foreseeable circumstances under which significant damage might occur; stresses from other environmental sources; and measures already in effect and their actual or anticipate beneficial impact. These enable the selection and adoption of appropriate risk management measures by State authorities in collaboration with the IMO, and are supposed to be flexible enough not to discourage

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23 See Nadelson, R. 'After MOX: The Contemporary Shipment of Radioactive Substances in the Law of the Sea', 237-44.

24 See Figure 4.

25 Convention on Biological Diversity, http://www.biodiv.org/convention/articles.asp. There are 188 Parties to the Convention, current to February 2005, including Norway which ratified on 9 September 1993 and Russia which ratified on 5 April 1995.

applications from countries with limited resources. Examples of PSSA's may be chiefly found in marine areas adjacent to North and South America, Australia and Europe.

Using these criteria the Norwegian government is evaluating, not without controversy, a proposition for a PSSA designation, including one covering the Lofoten – Røst – Vesterålen and the Tromsøflaket marine areas in the Barents Sea and the northern Norwegian Sea.[26] Traffic separation schemes are planned placed both within and outside the PSSA, north of Finnmark. Controversy exists whether traditional measures including MARPOL 73/78 and SOLAS Conventions are not sufficient. Examining the individual ecological criteria characterising a PSSA the areas of the Barents Sea examined appear to conform to or are fully in line with most. Taking the individual social, cultural and economic criteria set forth, the areas of the Barents Sea examined appear to have complied with most.

The measures being considered by Norway, *which also could be considered by Russia and Japan, include, extended limit of territorial sea (20 nm. may be argued possible since the U.S. enforces its coastal State environmental regime 20 nm. to sea from the baselines), implementation of a routing regime including, vessel traffic service (VTS), traffic separation schemes (TSS), automatic identification system (AIS), including distribution and coverage and stations, tugboats, skimmers and equipment depots at strategic locations, electronic chart display and information system (ECDIS), contingency management and a planning regime, including environmental risk analysis and oil spill contingency assessment, places of refuge and beaching, measures related to loading and unloading of cargo, control of emissions to air, management of oily wastes, sewage and garbage, including reception facilities, and ballast water management. A management plan is expected developed by Norway by 2006, covering specific activities dealing with the interactions between the hydrocarbon, fisheries, transport, biology and security interests.*[27] *A extensive management plan, where economic activity occurs in the context of sustainable development, implementing and operating these measures in practice is needed for the Okhotsk Sea. Models could be based upon the plans worked out by Australia on the Great Barrier Reef, the U.S. in the Florida Keys and Norway in the Barents Sea, as relevant. As part of this comprehensive studies are necessary to map environmentally sensitive and important areas Co-operation between Russia and Japan is important.*

Measures more stringent which may be considered based both upon PSSA's but also to be tailored to specific area needs under the treaties might include,

- adoption of vessel traffic management systems, including compulsory pilotage, mandatory vessel reporting, other VTS, operational criteria, speed restrictions, prohibited activities, and enhanced surveillance and monitoring detection capacity for illegal discharges, and other technologies;
- discharge restrictions, including prohibition of discharges and dumping of other wastes;

[26] See Figure 5.
[27] See Figure 6 for geographic coverage.

- introduction of special vessel construction requirements;
- introduction of specific 'areas to be avoided'; and
- introduction of specific 'no anchoring areas'.

Requirements might also be considered as conditions for entry into national ports for foreign vessels transiting the territorial sea, as is carried out by the U.S. and the E.U. With respect to civil liability for vessel-source oil pollution damage under the CLC and Fund Convention and 1992 Protocols,[28] in the event of a polluting incident *it is in a PSSA Russia or Japan would have the best opportunity of winning acceptance for obtaining stringent environmental reinstatement costs*, in addition to costs for preventative measures and lost profits.

In relation to the Barents Sea the Russian Foreign Ministry appears not opposed generally to SPMA's including PSSA's being established as long as they are specifically defined and reasonably sized geographically and include corresponding specific 'appropriate associated measures' which are to be implemented. The Russian Ministry of Natural Resources may have as much to say in the matter as the Ministry of Foreign Affairs, however. Norway thus likely stands a good chance of obtaining PSSA designation from the IMO as long as the size and placement of the PSSA is reasonable and the 'appropriate associated measures' are reasonable. Through no official statement from the U.S. State Department has yet been requested, indications are that they remain somewhat reserved, since all the protective measures can be achieved without the use of a PSSA.[29]

Correspondingly, it would seem possible *to extrapolate the same possibility for both Russia and Japan in their respective maritime zones in the Okhotsk Sea* should 'reasonableness' be the focus. Interestingly, two 'Areas to be Avoided'[30] were already adopted by the Soviet Union in the Okhotsk Sea, one as early as 1967. The first governs the waters off Cape Terpeniya, Sakhalin,[31] as well as an area around the Tjulenia Island, south of Cape Terpeniya.[32] Ten years later the fourth Kuril Strait and Proliv Bussol became a PSSA 'avant la lettre'.[33] In the Kurils the 'Etorofu Strait' ('Friza Strait') was a point of conflict between the Soviet Union and the U.S. vessels in

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[28] International Convention on Civil Liability for Oil Pollution Damage, 29 November 1969, (CLC), *New Directions*, Vol. II, (1973), p. 602; International Convention on the Establishment of an International Fund for Oil Pollution Damage 18 December 1971, (Fund Convention), *New Directions*, Vol. II, (1973), p. 611. Protocol of 1992 to Amend the CLC, in force 1996 with 57 State Parties, 29 February 2000. Protocol of 1992 to Amend the Fund Convention, in force 1996 with 53 State Parties, 29 February 2000. Both Protocols of 1992 as well as information concerning ratification obtained from the Oil Pollution Compensation Fund, 4 Albert Embankment, London SE1 7SR, 18 October, 1996. Russia is a Party to both the 1992 CLC Protocol and the 1992 Fund Protocol, current to 31 August, 2004. See http://www.imo.org.

[29] Roach, J. Ashley, Office of the Legal Adviser, U.S. State Department, Washington D.C., U.S. 'Telephonic Interview' 23 February, 2005.

[30] 'Recommendation on Establishing Traffic Separation Schemes and Areas to be Avoided by Ships of Certain Classes' IMO Resolution A.161(ES.IV)). See Peet, G. 'Particularly Sensitive Sea Areas – A Documentary History,' *The International Journal of Marine and Coastal Law*, Vol. 9, 471.

[31] Ibid. IMO Resolution A.284(VIII).

[32] The former was intended for protection of the marine environment, and the latter was a reservation for breeding sea bears and beavers. An attached economic value was also claimed for the latter coastal region. These areas in the Okhotsk Sea along with a French area were the first two PSSA's 'avant la letter.'

[33] Peet, G., 'Particularly Sensitive Sea Areas', 472-3. This area was to be protected by Traffic Separation Schemes and was first proposed in 1977 (Navigation Committee (NAV) XX/10 and adopted in 1978 Marine Safety Committee (MSC) XXXVIII).

late 1984 and the Golovnina Strait in mid-1986.[34] The Etorofu Strait separates the Habomais islands, occupied by the Soviet Union/Russia and claimed by Japan, and the Golovnina Strait separates two other southern Kuril islands, occupied by the Soviet Union/Russia and claimed by Japan.[35] For both the U.S. claimed transit passage under LOSC Part III, and the Russians innocent passage including under LOSC Part II, while the Russians claimed the fourth Kuril strait as the only strait used for international navigation.[36] The Korea, Tsugaru and Soya Straits into the Sea of Okhotsk, as well as the Tartar Strait, all are subject to restricted access.[37] This means that international tanker traffic must presumably utilise the fourth Kuril strait.

The above has focused chiefly on vessel-source pollution. In the Barents Sea related to pollution from marine hydrocarbon installations, though Russia has been invited by Norway, it has not yet become a party to the regional Convention for the Protection of the Marine Environment of the Northeast Atlantic[38] (OSPAR). This governs pollution from offshore platforms, dumping, and land-based sources, and deals with quality control and protection of biological diversity.[39] Ratification by Russia would move the scope of application of OSPAR eastward to also encompass the Russian Barents Sea. Similar provisions are also lacking for the Okhotsk Sea.

In implementation of OSPAR by Norway in the Norwegian Barents Sea hydrocarbon exploratory and production activities are strictly regulated starting with a comprehensive environmental impact statement. A general ‘0 discharge’ policy during exploratory drilling is required. Drillmud is reinjected, while a maximum of 5% of cleaned drillwater is permitted discharged. Some discharge of drillmud from the top hole section is also allowed in biologically non important areas. Trawler safe seabed installations are envisioned utilised, minimising the use of surface installations. As noted, an integrated Norwegian management plan is expected in 2006 to facilitate economic activity and maintain the qualify of the environment. This is drafted by an interministerial planning group, led by the Ministry of the Environment, and will be based upon comprehensive surveys and assessments of environmental impacts. This also covers environmental developments related to offshore platforms It will set forth tools for management and minimising impact, and set standards for zoning and economic activity in areas according to ecological function, environmental value and vulnerability. Co-operation with Russian experts is planned on setting ‘ecological

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34 See Roach J. and R. Smith, *Excessive Maritime Claims*, (Newport, Naval War College, 1994) Vol. 66, pp. 191-4, and 224-5, footnotes 55 and 56.

35 See Roach J. and R. Smith, *United States Responses to Excessive Maritime Claims*, (The Hague, Martinus Nijhoff Publishers, 1996) pp. 312-19.

36 Ibid.

37 Caminos, H., ‘The Legal Regime of Straits in the 1982 United Nations Convention on the Law of the Sea’, *Recueil Des Cours – Collected Courses of the Hague Academy of International Law*, Vol. 205, (1987), p. 208.

38 See http://www.ospar.org. This treaty in force the 25 March 1998 replaces the Convention for the Prevention of Marine Pollution from Land-base Sources, *ILM*, Vol. 13, p. 353, (1974), and the Convention for the Prevention of Marine Pollution by Dumping from Ships and Aircraft, *ILM*, Vol. 11, p. 262, (1972), both governing the Barents Sea.

39 Other relevant regional treaties and processes covering air pollution, and radioactive clean up can be viewed in Hønneland G. and A.K. Jørgensen, *Implementing international environmental agreements in Russia* (Manchester, Manchester University Press, 2003), pp. 74-5. For company solutions see R. Dean and M. Barry, ‘A Conflict of Interest for Russia: Offshore Oil vs. the Problems of Environmental Regulation’, (eds. M. Nordquist, J.N. Moore, and A. Skaridov) *International Energy Policy, the Arctic and the Law of the Sea*, p. 213.

standards' for the Barents Sea. *Russia would do well to implement similar measures as Norway in the Okhotsk Sea governing offshore platforms, and also the Russian Barents Sea when relevant to the industrial development.* This would not necessitate an international treaty but could be implemented under domestic legislation as part of the management plan.

3. Conclusions

In conclusion, more information is needed, but certain marine areas in the Okhotsk Sea already may be indicated possibly needing special environmental coverage related to international shipping due to their sensitivity. These would encompass but not be limited to the grey whale habitats, productive fishing grounds, the eastern shore of Sakhalin, the Tatar Strait, and zones around offshore platforms. Specific areas may include Aniva Bay in southern Sakhalin, Molikpak, and Piltun Lagoon. Other areas may likewise come into risk through ongoing hydrocarbon developments. Special coverage from the effects of international shipping *Russia and Japan may accomplish through attempting to designate various of these areas as PSSA's through the IMO or even SPMA's* as relevant. Or *Russia and Japan may decide to utilise traditional measures* including under MARPOL 73/78, and SOLAS Re. V/10 and IMO Assembly Resolution A.572(14) under the IMO. A *third alternative*, apparently being considered by Norway for utilisation in the Barents Sea, may be to rely on both the PSSA for sensitive marines areas, and traditional measures in areas surrounding or in the PSSA and in part as 'appropriate associated measures' affiliated with the PSSA. This strategy probably facilitates administration of the PSSA and is as well politically expedient, since it allows the PSSA to remain smaller and possibly more reasonable sized with a 'buffer zone' controlling its periphery. That traditional measures are taken in part as 'appropriate associated measures' would have the benefit that they are known under law of the sea. *The way stands open for Russia and Japan to do the same.* Regarding pollution from offshore platforms, Norway is implementing strict measures under OSPAR in the Norwegian Barents Sea. Russia using these as a model could do the same in the Okhotsk Sea and the Barents Sea when relevant, independent of a treaty.

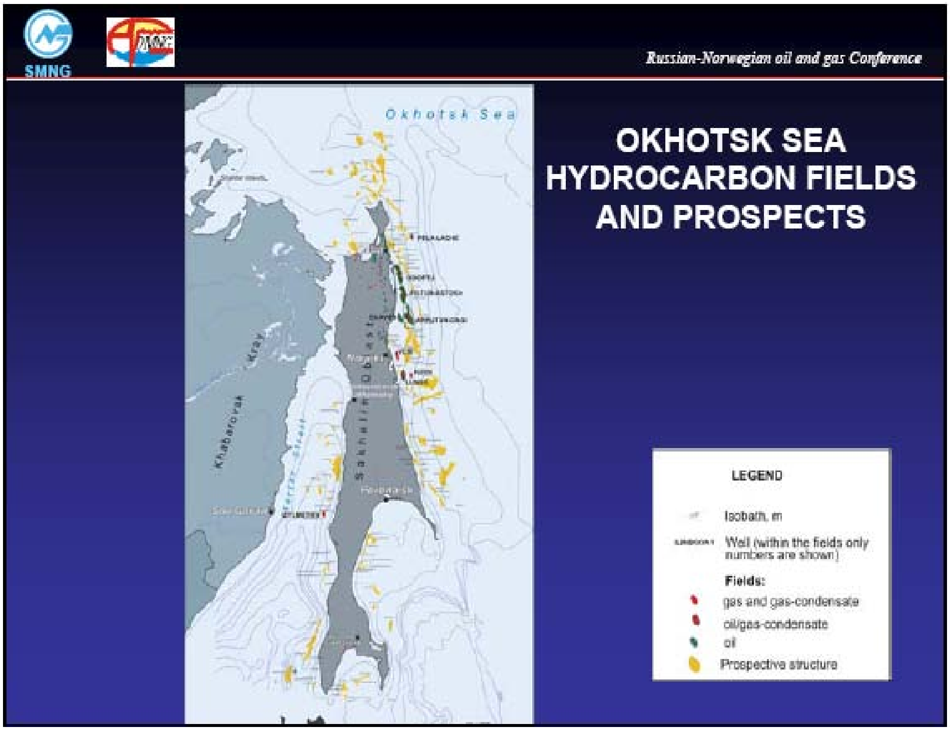

Figure 1 Hydrocarbon Developments - Okhotsk Sea[40]

[40] Obtained from Russian-Norwegian Oil and Gas Conference, 25-26 January 2005, 'Hydrocarbon Potential of the Russia Continental Shelf – Barents, Kara, Far East and Azov, Black and Caspian Seas, K. Dolgunov, V. Martirosyan, M. Vepreva (JSC Sevmorneftegeofizika), E. Kropp, V. Kudelkin (JSC Dalmorneftegeofizika).

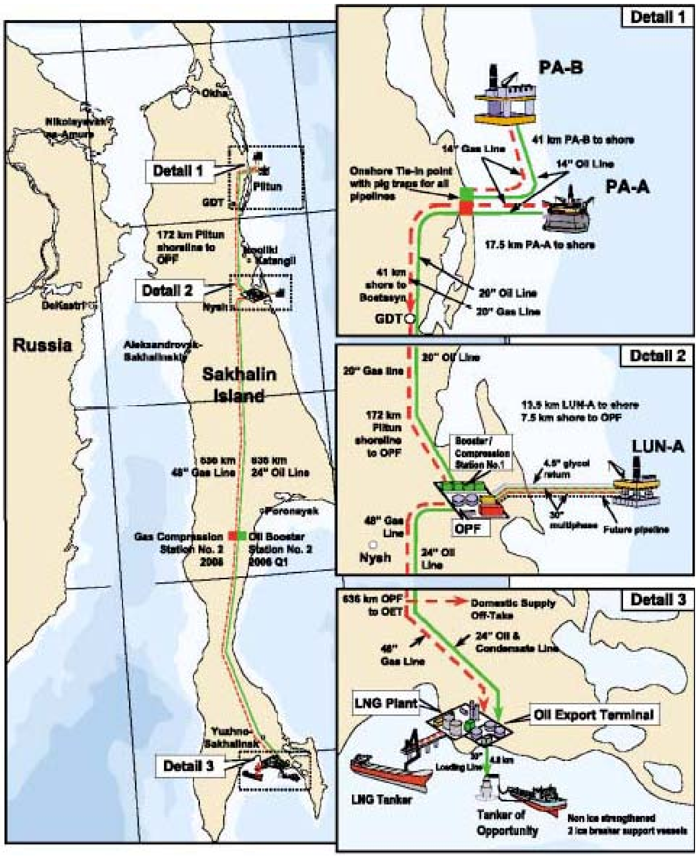

Figure 1a Hydrocarbon Developments - Okhotsk Sea

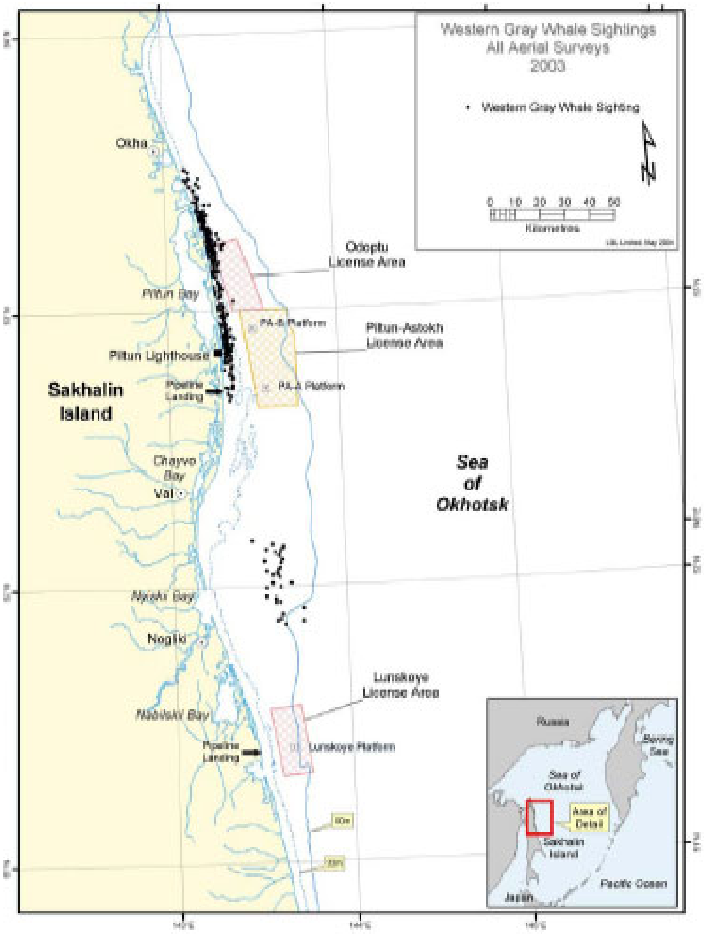

Figure 2 Gray Whales - Okhotsk Sea

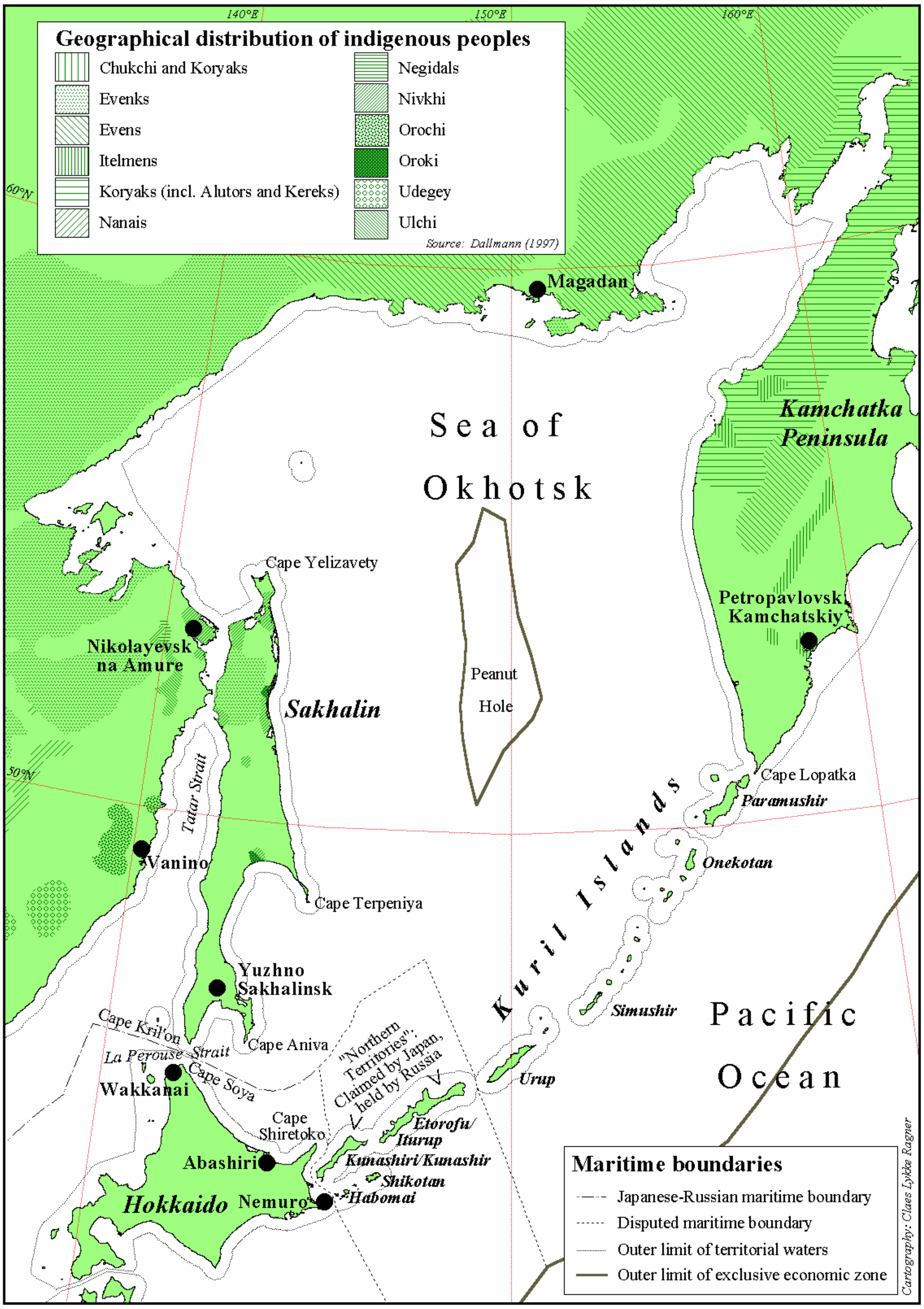

Figure 3 Okhotsk Sea - Jurisdiction and Indigenous Peoples

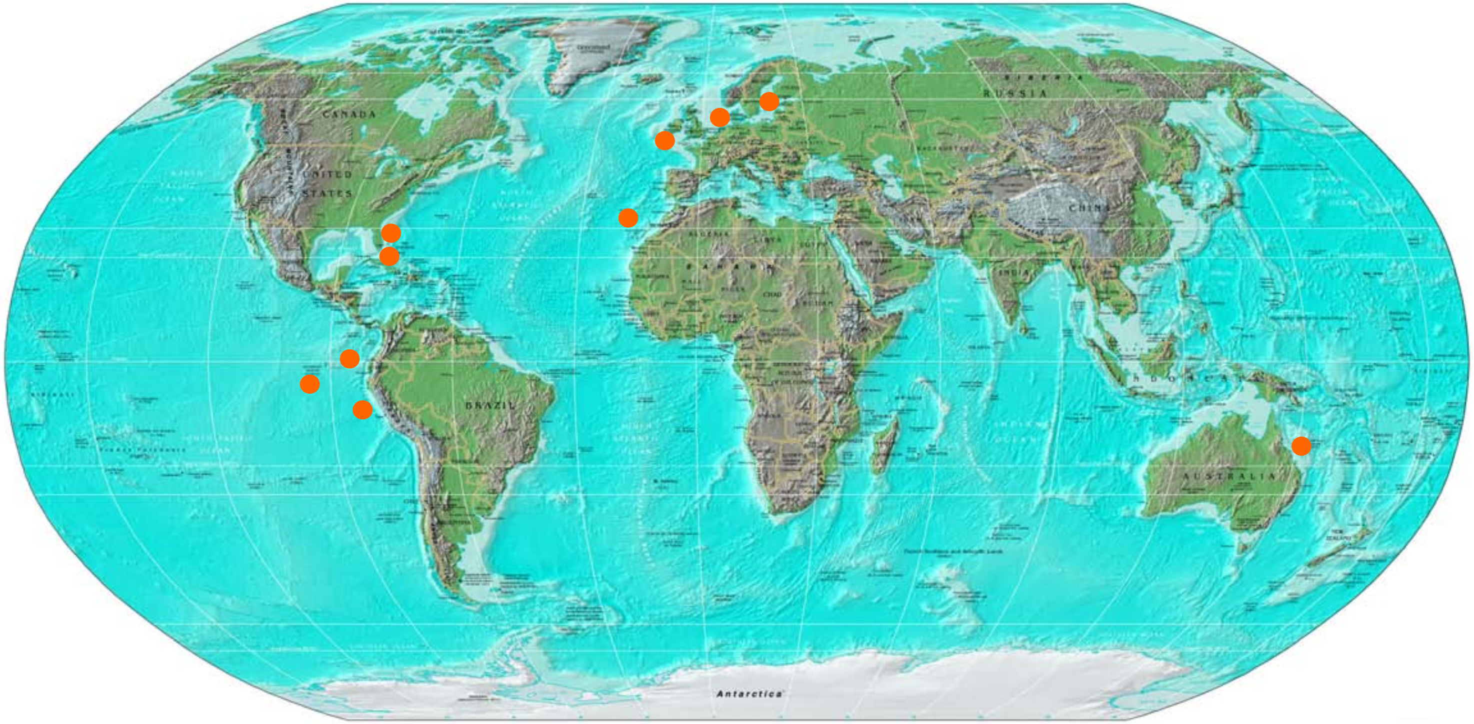

Figure 4 Designated PSSA's Globally

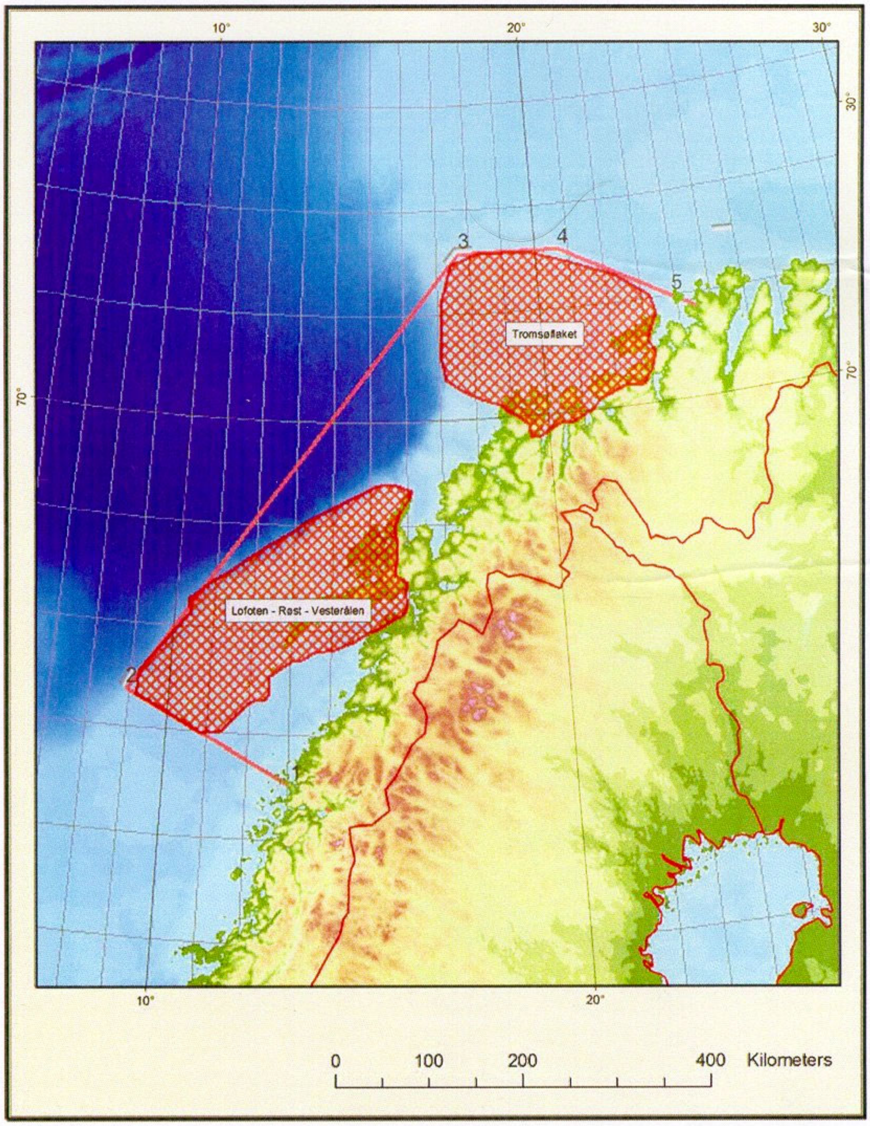

Figure 5 Barents Sea

Area proposed designated as PSSA in northern Norwegian Sea and the Barents Sea, indicated by a red line. Areas given in red hachure are of high environmental vulnerability. Sectors indicated in grey are suggested Traffic Separation Scheme. Obtained from Figure 10.1., Det Norske Veritas, *Report No. 2002-1621*, p. 112. Please note that distances appear in kilometre (km.). *1 nm. equals 1.852 km.* Thus, 100 km. on the chart equals approximately 54 nm.

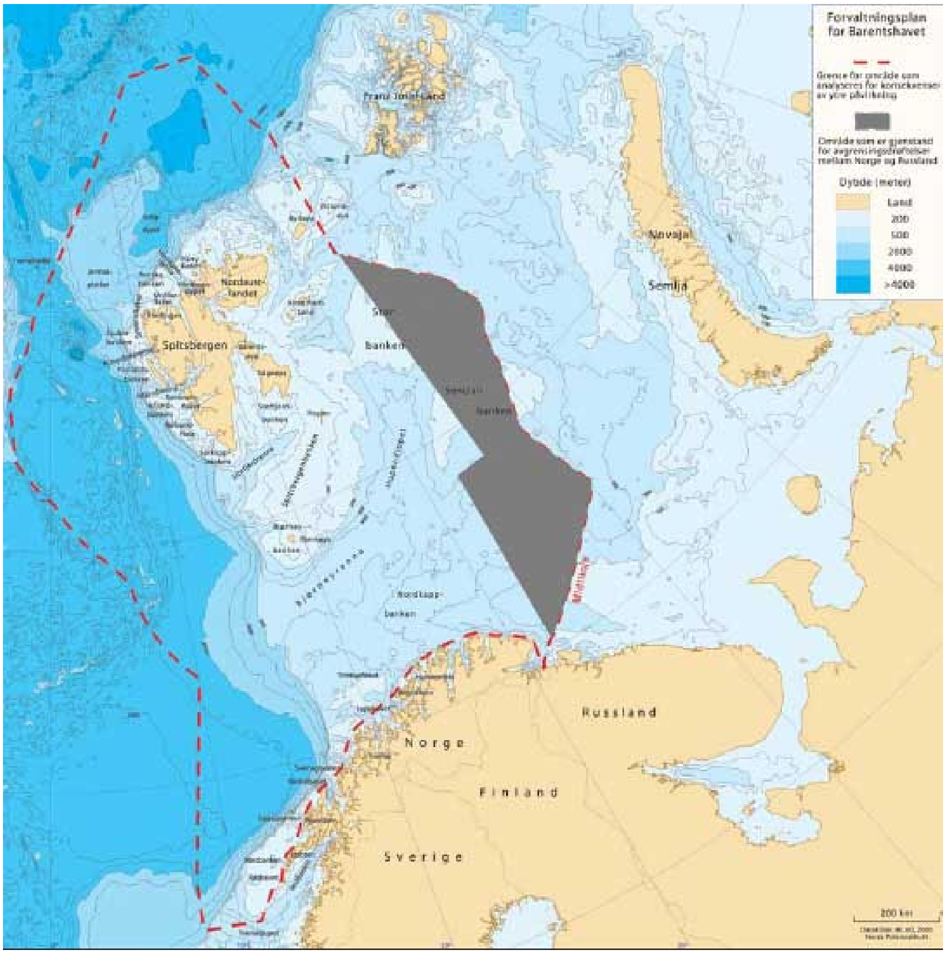

Figure 6 Norwegian Management Plan - Barents Sea

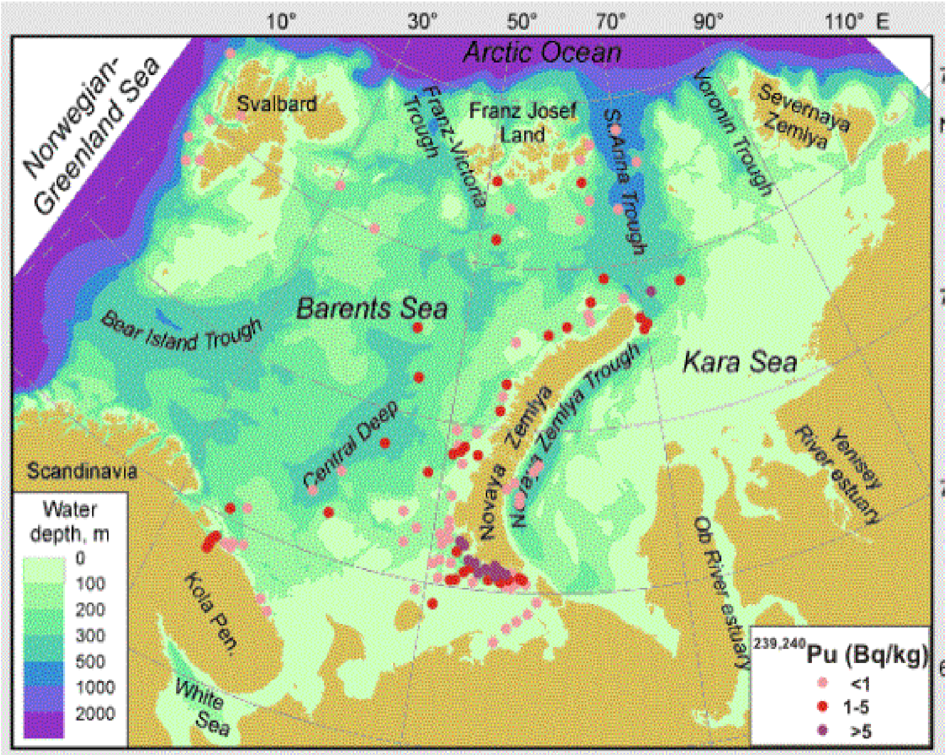

Figure 7 Radioactive Sources - Barents Sea

Conceptual Design of the Okhotsk Regime – Japan Proposal –

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National Maritime Research Institute
Japan

1. Introduction

The JANSROP Phase II Programme (hereinafter referred to as the “JANSROP II”) is an international research project composed of eight sub-programmes.[1] The project focused on the eastern part of the Northern Sea Route and related areas including some regions in eastern Siberia, Far East Russia and the Sea of Okhotsk. The project surveyed the distribution of natural resources and natural conditions in these regions. The results of the survey are summarized as a Geographical Information System (GIS): the JANSROP-GIS.[2] The project also gave conceptual plans for the development of these regions including infrastructures for the marine transportation of developed products.[3]

The core concept of the JANSROP II is sustainable development. Since its initial use in international documents in the late 1980s, the concept has been central to schemes and activities for environmental protection at the international, regional and domestic levels. Development in the abovementioned regions cannot be undertaken without due consideration of environmental protection. In the JANSROP II, an attempt was made to propose a conceptual design for an international regime to protect the environment of a marine area and the Sea of Okhotsk (see Figure 1) was chosen as an archetypal example.

The Sea of Okhotsk is a marginal sea in the northwestern Pacific Ocean. As shown in Figure 1, the Sea of Okhotsk is a semi-enclosed sea area bounded by the Russian mainland to the north, the Kamchatka Peninsula to the east, Sakhalin Island to the west and the Hokkaido and Kuril islands to the south. Its total area is about 1.5 million km^2. The continental shelf stretches out into the coastal areas off Sakhalin Island, the Russian mainland and the Kamchatka Peninsula. Beyond the continental shelf, there is a basin with a depth of roughly 1000 m in the center of the Sea of Okhotsk. The depth increases toward the south at around 48 degrees north forming the Kuril Basin with a depth of more than 3000 m in the north of the Kuril island chain. The mouth of the Amur River is located in the north of the Tartar Strait. The Amur River is 4350 km in length and has a catchment area of 205 million km^2, which means it is ranked 8th and 10th in the world on the basis of these properties, respectively.

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1 Kitagawa, H., 2006. JANSROP Phase II Programme: Primary Objectives and Outcomes. New Era in Far East Russia & Asia.
2 Kamesaki, K., 2006. JANSROP-GIS and Its Application, New Era in Far East Russia & Asia, OPRF.
3 Otsuka, N., 2006. Transportation Infrastructure in the Russian Far East. New Era in Far East Russia & Asia, OPRF.

Figure 1 The Sea of Okhotsk

Freshwater and substances from the Amur River play important roles in creating the unique oceanographic conditions and ecosystem of the Sea of Okhotsk. From a legislative point of view, the Sea of Okhotsk belongs to the territorial waters and EEZs of Russia and Japan with the exception of a high sea area in the center of the sea.

This paper presents a proposal from Japan on the conceptual design of an international environmental protection regime for the Sea of Okhotsk - the Okhotsk Regime. The proposal is a result of studies and discussions by the Japanese Working Committee of the JANSROP II. In this chapter, the proposal is described by answering the following three questions related to the Okhotsk Regime:

- Why do we need it? – The Need for Environmental Protection
- What issues should be taken into account? – Problems to be addressed
- How can we do it? – Regime Elements

2. Why do we need it? – The Need for Environmental Protection

2.1 Valuable Ecosystem

The Sea of Okhotsk is known as one of the sea areas with the richest marine products in the world. The annual fishing catch in the sea reached a peak of about six million tons in 1980s.[4] Although the catch has been in decline after that peak, it was still more than two million tons in 2001 in which Russian and Japanese catches accounted for 56% and 28%, respectively.

Rich marine production in the Sea of Okhotsk is supported by very high primary productivity. Figure 2 shows the distribution of phytoplankton in the north-west Pacific region. The figure shows areas of high phytoplankton concentration in the Sea of Okhotsk and the East China Sea. This high primary production in these areas is a result of the nutrient supply from the rivers flowing into the seas. It can be seen in Figure 2 that the area of high primary production is widely dispersed in the Sea of Okhotsk, while it is limited in the vicinities of the river mouths in the East China Sea. Recent studies show that there is a unique oceanographic mechanism in the Sea of Okhotsk that transports the nutrients supplied by the Amur River into the inner sea areas.[5] The mechanism supports the high primary production over the entire sea area and thus the richness of the Sea of Okhotsk.

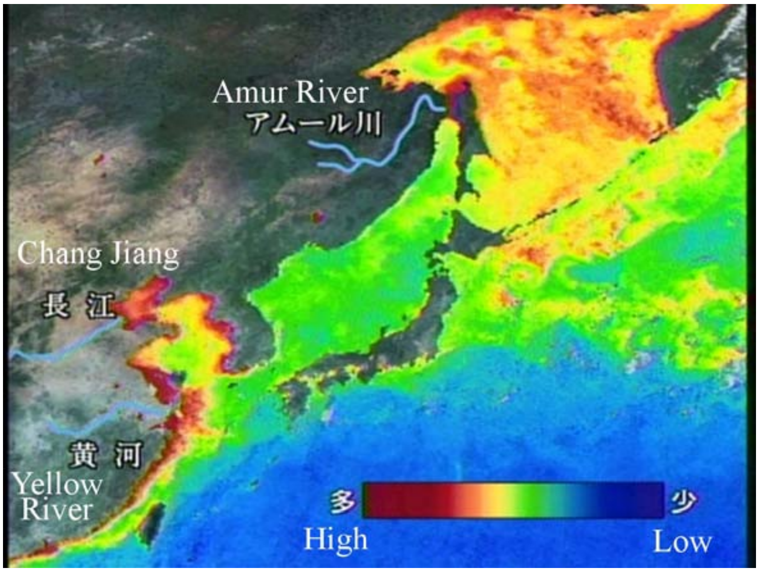

Figure 2 Distribution of Phytoplankton in the North-West Pacific Ocean[6]

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4 Otsuka, N., 2005. Marine Products in the Sea of Okhotsk. International Northern Sea Route Conference, Tokyo.

5 Nakatsuka, T. Fujimura, T., Yoshikawa, C., Noriki, S., Kawamura, K., Fukamachi, Y., Mizuta, G. and Wakatsuchi, M., 2004. Biogenic and Lithogenic Particle Fluxes in the Western Region of the Sea of Okhotsk: Implications for Lateral Material Transport and Biological Productivity. Journal of Geophysical Research, Vol. 109, C09S13.

6 The original picture was taken from a TV program entitled "Kiseki no Sekai Isan (World Heritage)" produced by NHK.

The very high productivity of the Sea of Okhotsk fosters not only living marine resources for fisheries, but also other creatures such as marine mammals and birds. As a result, the Sea of Okhotsk possesses a very high level of biodiversity. Endangered species such as the gray whale can also be seen in the sea.

Development of the Sea of Okhotsk should be conducted giving due care to the protection and preservation of its valuable ecosystem and biodiversity.

2.2 Vulnerable Environment

The Sea of Okhotsk is the southernmost sea area in the northern hemisphere and experiences a sizable amount of sea ice in winter. Figure 3 shows the seasonal change of sea ice extent in the Sea of Okhotsk. The figure shows the average sea ice extent over a period of thirty years from 1971 to 2000. Sea ice occurrence takes place in the north-eastern coastal areas in early December. It then spreads toward the south and its coverage reaches about 80% of the entire sea area during the maximum extent in March.

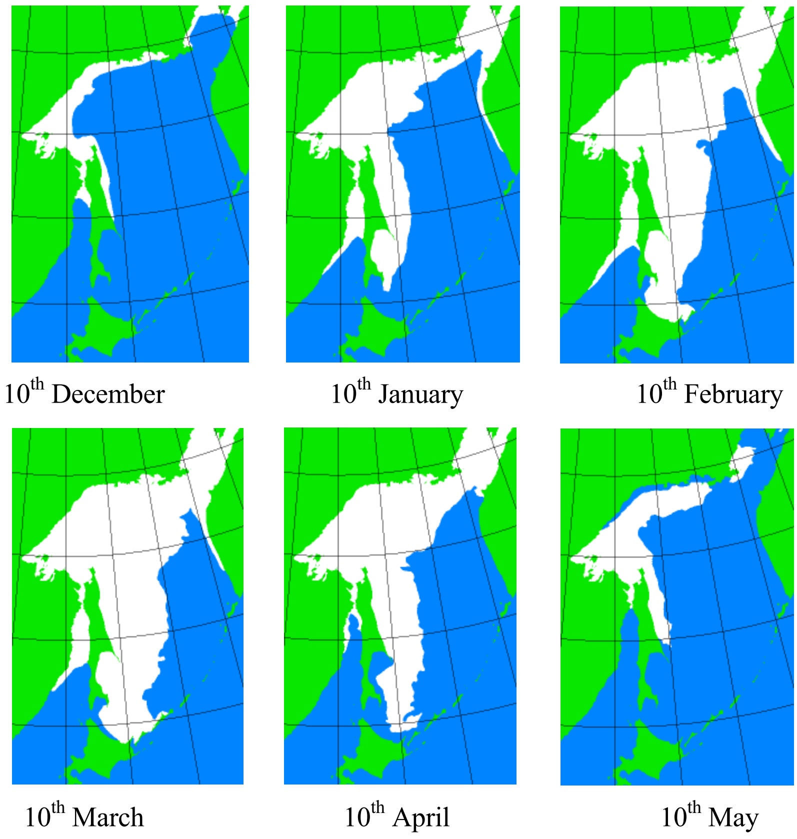

Figure 3 Seasonal Change of Sea Ice Extent in the Sea of Okhotsk[7]

[7] http://www.data.kishou.go.jp/marine/ice/okhotsk_normal.html

Ice-covered waters are vulnerable to pollution for several reasons. Biodegradation plays an important role in the decomposition of pollutants into harmless substances in the waters of moderate temperatures. In ice-covered waters, however, conditions such as cold temperatures and shading effects by the ice cover significantly lower the level of biochemical activities. Pollutants can remain for longer in the water column. In cases of the spilling of pollutants such as oil, a prompt response is the key to minimizing the adverse effects, but the presence of ice and cold temperatures make such operations difficult and sometimes impossible. Pollutants, if kept in contact with ice under low-temperature conditions, may become trapped by the growth of ice around them.[8] This could result in a pollutant-spreading mechanism unique to ice-covered waters in which the trapped pollutants are transported by the movement of ice.

With the recognition of their vulnerability to pollution, ice-covered waters have received special attention for environmental protection. The Baltic Sea and the sea area around the Antarctic are designated as MARPOL Special Areas where ships are required to comply with stricter discharge restrictions than those for other sea areas. These sea areas are also protected by environmental protection schemes under the "Convention on the Protection of the Marine Environment of the Baltic Sea Area, 1992" (Helsinki Convention) and the Antarctic Treaty, respectively. For the Arctic Ocean, there are no internationally recognized conventions or agreements for environmental protection. Instead, the Arctic Council undertakes various programs for the protection and monitoring of the Arctic environment.

In contrast to these other ice-covered waters in the world, the Sea of Okhotsk has never received special attention for environmental protection. There should be some special protection scheme for the Sea of Okhotsk.

2.3 Oceanographic Conditions

Figure 4 (left) shows the surface water circulation envisaged from the data obtained by satellite-tracked drifters. There are currents off the east coast of Sakhalin Island running southward. In-situ measurements of current velocity showed that the volume of water transported by the currents, such as the East Sakhalin Current (ESC), could be as much as 12×10^6 m^3/s in winter.[9] This is four to five times larger than that of the Tsushima warm current. Japan is located downstream from this strong ESC and from the current pattern in Figure 4, it can easily be inferred that if marine pollution such as an oil spill took place in the ESC area, for example, the pollution would most probably reach Japan.

Figure 4 (right) shows the movement of sea ice in the Sea of Okhotsk analyzed from satellite imagery. In the Sea of Okhotsk, landfast ice develops only in limited areas such as the Tartar Strait. Most of the sea ice is pack ice. Figure 4 (right) shows a very active movement of sea ice in the Sea of Okhotsk induced by strong winds from the Eurasian continent as well as water circulation. As previously described, there is a

[8] Wadhams, P., 2000. Ice in the Ocean. Gordon and Breach Science Publishers, p. 351.
[9] Mizuta, G., Fukamachi, Y. Ohshima, K. and Wakatsuchi, M., 2003. Structure and Seasonal Variability of the East Sakhalin Current. Journal of Physical Oceanography, Vol. 33, pp. 2430 – 2445.

pollution-spreading mechanism unique to ice-covered waters in which pollutants are trapped and transported by ice. The pollutants can reappear in spring in sea areas away from the site where the original pollution was located. The active movement of sea ice in the Sea of Okhotsk could enhance that mechanism.

It should also be noted here that sea ice provides some kinds of phytoplankton, which are called ice algae, with habitats in winter.[10] In spring, with the melting of ice and the increase of insolation, ice algae triggers a generous bloom of phytoplankton, the spring bloom. The spring bloom is followed by propagation of zooplankton and other creatures in the higher levels of the food chain, and is believed to play a very important role in the ecosystem of the Sea of Okhotsk. Pollution of sea ice could adversely affect the ice algae, and in turn the entire ecosystem.

Figure 4 (left) also shows a current moving away from the Sea of Okhotsk to the Pacific Ocean through a strait (the Bussol Strait) in the Kuril island chain. Recent studies revealed that the Sea of Okhotsk plays an important role in the water structure of the North Pacific Ocean by way of water exchange through the Kuril straits.[11] In the

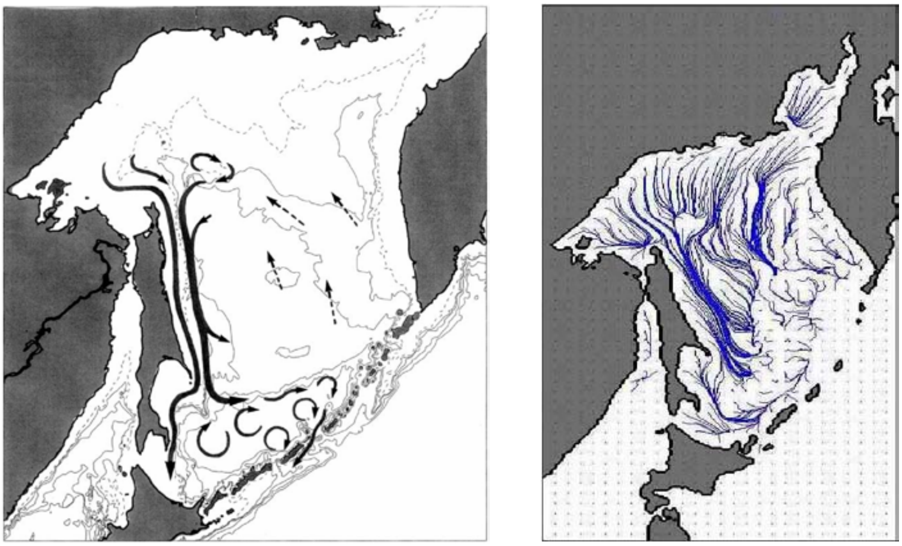

Figure 4 Surface Water Circulation (left)[12] and Sea Ice Movement (right)[13] in the Sea of Okhotsk

[10] Takahashi, M. and Shirasawa, K., 2002. Sea Ice Ecosystem (in Japanese). Kaiyo Monthly, Special Issue No.30, pp. 5 – 10, Kaiyo-shuppan.

[11] Itoh, M., Ohshima, K. and Wakatsuchi, M., 2003. Distribution and Formation of Okhotsk Sea Intermediate Water: An Analysis of Isopycnal Climatological Data. Journal of Geophysical Research Vol. 108 No. C8, 3258.

[12] Ohshima, K, Wakatsuchi, M. and Fukamachi, Y., 2002. Near-surface Circulation and Tidal Currents of the Okhotsk Sea observed with Satellite-tracked Drifters. Journal of Geophysical Research Vol. 107 No. C11, 3095.

[13] Enomoto, H., Kumano, T., Kimura, N., Tateyama, K., Shirasawa, K. and Uratsuka, S., 2003. Sea-ice Motion in the Okhotsk Sea Derived by Microwave Sensors. Proceedings of the Thirteenth (2003) International Offshore and Polar Engineering Conference, Vol. 1, pp. 518 – 522.

North Pacific Ocean there is a water mass called North Pacific Intermediate Water (NPIW). NPIW spreads over a wide area in the Temperate Zone of the North Pacific Ocean at an intermediate depth and is considered to influence the climate. It has been shown that NPIW originates in the Sea of Okhotsk. The Sea of Okhotsk is the only site where NPIW interacts with the atmosphere in exchanging heat and extracting gases such as oxygen and carbon dioxide from the water. Pollutants excreted in the Sea of Okhotsk can eventually be transported to NPIW.

Oceanographic conditions in the Sea of Okhotsk could thus provide a spreading mechanism for marine pollution in the sea. Pollution from a source or in an area can be easily transported to other parts of the sea or even to outer waters and so measures to prevent and minimize pollution are required.

3. What issues should be taken into account? – Problems to be Addressed

3.1 Pollution from Ships

There is a wide range of scenarios that can result in marine pollution. The United Nations Convention on the Law of the Sea (UNCLOS) contains provisions on the protection and preservation of the marine environment from six different pollution sources. They are pollution from land-based sources, seabed activities subject to national jurisdictions, activities on the seabed beyond the limits of national jurisdictions (the Area), dumping, vessels and the atmosphere. Among these, it was decided to take pollution from ships as the issue to be considered in the design of the Okhotsk Regime. The Sea of Okhotsk has been subjected to little human activity other than fishing over a long period. Future development of the sea, such as the exploitation of natural resources, would result in a rapid increase in marine transportation. Pollution from ships would be of primary importance in such a situation.

This does not mean, however, that pollution from sources other than ships can be ignored. Generally speaking, ships contribute only a small part of marine pollution. Among the abovementioned pollution sources, land-based causes are estimated to contribute 70% of marine pollution in the world, while pollution from ships and dumping accounts for only 10% each.[14] In the Sea of Okhotsk, land-based pollution in rivers like the Amur River, for example, may significantly contribute to marine pollution. Land-based pollution is problematic not only because of its quantity. Many of the pollutants originating from land-based sources exhibit toxicity, persistence and bioaccumulation in the food chain. Despite its importance, however, there has been little action at the international level to respond to marine pollution from land-based sources. At the regional level, the “Convention for the Protection of the Marine Environment of the North-East Atlantic” (OSPAR Convention) provides schemes to preserve and protect its marine environments against land-based pollution. This is, however, an exceptional case and there is practically no scheme in place to guard against land-based pollution in most of the sea areas in the world. In view of this situation, it was decided that the Okhotsk Regime should start by addressing pollution

[14] Agenda 21, Chapter 17: Protection of the Oceans, B. Marine Environment Protection, 1992.

from ships, but that in future, it should include pollution from other sources whenever it is deemed workable.

Marine pollution from ships is an issue that has a relatively long history of international discussion compared with other environmental areas. There have been various international schemes agreed upon to prevent marine pollution from ships including the MARPOL 73/78 Convention. Marine pollution from ships has two aspects in terms of the causes of the pollution: operational pollution and accidental pollution. The major source of pollution from ships under ordinary operating conditions is their discharge of waste. Other ship operations like anchoring or noise from machinery may also have adverse effects on the marine environment. In regard to accidental pollution, preventative schemes are two-fold: securing the safety of ships as a precautionary measure to prevent accidental pollution and the requirement of schemes to respond to accidents in order to minimize the effects of pollution.

The Okhotsk Regime should include measures against pollution from ships. In designing such initiatives, it is important to take into account the characteristics of natural conditions and shipping in the relevant sea areas.

3.2 Shipping Safety in Ice

The spilling of pollutants due to shipping accidents can result in acute marine pollution and those involving large oil tankers are of the highest concern. The cases of recent marine accidents involving the oil tankers *Prestige* or *Nakhodka* need not be brought up to show that large-scale oil spills from tankers can result in severe pollution over wide areas in sea and costal regions. Such pollution could result in long-lasting impacts on the ecosystem and also on the socio-economic activities in the affected areas. Securing shipping safety is important as a precautionary measure against marine pollution from shipping accidents.

The most important factor to be taken into consideration concerning shipping safety in the Sea of Okhotsk is the presence of sea ice in winter. Sea ice presents hazardous conditions for ships and ice features like ridges or hummocks are difficult obstacles to navigate. Ships may run into unnavigable conditions and eventually become stuck in the ice. Ship hulls are exposed to heavy loads due to contact with surrounding ice that could cause structural failures. Ice loading on propellers and rudders could also lead to accidents.

In view of the hazards that ice presents to ship navigation, there are rules to ensure shipping safety so as to prevent marine pollution from accidents in many ice-covered waters in the world. For the Sea of Okhotsk, however, there is no such recognized rule. Some rules for shipping safety in ice are required as an element of the Okhotsk Regime.

4. How can we do it? – Regime Elements

4.1 PSSA Designation

As described in the previous section, the Sea of Okhotsk possesses a valuable ecosystem and at the same time is vulnerable to pollution. The sea needs to receive special protection. There are two internationally recognized schemes for the special protection of sea areas against pollution from ships - the scheme of Special Areas under the MARPOL 73/78 Convention and the scheme of the Particularly Sensitive Sea Area (PSSA).

In a Special Area, ships are required to comply with stricter discharge restrictions than those for other sea areas. Definitions of existing Special Areas and associated discharge restrictions are contained in the MARPOL 73/78 Convention. Designation of a new Special Area requires amendments to the convention. A PSSA designation can be associated with environmental protection measures. Measures other than discharge restrictions can be adopted such as shipping routes, reporting systems, compulsory pilotage schemes and vessel traffic management systems. Taking into account the wider coverage of environmental protection measures, it is proposed to designate the Sea of Okhotsk as a PSSA (hereinafter referred to as the "Okhotsk PSSA").

To be designated as a PSSA, a sea area must meet certain criteria. The IMO adopted new guidelines for the designation of a PSSA[15] in 2002. According to the guidelines, a PSSA proposal is required to include descriptions of the sea area according to ecological, socio-economic and scientific criteria. Table 1 is a list of the 10 sea areas that have been designated PSSAs by the IMO.

Table 1 List of Adopted PSSAs

PSSA	Proposed by	Year
the Great Barrier Reef	Australia	1990
the Sabana-Camagüey Archipelago	Cuba	1997
Malpelo Island	Colombia	2002
the sea around the Florida Keys	United States	2002
the Wadden Sea	Denmark, Germany and Netherlands	2002
Paracas National Reserve	Peru	2003
Western European Waters (2004)	Belgium, France, Ireland, Portugal, Spain and United Kingdom	2004
Extension of the existing Great Barrier Reef PSSA to include the Torres Strait	Australia and Papua New Guinea	2005
Canary Islands	Spain	2005
the Galapagos Archipelago	Ecuador	2005
the Baltic Sea area	Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland and Sweden	2005

[15] IMO resolution A.927(22), 2002. Guidelines for the Designation of Special Areas under MARPOL 73/78 and Guidelines for the Identification and Designation of Particularly Sensitive Sea Areas.

It is premature and even meaningless to discuss the detailed design of the Okhotsk PSSA at this stage, so general comments will be made here. As shown in Table 1, there was a rapid increase in PSSA designations after the adoption of the new guidelines in 2002. There have been proposals for the designation of PSSAs over a wide area covering territorial waters and EEZs of several coastal states. In opposition to this trend, however, there is criticism that the original concept of a PSSA has been hijacked to protect a "special area" vulnerable to pollution from ships. The Sea of Okhotsk is a vast sea area of about 1.5 million km^2. It stretches from 44°N in the south to 62°N in the north. The natural conditions so as the ecosystem vary widely in the sea area. It doesn't seem appropriate to designate the whole area of the Sea of Okhotsk as a PSSA. The area of the Okhotsk PSSA has to be reasonably sized and clearly defined so that it can effectively minimize the adverse effects of pollution from ships.

As previously described, there are a wide range of options for environmental protection measures associated with a PSSA. Taking into account the nature of the Sea of Okhotsk as a seasonal ice zone, one of the measures to be taken in the Okhotsk Regime would be a special restriction on discharges from ships. Stricter discharge restrictions than other areas are required to protect its vulnerable marine environment. Adoption of stricter restrictions may result in illegal discharges from ships, so to minimize these it is necessary to prepare sufficient waste reception facilities on land. Systems for the monitoring of illegal discharges are also important.

The Sea of Okhotsk is a semi-enclosed sea area connected with other seas by narrow straits. To secure shipping safety in these straits, a traffic management system may be required as a component of the Okhotsk PSSA. Taking into account possible marine transportation routes and natural conditions such as the width, depth and currents of the straits, the Soya Strait (La Perouse Strait) seems to be a site that requires such a system.

4.2 Winter Navigation Guidelines

In some ice-covered waters in the world, there are regulatory regimes legislated by coastal states for shipping safety, and in turn for pollution prevention. In the Arctic Ocean, Canada and Russia have rules covering shipping in ice-covered waters under their jurisdiction. It is claimed that the legislation of rules is afforded legal authority by Article 234 of UNCLOS. The Article grants coastal states the right "to adopt and enforce non-discriminatory laws and regulations for the prevention, reduction and control of marine pollution from vessels in ice-covered areas within the limits of the exclusive economic zone." Under the Article, Canada and Russia promulgated the "Arctic Waters Pollution Prevention Act" and "Regulation for Navigation on the Seaway of the Northern Sea Route," respectively, and require foreign vessels to comply with them and their associated regulations.

Article 234 defines ice-covered areas as areas "where particularly severe climatic conditions and the presence of ice covering such areas for most of the year creates obstructions or exceptional hazards to navigation, and pollution of the marine environment could cause major harm to or irreversible disturbance of the ecological balance." The Arctic Ocean may be regarded as an "ice-covered area" under this definition. However, the Sea of Okhotsk is a seasonal ice area, and is not deemed to meet the UNCLOS definition.

Besides domestic regulatory regimes, two series of guidelines for ship navigation in ice-covered waters were elaborated recently as a result of international and regional collaborations and agreements. In 2002, the IMO adopted "Guidelines for Ships Operating in the Arctic Ice-covered Waters."[16] These guidelines cover a wide range of issues related to shipping in Arctic waters including ship construction, equipment, operational matters, environmental protection and damage control. More recently, the Helsinki Commission (HELCOM), the governing body of the Helsinki Convention, adopted a recommendation in 2004 which urges signatories to apply the "Guidelines for the Safety of Winter Navigation in the Baltic Sea Area."[17] The guidelines provide instructions for signatories to establish an ice surveillance system, adequate equivalents of ice classification rules and safety requirements, and guidance related to operational matters for winter navigation in the Baltic Sea area.

It is proposed to adopt some of the guidelines for winter navigation in the Sea of Okhotsk as an element of the Okhotsk Regime. The abovementioned guidelines are of a different nature. The Arctic Guidelines contain relatively general provisions for a wide range of issues. For ship structure and machinery, the guidelines make reference to the Unified Requirements by the International Association for Classification Society (IACS) for detailed design requirements. The guidelines can be regarded as a framework for shipping rules in the Arctic waters. On the contrary, the Baltic Guidelines focus on several issues of importance for winter navigation in the Baltic Sea area. The guidelines contain specific traffic restriction rules based on ship ice class and ice thickness in the areas in question. The two series of guidelines could, however, provide good points of reference for the consideration of winter shipping guidelines for the Sea of Okhotsk.

4.3 Pollution-Combating Schemes and Technology

Although precautionary measures for shipping safety are designed to minimize the risk of accidents, there is always the possibility of shipping accidents due to factors such as unavoidable weather conditions or human error. A scheme to respond to pollution from such accidents will be an important element to be included in a marine environment protection regime. Large-scale pollution such as an oil spill from a large oil tanker could affect a wide sea area beyond the boundaries of territorial waters or the EEZs of coastal states. International cooperation is essential for response operations against such trans-boundary pollution.

The United Nations Environment Programme (UNEP) launched the Regional Seas Programme in 1974, aiming to promote cooperation between neighboring coastal states for environmental protection of their oceans and coastal areas. Today, more than 140 countries participate in thirteen Regional Seas Programmes under the auspices of UNEP.[18] The Regional Seas Programs function through a Regional Action Plan. One

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[16] IMO MSC Circular 1056/MEPC Circular 339, 2002.
[17] HELCOM Recommendation 25/7, http://www.helcom.fi/Recommendations/en_GB/rec25_7/
[18] http://www.unep.org/regionalseas/About/default.asp

such Regional Action Plan is the North-West Pacific Action Plan (NOWPAP). NOWPAP was agreed to in 1994 by Japan, Russia, South Korea and China with the target areas being the Sea of Japan and the Yellow Sea.

One of the action plans in NOWPAP (NOWPAP/4) addresses regional cooperation for preparedness for, and responses to marine pollution in the NOWPAP area. In 2003, the four countries agreed on the "NOWPAP Regional Oil Spill Contingency Plan" that provides a framework for cooperation on policy and responsibility, response elements and planning, response operations, reports and communications, administration, logistics and funding.[19] Japan recently proposed an expansion of the NOWPAP area so that a part of the Sea of Okhotsk is included in the area where the above contingency plan is applied.[20] The expansion will be discussed at the 10th Inter-Governmental Meeting in 2005. If such an expansion is agreed to, NOWPAP, or some modification thereof, could be a good basis for a pollution-combating scheme in the Okhotsk Regime.

In considering a pollution-combating scheme for the Sea of Okhotsk, it is important to also pay attention to technology for pollution prevention in ice-covered conditions. To date, various methods and devices have been developed as responses to accidental pollution - especially oil spills - from ships in open water conditions. However, there has been much less progress in technology for combating pollution in ice-covered waters. The Okhotsk Regime needs to recognize the importance of this form of pollution and promote technology for its prevention.

4.4 Creating Scientific Bases

Measures to protect and preserve marine environments should be adopted and undertaken based on an accurate and appropriate understanding of the sea area in question. In the OSPAR Convention, signatories are required to regularly undertake and publish joint assessments of the quality status of the marine environment and its development. For this purpose, the OSPAR maritime area is subdivided into five regions as shown in Figure 5. Quality assessments are undertaken for each region and the results are summarized as a Regional Quality State Report. The reports assess the status of the quality of the regions from various aspects including geography, hydrography and climate, human activities, chemistry and biology, and then make an overall evaluation. The reports from the five regions form the basis of a general Quality State Report for the entire OSPAR maritime area. The Quality State Report is used as a scientific basis for the OSPAR Commission to decide strategies and to adopt decisions and recommendations for environmental protection of the OSPAR maritime area.

[19] NOWPAP MERRAC, 2003. Memorandum of Understanding (MOU) on Regional Co-operation regarding Preparedness and Response to Oil Spills in the Marine Environment of the Northwest Pacific Region & NOWPAP Regional Oil Spill Contingency Plan.

[20] Haruta, K., 2005. Countermeasure against Oil Pollution at Sea in Japan – Current Situation and Challenges –" Sakhalin Project Symposium.

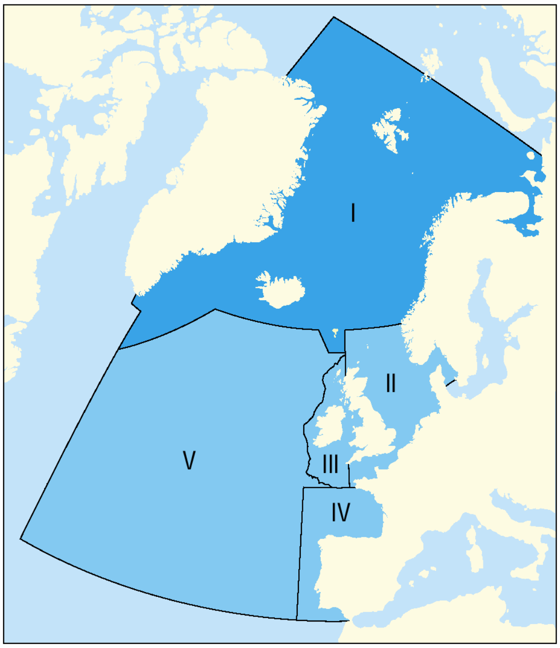

Figure 5 Subdivision of the OSPAR Maritime Area for Quality Assessment[21]

Contrary to the OSPAR maritime area, the natural conditions in the Sea of Okhotsk are poorly understood and it is only recently that international collaboration has taken place to study the sea. An outline of one such international research project is described by Wakatsuchi in this book.[22] The project was carried out on the basis of international collaboration between researchers from Japan, Russia and the US and resulted in important findings - such as the surface water circulation shown in Figure 4 - regarding the natural conditions of the Sea of Okhotsk.

One of the most urgently required actions towards the formulation of the Okhotsk Regime is the creation of scientific knowledge bases from which a detailed design of the regime could follow. It is also important to continue monitoring the marine environment and to review the effects of protection measures.

5. Summary

This paper describes a proposal for an international regime for the environmental protection of the Sea of Okhotsk – the Okhotsk Regime. The need for environmental protection of this area is presented from the point of view of its ecosystem, vulnerability to pollution and oceanographic conditions of the sea. As issues to be addressed in the creation of the regime, pollution from ships and shipping safety in ice

21 OSPAR Commission, 2000. Quality Status Report 2000.
22 Wakatsuchi, M., 2006. Natural Conditions of the Sea of Okhotsk. New Era in Far East Russia & Asia, OPRF.

have been discussed. Proposed regime elements include PSSA designation (the Okhotsk PSSA), winter navigation guidelines, a pollution-combating scheme and creating scientific bases for the Sea of Okhotsk.

A marine environmental protection regime has to be designed in consideration of the characteristics of the sea area in question. The most important natural feature that distinguishes the Sea of Okhotsk from other sea areas is the presence of sea ice in winter. The presence of sea ice makes the sea vulnerable to pollution and the present proposal takes this characteristic into account in the design of the Okhotsk Regime.

It goes without saying that international discussion and cooperation are essential toward the establishment and successful execution of the Okhotsk Regime. In this regard, the most important international relationship is naturally that between Japan and Russia. The two countries face the Sea of Okhotsk and could directly suffer from the adverse affects of marine pollution there. On the other hand, it is also true that there is currently a territorial dispute between these two countries in the Sea of Okhotsk. Marine pollution, however, is trans-boundary by nature. There have been no international schemes addressing the protection and preservation of the valuable and vulnerable ecosystem and biodiversity of the Sea of Okhotsk against marine pollution and so it is sincerely hoped that the two countries can collaborate and work toward the Okhotsk Regime beyond territorial disputes. The author believes this is possible.

PROPOSAL FOR AN INTERNATIONAL OKHOTSK MARITIME REGIME

A Proposal for an International Okhotsk Maritime Regime

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Proposal of a Marine Environment Management Scheme for the Sea of Okhotsk

In a world with diminishing natural resources, arctic and sub-arctic areas have become a region of global importance because of their abundant resources and strategic position. In these areas, operations demand a high level of scientific and technical achievement.[15,16,25] Recent high oil prices have deepened interest of Asian markets in oil and gas production on the Sakhalin shelf.[12] The volume of oil and gas transportation in the Sea of Okhotsk will grow dramatically in a few years, which might cause serious tanker accidents, or more probably, frequent though small spills of pollutants.

The increase in marine access for transport and offshore development requires new international and revised national regulations on marine safety and environmental protection. Workable measures should be taken to increase services such as improved ice charting and forecasting, traffic control and routing measures, strengthening of port-state control ability, improved facilities for waste disposal on shore and enhanced emergency response systems focusing on oil-in-ice cleaning capabilities. Every regulation should be based on reliable scientific update data. However, scientific data of the Sea of Okhotsk, in particular ecological data seems to be insufficient for clear and responsible regulations.[28] Prior to an international agreement on a marine environment management, an international agreement for scientific study of the Sea of Okhotsk is vital. This will likely be carried out by core members of Japan and Russia on the basis for a long term. Comprehensive studies are also necessary to map environmentally sensitive and important areas. Such studies should be repeated or at least, carried out periodically.

A maritime regime would play a significant role in solving or at least managing the problem in attaining environmentally sound and sustainable development.[31,32] Lacking reliable and satisfactory scientific data on natural and biological conditions, it might be premature to propose a maritime regime in the concrete, but we point out and assert aggressively the absolute and urgent necessity for a maritime regime for the Okhotsk Sea, particularly for sustainable resources development and their transportation in the area.

An Okhotsk marine regime would derive valuable suggestions form the Norwegian environmental measures for the Barents Sea,[22,23,24] the Canadian ice regime,[18,19] the Russian ice certification and the NSR regulations which were studied in the JANSROP II reports.[20,21,30] The IMO's Particularly Sensitive Sea Areas (PSSA) Guidelines[2] are also valuable, as well as a number of papers published on the effectiveness of international environmental regimes analyzing their casual connections and behavioral mechanisms.

For the moment, the proposal of a substantial structure of the Okhotsk regime is out of our scope and excludes legal and jurisdiction issues, which are matters of considerable concern in the regime structure. We simply point out major elements to consider for the regime from the scientific and technological views on the marine environment. Such a proposal might encounter legislative criticism from specialists on international law. We will humbly accepted the comments. Figuratively speaking, to excite such reaction is surely one of the objectives of our regime proposal.

On the Regime Principle

Moral justification, the weakest of four categories of justification, i.e. utilitarian, ecological, aesthetic and moral, has to do with the belief that various aspects of the environment have a right to exist and that it is a moral and therefore social obligation of human beings to many nonhuman organisms, to entire ecosystems and even to inanimate objects.[11,13] The United Nations General Assembly World Charter for Nature, signed in 1982, states that species have a moral right to exist. The analysis of such issues is the province of a new discipline known as environmental ethics. Another major concern of environmental ethics is our obligation to future generations. Sustainability should be defined as ensuring that future generations have equal or more opportunities to the resources that the earth offers.[14]

The Sea of Okhotsk falls almost entirely under the jurisdiction of the Russian Federation, with the exception of islands of Hokkaido of Japan. The high sea area is totally enclosed by the Russian EEZ. The Sea of Okhotsk and surrounding regions have been relatively undeveloped with very low shipping frequency particularly in the long winter season. Even though overfishing in the area is at the threshold level, Russia and the most of the Far Eat Asian countries have deeply been dependent on the marine products.[30]

However, recent rapid exploitation and development of oil and gas on the continental shelf of the Sakhalin Island have begun to show symptoms of changing the features and threatening the ecosystem of the region, in particular in the coastal zones. In developed countries, to ignore the role of humans and their impact on coastal evolution would be fallacious. Almost all coastal systems have been influenced by human intervention, and the last two centuries of evolution have been dominated by attempts to control the shoreline. Shorelines have significant influence on coastal ecosystem. Coastal resources are now seen as valuable (for tourism, minerals, agriculture, aquaculture, fishery, marine industry, etc.), although it is only since the 1970's that any serious resource conservation has been attempted, and often then on a limited scale. National initiatives are now emerging in various countries, and further efforts are being made in developing countries where most coastal resources are still being depleted. However, it is very difficult to break free of existing administrative structures, and in many places regional and local interests still have over-riding influence. In the Sea of Okhotsk, it is still not too late to prevent such over-riding influence on the shoreline and coastal ecosystem. The proposal for maritime regime should take into account of these natural, social and jurisdictional conditions.

Measures, matters and elements relevant for the protection of marine environment of the Sea of Okhotsk were discussed in several papers[7,8] and especially in detail in Schei's and Brubaker's papers.[23,24] In this paper, we will simply sum up proposals for promoting deeper interest in environmental issues of both governmental and non-governmental decision-makers, for urging them to initiate action on immediate and effective measures, and for linking domestic and international pollution control.

Measures and Matters Relevant for the Protection of Marine Environment of the Sea of Okhotsk

The measures and/or matters relevant for the sustainable development and marine environment protection under an Okhotsk Maritime Regime which should be adopted, or at least thoroughly discussed include the following.[1,3,4,5,7,8,10,17,18,21,22,23]

- further investigation of nature and ecosystem of the area with collaboration between Russia, Japan and other countries.
- establishment of a global international or bi-national cooperation system for environmental protection of the area;
- conclusion of effective regional cooperation agreement for executions of marine environmental protection;
- establishment of a closely linked international monitoring system for marine environment and data centre;
    - a physical-oceanographical monitoring system for marine resources,
    - a marine biological monitoring system (in future),
- responsible fishery management in an international framework;
- reasonable environmental regulations for exploratory and productive drilling;
    - thorough surveys before any drilling,
    - continuous monitoring,
    - drill-mud reinjection and discharge,
    - drill-water discharge,
    - trawl-safe seabed installations,
    - minimizing surface installations,

- use of the same environmental standards by Western oil companies in conjunction with their consortium partners and subcontractors as in their home countries, particularly the E.U. and the U.S.;
- reasonable vessel requirements suitable for the Sea of Okhotsk;
  - structure requirements
  - stopping and maneuverability requirements
  - icing requirements
  - speed limitation guidelines
- bi-national traffic management system based on vessels information and traffic analysis;
  - marine traffic service,
    - optimum routing service with hydrometeorological information,
    - real time ice information service with forecasting,
  - traffic separation schemes,
  - automatic identification system,
  - implementation of routing regime,
  - compulsory pilotage in selected and informed coastal areas,
    - year-round pilotage,
    - seasonal pilotage,
  - mandatory ship's reporting,
- international collaborative search and rescue system;
- international sharing the use of emergency units and facilities;
- preparation of hazardous and sensitive area maps, and guidance based on them;
  - unusual features,
    - depth of water,
    - sunken rocks,
    - sea bottom slope,
    - wind and predominant wind direction,
    - waves and swell,
    - ice concentration and features,
    - fog,
  - accessibility of rescue station or emergency assistance,
  - marine ecosystem,
    - fish hatching zones,
    - peculiar crustacea,
    - marine mammals,
    - marine birds,
  - fishery,
    - scientific rationale for studies on marine resources
  - aquaculture spots,
  - marine protected areas,
    - adoption of protected marine areas; advanced UNCLOS PAs;
  - non-anchoring areas and areas to be avoided,
  - beach and coastal peculiarity,

  - areas which are ‘hot spots’ where several interests intersect,
- electronic chart display and information system;
- contingency management;
- open and digital display of risk analysis and oil spill contingency assessments;
  - safety assessment, risk analysis and presentation of the procedures,
  - formulation of and implementing risk control and management,
  - oil spill contingency assessments,
- places of refuge and beaching;
- tugboat with fire pump at strategic locations;
- management of oily wastes, hazardous chemicals, sewage and garbage;
- reception facilities of oily waste, hazardous chemicals, sewage and garbage in port facilities;
  - fee reductions in port and other incentives to promote facility use,
  - speeding-up in processing of waste,
  - update facilities information service for waste management,
  - promotion of waste recycle,
- management of ballast water and other polluted water on board;
- control of emission of engine-exhaust gas to air, NOx, SOx, suspending particles, etc.;
- control of noise from vessels;
  - noise emission to air,
  - noise emission into water,
- strict control for dumping from vessels;
- loading and unloading guidance to avoid pollution through cargo handling;
- reporting system of ship data, data centre and information service;
- quick and easy inspection system for vessels in ports with instructions by specialists via satellite conversation and information exchange;
- training and certification of crew for operations in ice-infested waters;
- support of the international funds for marine environment protection, including clear and reasonable procedures of indemnity and establishment of a higher tier international indemnity if necessary;
- international or bi-national secretariat for management of marine environment protection;
  - international scientists committee,
  - executing committee,
  - contingency committee,
  - planning section for more effective system for marine environment protection,
  - fund committee
- establishment of a guideline for tourism;
  - certification of agents and tour-guides,
  - protected areas for tourism,
- protection of indigenous peoples’ life, society and culture.

Some of these measures should urgently be carried out, while others can be employed through considerable commercial operations and practical experience.

To protect vessels and offshore structures, particularly from damage due to ice, effective and reliable means should be adopted, including those to avoid accidents caused by icing in the Sea of Okhotsk. An urgent issue is additionally to develop and improve response options for dealing with accidental oil spill in ice-covered waters, and to determine the most appropriate strategy for coping with spilled oil in specific ice conditions which vary with the time and place. Successful oil spill response is dependent upon immediate availability of the best clean-up technology. Responding organizations need access to all available responding equipment in a timely manner through multi-national and regional collaborations beyond the jurisdictional borders.

Currently mechanical recovery of spilled oil in pack ice is limited, and new techniques to deflect and separate oil, ice and water should be developed. The use of dispersants for spills in ice has been little considered. In some occasions, icebreakers and ice-strengthened vessels could be useful in creating mixing energy for the longer retention of dispersants in cold water, where a lack of natural mixing energy exists due to the dampening forces of the ice and increasing of viscosity. Particular attentions should be paid to the following technical issues;

· detection of oil in ice by remote sensing,
· deflection of oil and separation of oil, ice and water,
· transfer of icy, oily waste,
· updating of mechanical recovery, and
· limited use of dispersants with some additional systems.

Legal and Other Elements Relevant for an Okhotsk Maritime Regime

Ship-source marine pollution has attracted special attention for a long time, and international agreements and regulations have been widely accepted by States for reducing and/or diminishing marine pollution accidents. This is probably because shipping is an international industry that could be regulated with globally admitted international rules established and developed through intergovernmental organizations. Current intergovernmental regulations and the background behind their establishments and revisions are certainly useful references for discussion of an Okhotsk regime.

The regime can take some credit for increasing the number of reception facilities available today and for expanding regulations to include accidental oil spills, platforms, and a wide array of other marine and air pollutants from ships. The regime has been most effective when targeting the actions of non state actors in way, that take account of the existing incentives and abilities of governments and corporations. Progress, when it has occurred, has required the coupling of pressures from powerful states with evaluation of previous experience to direct efforts toward successful new policies.

Satisfactory marine environmental protection for the Sea of Okhotsk will necessitate discussion and/or consideration of the following items and elements.[2,6,18,26,27,29]

- the pre-cautionary approach;
- effectiveness and institutional design of international environmental regime;
  - legal and normative approach,
  - political approach,
  - economic approach,
- flexibility of the regime;
- public participation in establishment and management of the regime;
- a high regard for legal experts' suggestions;
- serious attention to the reality, scientific evidence, biological views, and viability;
- conventions, protocols and agreements on marine environment;
  - Agenda 21,
  - UNCLOS and UNCLOS PA,
  - London Dumping Convention
  - MARPOL73/78,
  - SOLAS,
  - IMO PSSAs,
  - OSPAR Convention,
  - NOWPAP,
- national law and regulations governing;
  - Draft Russian Federal Law on Northern Sea Route,
  - Russian Ice Certification system,
    - book of navigation,
  - Maritime Law and Relevant Regulations of the Russian Federation,
    - Regulations for Navigation on the Seaways of the Northern Sea Route,
    - Guide to Navigating through the Northern Sea Route,
  - Implementation of the Russian domestic environmental regime,
  - Japanese law and regulations for maritime issues,
  - Canadian Zone/Dates system,
    - flexible table of entry and exit dates,
  - Canadian Arctic Ice Regime Shipping System,[29]
    - ice numeral system,
  - Canadian Arctic Shipping Pollution Prevention Regulations,
- fishery management;[9,17]
  - CBD,
  - Convention on Fishing and Conservation of the Living Resources of the High Seas,
  - CCAMLR,

Concluding Remarks

We would like to humbly accept comments and criticisms to our perhaps somewhat indefinite proposal. However, it be realized that our human society has now become powerful enough to cause unrecoverable damage to our environment on earth.

It is difficult to generalize the role of international environmental regimes as forces in domestic laws and regulations. Even sometimes, well-financed private actors have had a capability to avoid international environmental regulations and agreements. Ironically, the occasional serious marine disasters, followed by marine pollution appear to have considerably benefited the marine environment, by providing revisions of international and domestic regulations, by attracting policy-makers' and legislators' attention, and by stimulating pollution control and relevant scientific research. Despite the IMO's guiding principle of 'safer ships and offshore structures in cleaner seas and oceans', which is now replaced by "safe secure and effective shipping on clean oceans", the marine society has indeed been dependent upon disastrous marine accidents to force the revisions of rather weak agreements and for establishment of more effective regulatory frameworks. We need to cease with such a bad habit in the shipping world, particularly so in the Sea of Okhotsk with an extremely fragile ecological structure.

Careful reviews of the major marine conventions, protocols, and international agreements, the domestic law and regulations in Russia, as well as the current state of hydrocarbon development in the region, suggest that it might be rather late to think about and implement a maritime regime for the Okhotsk Sea, although Russian and Canadian experiences clearly show that resources development, shipping experience and environmental regime are a sort of the Trinity which deeply influence one another.

It is a matter of regret that we cannot yet turn them into a unique maritime regime for the Okhotsk Sea. Until governments systematically examine needs and existing responsibilities, such a regime will have to be on the order the oceans for the twenty-first century.

To make the world a better place, our path towards sustainable development involves an evolution of our values to include human beings within a framework that is socially, politically, economically and environmentally just.

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Biography

Lawson BRIGHAM

Born in Greenport, New York in 1948, Dr. Brigham graduated from the U.S. Coast Guard Academy and served as a Coast Guard officer from 1970-1995. He was commanding officer of icebreakers on the American Great Lakes and on voyages to the Arctic and Antarctic (aboard the icebreaker 'Polar Sea'), and was chief of strategic planning for the Coast Guard. Dr. Brigham received his PhD from Cambridge University in the United Kingdom and he has published widely on Arctic marine transportation and polar science. Dr. Brigham is Deputy Executive Director of the U.S. Arctic Research Commission in Anchorage, Alaska, and is currently Vice Chairman of the Arctic Council's Working Group on Protection of the Arctic Marine Environment (PAME). He is also Chairman of the Arctic Council's 'Arctic Marine Shipping Assessment 2005-2008.' Dr. Brigham was a member of the INSROP International Advisory Group during 1993-1999 and is a contributing author to the Arctic Climate Impact Assessment. Captain Brigham was elected a Fellow of the Arctic Institute of North America in 1995.

R. Douglas BRUBAKER

Born in 1946, Dr. Brubaker studied law at the University of Oslo, Faculty of Law, Oslo, Norway and New College of California, San Francisco, U.S. and became a member of the California Bar. He later obtained a Doctorate of Law in March 2002 from the University of Stockholm, Faculty of Law, Stockholm, Sweden. Now he serves as Senior Research Fellow at the Fridtjof Nansen Institute. His main research areas are Arctic jurisdiction, environmental law, international law of the sea, international law, nuclear liability law, and human rights and indigenous rights.

Vladimir M. CHLENOV

Vladimir Mikhailovich Chlenov, Minister of Transport, Communication and Informatization of the Sakha Republic (Yakutia), was born in October 14, 1950 in Abdulino, the Orenburg region. While experienced in the manufacturing industry, military service and regional political activities, he graduated from the Yakutsk State University in 1984 and Khabarovsk high political school in 1990. he has contributed a great deal to the regional and federal societies, pursuing a career in regional politics for Nurba and other regions in Yakutia, playing a subordinate and then leading roles: Deputy Minister of Food Industry YASSR (1991); Minister of Material Resources, Trade, Transport and Communication/Deputy Chairman of the Republic Government (1995); Minister of Transport, Communication and Informatization of Yakutia (2002). Under his able leadership, the fundamental basis for the future development of transport infrastructure, communication and information network has been established in Yakutia.

Yuri N. GRIGORENKO

Dr. Yuri N. Grigorenko was born in Leningrad, Russia, in 1936. He received his PhD from the Geological Faculty, Leningrad State Mine Institute (1959). Dr. Y.Grigorenko initiated his career at the All Russia Petroleum Research Exploration Institute (VNIGRI) in St. Petersburg, Russia. His career at the Institute includes the posts of Head of Marine Petroleum Geology Department and a Research Deputy Director. He has more than 40 years' experience in theoretical and applied problems of offshore and on-shore petroleum geology of Russia, especially Far East and Polar Seas. He is Dr.Sc. in Petroleum Geology (1996), author of 5 monographs and 185 articles, Member of the Russian Academy of Natural Sciences, AAPG Active Member, Honorary Geologist of the Russian Federation.

Yeong-Seok HA

Prof. Yeong-Seok Ha is Dean of External Affairs at Keimyung University, in Daegu, South Korea, as well as the Editor-in-Chief of the Journal of Shipping & Logistics. Prof. Ha was born in Ui-Ryung, Kyungsang Nam-Do in 1957. He received his Ph.D. from the Department of Economics, Graduate Center of The City University of New York in 1991. After his graduation, Prof. Ha joined the Korea Maritime Institute (KMI) as a senior researcher. He has been working with Keimyung University as a professor at the Department of International Commerce since 1993. His scope of work includes the shipping industry, shipping economics and international logistics. Currently he is researching "Promotion Strategies for the Port of Pohang," and "The Structural Change of the Shipping Industry in South Korea." He also is a visiting researcher of Daegu-Kyungbuk Research Institute, an adviser of The Daegu Chamber of Commerce and Industry and a member of The Logistics Committee for Deagu Metropolitan City.

Yuichiro ISHIKAWA

Born in Tokyo in 1951, Mr. Ishikawa graduated from Faculty of Commerce, Hitotsubashi Univ. and entered Marubeni Corporation in 1974. He has held numbers of positions mainly in the field of corporate management in Marubeni Corp. and has experience and knowledge in the areas such as finance, accounting, risk management, transportation, insurance. His working experience includes assignments abroad in total 13 years; in Germany (twice) and in London, UK. From 1993 through 1998 he had served as General Manager of Corporate Management Dept. at Marubeni Deutschland GmbH. In April 2001 he was appointed as Deputy General Manager of Finance Department at Marubeni Corp. and in April 2002 as General Manager of Finance & Logistics Administration Department. Since April 2003 he has served as Senior Operating Officer of Finance & Logistics Business Division.

Koh IZUMIYAMA

Born in Sapporo in 1957, Dr. Izumiyama began to work for Ship Research Institute, Ministry of Transport (current National Maritime Research Institute) after graduating from Hokkaido University in 1983. He is currently a head of Ice Engineering Group at the Institute. Dr. Izumiyama engaged in the research of ice transiting ships, ice load on marine structure and ice model test technology. He has recently pursued issues on oil spills in the ice bound sea. During that period, Dr. Izumiyama joined the 26th Japan Antarctic Research Expedition and worked at the National Research Council of Canada as a visiting researcher for a one-year term. Dr. Izumiyama participated in the NSR experimental voyage in INSROP project.

Kazuhiko KAMESAKI

Born in Fukuoka prefecture in 1951, Dr. Kamesaki graduated from the master's course of Naval Architecture at Kyushu University. He initiated his career at NKK Corporation and with the development of the icebreaker, "Shirase", he has specialized in ice engineering topics over 20 years since 1979. He was responsible for thesis screening, the NSR experimental voyage and the simulation of navigation of INSROP project. Dr. Kamesaki is presently a general manager of Naval Ship Development Department at Universal Shipbuilding Corporation, a member of the JANSROP PHASE Ⅱ domestic committee and a head of ISO TC67/SC7/WG8 "Arctic Structure" in Japan.

Hiromitsu KITAGAWA

Born in Tokyo in 1935, Prof. Kitagawa initiated his career at Ship Research Institute, Ministry of Transport (current National Maritime Research Institute) after graduating from the Department of Naval Architecture at Yokohama National University. His career at the institute included the posts of Head of Ship Performance Division and General Director of the Institute. After a stint as President of Shipbuilding Research Centre of Japan, he was appointed as Professor of Civil Engineering at Hokkaido University, chairing the Ice and Snow Technology Laboratory. His specialized fields include ice engineering and fluid dynamics. Prof. Kitagawa served as the overall coordinator of INSROP and JANSROP I & II project.

Willy ØSTRENG

Prof. Willy Østreng is Scientific Director of the Center for Advanced Studies at the Norwegian Academy of Science and Letters in Oslo. He is also Chairman of the Board of Directors of the research company, Ocean Futures Research and Development in Oslo, and Affiliated Professor of the Department of Politics at the University of Alaska Fairbanks. He was Director of the Fridtjof Nansen Institute from 1978 to 2003 and adjunct Professor of International Affairs in the Department of Sociology and Political Science at the Norwegian University of Science and Technology in Trondheim from 1994 to 2004. He headed the Secretariat and the Joint Research Committee of the International Northern Sea Route Programme (INSROP) from 1993 to 1999, and has published more than 160 scientific works (22 books) on northern security, international resource management, polar and ocean policy and the preconditions of interdisciplinary research. His latest books relating to the Northern Sea Route are: *National Security and International Environmental Cooperation in the Arctic – the Case of the Northern Sea Route*, Kluwer Academic Publishers, 1999 (Editor and author), *The Natural and Societal Challenges of the Northern Sea Route. A Reference Work*, Kluwer Academic Publishers, 1999, (Editor and author), *Order for the Oceans at the Turn of the Century*, Kluwer International Law, 1999 (Editor and author) and *Science without Borders. The History,Concept, Theory, Methodology and Practicality of Interdisciplinary Research*, (Author) forthcoming, 2005.

Natsuhiko OTSUKA

Born in Hokkaido in 1958, Dr. Otsuka started his career at TOA Corporation after graduating from Civil Engineering Department at Hokkaido University in 1981. His scope of work included designing and analysis of ports, fishery harbor facilities and LNG pier. After joining North Japan Ports Consultant Corporation Ltd. in 1991, he has engaged in designing and hydraulic analysis of ports and fishery harbor and, since 1995, has served as a general manager of engineering department. Dr. Otsuka received his PhD from School of Engineering, Hokkaido University in 2001.

Vsevolod PERESYPKIN

Dr. Vsevolod Peresypkin was born in 1931 in Zaporozye, Ukraine. He has graduated from Arctic Higher Marine College (now State Marine Academy). He began his work as engineer-hydrographer in Archangel Hydrobase in 1954. After 8 years, he joined State Hydrographic Office of Merchant Fleet while working as chief engineer and as director general. In 1986, Dr. Peresypkin started to work as general director of Central Marine Research & Design Institute. Dr. Peresypkin holds Dr. Science Degree who is a member of Transport Academies of Russia and Ukraine. Dr. Peresypkin was awarded State Prize in 1981. Dr. Peresypkin participated in several hydrographic expeditions in Arctic and other world regions. Dr. Peresypkin has participated in several tasks at IMO for 30 years. He was vice-chairman of Sub-Committee on Safety of Navigation for 15 years since 1990 till 2005. Dr. Peresypkin holds a lot of State Awards and Honorary Titles. Dr. Peresypkin has published a lot of scientific articles and among them are 3 books and 4 monographs.

Victor SANTOS-PEDRO

Dr. Santos-Pedro is Director at the Marine Safety Headquarters of the Department of Transport in Ottawa, Canada. He leads a group dealing with Arctic shipping regulations and in general with ship design, construction, and equipment standards, including offshore and special ships, recreational boats, as well as product approval. His Branch has major regulatory initiatives underway that touch most marine operations in Canada: small vessels including passenger ships, pleasure craft, and fishing vessels. Dr. Santos-Pedro obtained his formal education in England, in Naval Architecture and is qualified as a Chartered Engineer in Europe and as a Professional Engineer in Canada. His career has spanned offshore projects, stability analyses, ship inspections, design, R&D management, and leading the development of shipping rules, including international standards. Dr. Santos-Pedro has written professional papers, given many special presentations, and received the Canadian Coast Guard Commissioner's Commendation for his leadership work with the Polar Code. Dr. Santos-Pedro speaks several languages and has many years of leadership and consultation experience in international and environmental protection issues particularly as it relates to polar and ice-covered waters shipping.

Peter J. SCHEI

Dr. Peter J. Schei is the Director of the Fridtjof Nansen Institute in Norway. He is a biologist by training and has his degree from the University of Oslo, Norway 1971. Schei has a long carrier in International Environment Politics as Negotiations director and as head for the Norwegian Delegation to CITES (1979-2004), CBD (1990-2004), Biosafety Protocol (1996-2004) and Ramsar Convention (1995-2004). He has been president for SBSTTA under CBD (1996-7) and has been member of the Bureau for CBD and Standing Committee under CITES. Under CBD he has been particularly active in the area of Invasive Alien Species, Ecosystem Approach and in developing Principles for Sustainable Use. In 2002 he was working for the Secretary General for UN preparing the WEHAB Initiative for the WSSD summit in Johannesburg. Schei was responsible for the Norwegian strategy for Sustainable Development 1989 and has been working with Jeffrey Sachs on the Millennium Project (2005). He has also been initiator and very actively involved with the MA (Millennium Ecosystem Assessment) (1999-2005). Dr. Schei was heavily involved with the Antarctic Treaty system in the early development of CAMMLR and the Protection Regime of Antarctica. He has also been Executive officer for Polar Affairs in the Ministry of Environment.

Gennady N. SEMANOV

Dr. G. Semanov has more than 30 years professional experience as project manager and as environmental specialist within environmental risk assessments, marine oil spill contingency planning and response, prevention of pollution from ships and international cooperation related to these issues. He has more than 150 publications and 15 inventions. Dr. G. Semanov has been acting as coordinator for INSROP (International Northern Sea Rout Program) subprogram and team leader for environmental projects related to protection of marine environment including international program ARCOP and the projects for development and implementation of national oil spill contingency plan in Russia; Baltic, Black sea, Arctic, Far East regional contingency plans, objects contingency plans for Lukoil, Transneft, ports and others. He has been the project leader related to development of normative documents Ministry of transport concerned environment problems. Dr. G. Semanov is permanent member of Russian delegation on MEPC of IMO, EPPR of Arctic Council, HELCOM.

Yaroslav Nikolayevich SEMENIKHIN

Dr. Semenikhin Yaroslav Nikolayevich was born in 1938 in Vladivostok, Russia. After graduating from the Far Eastern Marine University he worked as a passenger ship master. From the 1976 he worked as a head of research laboratory of commercial information and prediction in international shipping in the Pacific Ocean. In the 1983 graduated from the jurist department of Far Eastern State University. From the 1988 became a general director of Far-Eastern marine research, design and technology institute. Candidate of economic sciences, professor, doctor of transport, member of the Russian Academy of transport, member of the "Scientific-experts council of Marine Collegium of Russian Government", director of the Far Eastern branch of "Union of Russian shipowners". He has about 80 publications on transport development and transport infrastructure in Eurasian region. As a specialist in law and economics of transport, transport systems, sea transport he has managed many works that have influenced on the development of the Far Eastern region.

Gennady Yakovlevich SEREBRJANSKY

Dr. Serebrjansky Gennady Yakovlevich was born in 1945 in Lesozavodsk, Russia. After graduating from the Far Eastern Technical University he worked as an engineer in "Dalmorniiproect". From the 1974 he worked as a chief engineer in "Glavdalvodstroy". From the 1975 became projects manager, deputy chief engineer JSC "FEMRI". From the 1991 works as a chief engineer JSC "FEMRI". As a well known hydraulic engineer he managed different very important projects concerning ports building in the Far East of Russia (in Nakhodka oil

port, Vladivostok commercial port and many others). He has contributed a great deal to the development of sea transport, shipping safety and ports development in the Far East.
(He passed away in June 2005.)

Vladimir VASILYEV

Vladimir Vasilyev was born in Leningrad in 1960. He has graduated from State Marine Academy in 1983. After post-graduate study and work in the Academy, he was sent by Ministry of Merchant Fleet of the USSR to Central Marine Research & Design Institute. Starting his work as a researcher he is now deputy Director General of the Institute. His area of responsibility is safety of navigation, maritime law, navigation and communication aids. Holding Ph.D. in system engineering Dr. Vasilyev also has graduated from Faculty of Law, Russian Institute of Management. Dr. Vasilyev has published more than 40 scientific articles in different fields – from radio electronics to maritime law. Dr. Vasilyev actively participates in international cooperation on behalf of Ministry of Transport of Russia. Being member of Russian delegation to IMO Sub-Committee on Safety of Navigation he is also member of competent persons panel approved by the IMO Maritime Safety Committee under the provisions of the STCW Convention.

Masaaki WAKATSUCHI

Born in Hiroshima in 1944, Prof. Wakatsuchi started his career in 1971 and served until 1986 as an Assistant Professor at Institute of Low Temperasture Science, Hokkaido University. During that period, from 1975 through 1977, he was a Member of Overwintering Party of the 17th Japanese Antarctic Research Expedition. In 1986 he became an Associate Professor (Physical Oceanography) of Institute of Low Temperature Science and Graduate School of Science, Hokkaido University. From 1987 till 1989, he had served as a Visiting Scientist at School of Oceanography, University of Washington, U.S.A. Since 1990 he has served as a Professor (Physical Oceanography) at Institute of Low Temperature Science and Graduate School of Earth Environmental Sciences, Hokkaido University. From 2001 through 2003, he was a Director of Institute of Low Temperature Science, Hokkaido University and from 2004 through 2005 a Director of Pan-Okhotsk Research Center, ILTS. In April 2005, he was again appointed as a Director of ILTS.

Hajime YAMAGUCHI

Prof. Yamaguchi was born in Mie prefecture in 1955. He received his PhD from the Department of Naval Architecture and Ocean Engineering, University of Tokyo in 1983. Prof. Yamaguchi joined the teaching staff at the same department in 1983. He is currently a professor at the Department of Environmental and Ocean Engineering, University of Tokyo. He is working on polar environmental engineering including numerical sea ice forecasting and fluid engineering. During 1992-1993 he was a guest researcher at the institute for Marine Dynamics, National Research Council of Canada. Prof. Yamaguchi has received several awards from such bodies as the Society of Naval Architects of Japan, the Ocean Offshore and Arctic Engineering Division of the American Society of Mechanical Engineers and the Visualization Society of Japan.