REPORT OF OPENING SESSION

The Opening Session was called to order at 8:30 am on of October 11th. The Chairman, Dr. Hyung-Tack Huh, who welcomed delegates, observers and researchers to the Eighth Annual Meeting. Dr. Huh called upon Vice-Governor Vladimir A. Stegny to welcome participants on behalf of the Government of the Prymorye Region.

Dear Mr. Chairman, Executive Secretary, distinguished delegates, members of the Secretariat and Local Organizing Committee, participants, observers, ladies and gentlemen:

It is the first time that Russia is hosting an annual meeting of the North Pacific Marine Science Organization. The City of Vladivostok, the Primorski Krai capital, is the venue of the Eighth Annual Meeting. On behalf of the Russian Far East, let me welcome you to the Pacific Russia.

It is a great honor for Vladivostok and the entire Primorski Krai to host the Eighth Annual Meeting attended by such a large number of participants from the scientific communities of the Pacific Rim countries.

Fisheries and marine transport are by far the most important sectors of the Russian Far East economy. Work at sea creates jobs, thus providing for considerable employment for the population. The Far East fisheries account for more than 70% of Russian catches. The maximum catch was observed in 1988, which could be explained by a very high abundance of two particular species - pollock and sardine. In 1993-94 the catch was at its minimum. That was due to the sardine disappearance in the Russian waters and to the pollock population drop. These two species alone - pollock and sardine - in the years of their maximal abundance, accounted for 66% and 17% of the catch in the Russian Far East respectively. Only two species predominance in the catches makes Far East fishery very vulnerable, and as a result the responsibility of scientists increase. Also of paramount importance is research of both ecosystems and the prediction of environmental long term changes.

The changes occurring in the resource structure of the fishery cannot but strongly influence the conditions of fisheries management. First and foremost, these changes depend on the environment, and joint scientific efforts in the area of marine studies are difficult to overestimate. In this respect PICES is a unique international organization of scientists with unprecedented capabilities to accumulate scientific knowledge in the largest range of events observed in the Pacific, and the results of anthropogenic pressure on the marine environment.

I would like to emphasize the following: PICES is represented by both the governments and scientific organizations of the Pacific Rim countries with very different levels of ethnic, cultural and economic backgrounds. This last factor is very valuable in the light of different approaches towards ocean investigation and development, since the number of aspects to be considered while planning the ocean management in the interests of mankind is increased. And the intermixing of various viewpoints mutually enriches the parties through cooperation.

No doubt, the World Ocean is a unifying area for making our scientific effort worthwhile. Methods and techniques of scientific investigations, those instruments for carrying out marine research, are gradually being standardized. This is also important because the results of scientific studies will be equally shared by all PICES member countries. Moreover, of no less importance are the national identities and traditions of each and every State involved, of scientific schools and particular results of research obtained. Recognizing this fact will surely make the mutual understanding easier, and this is one of the main objectives of any international organization. PICES should not be an exception.

Why have we picked Vladivostok of all the cities as the venue of PICES Eighth Annual Meeting? It is because this city in the Pacific Russia is most representative in the areas of research with concentrated science and technology potential in the Far East. It meets the demands of national economy of the Russian Far Eastern regions. At the same time Vladivostok is one of the youngest Russian cities in the Pacific. By founding the port Vladivostok, father-founders put an end to a remarkable historic epoch of great geographic discoveries and development, when the Russian pioneers discovered new territories along the coastline of the Pacific in the 18th and 19th centuries, including the Okhotsk Sea coast, Kamchatka, the Kuril Ridge, Sakhalin, and Alaska.

Glorious traditions of Russian researchers of the Pacific and World Oceans were upheld in the 20th century. The contribution of Russian fisheries science to the World Ocean and its bioresources research has been especially great: the last century has witnessed years when scientific investigations had covered 70% of the marine basins in the open areas of the World Ocean.

Despite the economic difficulties, marine studies are underway today in the Far East. One should emphasize the farsighted policy of the TINRO-Center administrators who, during the years of reforms in Russia, managed both to retain the research fleet, to continue the growth of its numbers, and improve its technical and scientific equipment. Fifteen research vessels of different profiles enable the Center to constantly monitor marine bioresources and to study the environment. The scientists record global changes of the environment parameters, which considerably influence the number and distribution of marine inhabitants and change the conditions of economic management in the Ocean.

In this respect of great importance to us is the participation of Russian scientists in such International Programs on ecosystems research as "GLOBEC", in scientific symposia and working meetings on "Nature and the Impact of Climatic and Oceanological Epochs Changes on the North Pacific", "Modelling and Forecasting Physical Processes in Subarctic Region of the North Pacific", "Ecological Consequences of Oil Spills and Oil Deposits Development", etc. The last subject is very relevant for the Sakhalin region with its unprecedented potential for Russian offshore oil extraction. No doubt, it will be very difficult here to strike a balance of interests among ecological movements, fishermen and oil developers. In this respect, we should follow a strictly scientific and independent analysis and evaluate comparative advantages versus negative consequences of this gigantic project. Profit of the Sakhalin Oblast and foreign investors of the oil development project are put on the scale against the impact of inevitable pollution of the sea on marine ecosystems resulting thus in losses for both the Russian fishermen and those of the neighboring countries in the regions.

On the threshold of the new millennium with an extremely high level of human activity, it has become even more difficult to preserve harmony of relations between man and nature. Nature can very easily destroyed as a result of rash actions undertaken by man for his selfish, and as a rule short-term, purposes aimed at making nature look "more culture-oriented". One cannot stop all the economic activities including those in the World Ocean. We should go on with these activities but they should be preceded by painstaking research to evaluate possible consequences as well as possible economic benefits.

I am sure that in this respect PICES will open a lot of new opportunities for both the scientists and those responsible for political and economic decision-making based on rigorous scientific knowledge. PICES also means unlimited opportunities for mutually beneficial scientific cooperation, exchange of latest information and scientific knowledge dissemination.

Hopefully, the present Meeting will make a considerable contribution to solving the problems facing the organization. I would like to wish successful work to all the participants of the Annual Meeting, and have no doubts that your scientific findings will find practical

implementation. Thank you for the attention.

Dr. Huh thanked the Vice-Governor and asked Mr. Alexander Chistyakov (Deputy Chairman, State Committee of Fisheries, Russian Federation) to welcome participants on behalf of the Russian Government.

Dear Mr. Chairman, dear Executive Secretary, distinguished delegates, dear members of the Secretariat and Local Organizing Committee, ladies and gentlemen:

It is with great pleasure that I welcome the delegates and participants of the Eighth Annual PICES Meeting in Vladivostok on behalf of the State Committee of Fisheries of the Russian Federation.

The Far East is the main fishing region in Russia, and it is the Far Eastern fishermen who are mostly interested in practical scientific results both in the area of fundamental research and applied studies of the World Ocean. An opportunity of long-term forecasting of the ecosystems' changes in the Northern Pacific is a sine qua non condition to formulate tactical and strategic fishing policy in the Russian Far East. Activities of such a highly prestigious international organization as PICES are a very important contribution to a rational development of marine bioresources.

TINRO-Center is the largest research and fisheries management organization in Russia. The Center is actively involved in international scientific and technical cooperation with many Pacific Rim countries, and it has a vast experience in this area. This experience proved very beneficial when Russia joined PICES. The TINRO-Center Director represents Russia in PICES, and I would also like to highlight the efforts of TINRO-Center in organizing and holding this Eighth Annual Meeting.

Efficient and rational utilization of all the World Ocean resources first and foremost depends on the depth of scientific knowledge about global processes occurring in the hydrosphere. Such kind of work is above the effort of any one scientific institution or even country. It is by joint research of all the countries interested in intensive studies of the Ocean that we can reach the necessary level to represent the trends of marine ecosystems' changes.
I am absolutely sure that the present Annual Meeting will help us to move one step further on the way to achieving the objectives set forth by PICES. I would like to wish successful and fruitful work to all the participants of this meeting. Thank you.

Dr. Huh then called upon Dr. William G. Doubleday to make a statement on behalf of the Canadian Government.

Mr. Chairman, honourable Vice-Governor, honoured guests, distinguished Delegates, and colleagues!

On behalf of Canada and the Canadian delegation, I wish to thank Russia for inviting PICES here to Vladivostok for the Eighth Annual Meeting. With this meeting, the scientists of PICES have been able to meet their colleagues at home in all member states and all member states have had an opportunity to meet PICES. We from overseas can now appreciate the close links between the Far Eastern Region of Russia and the sea, with its living and non-living resources.

Today, I will emphasize two themes: observing the influence of extreme climate events on marine ecosystems and improving the observation of the oceans.

PICES member countries and PICES scientists were very active during the big 1997-98 El Niño, observing the changes in the ocean and its ecosystems. We will see the results of this work at the Beyond El Niño symposium next spring. I expect this symposium, with the participation from several co-sponsoring fisheries commissions, will give new insights into the influence of climate extremes on living marine resources. We can expect more extreme climate variations in the future. PICES should seize these opportunities as they arise in order to gain understanding of how climate change will affect ocean ecosystems in the

coming century.

Observation of the oceans has always been limited. The lack of widespread and reliable data has held back description and understanding of the oceans. We are on the threshold of obtaining much better observations of the ocean. The ARGO system of profiling drifting buoys will have a similar effect on advancing ocean modelling and forecasting as weather balloons have had on meteorology. ARGO and other elements of GOOS, the Global Ocean Observing System, will provide a stronger base for the coupled ocean-atmosphere models, which forecast future climate. If we can forecast ocean conditions six months ahead, we will be able to provide useful weather forecasts six months ahead because the ocean is the dominant factor influencing weather on this time scale. Ocean observation of the North Pacific will require a major effort by PICES member countries. PICES should play an active role in coordinating both ARGO and GOOS in the North Pacific to ensure that the best possible results are achieved.

Mr. Chairman, Canada has been a strong supporter of PICES from the beginning. We continue to support the growth of PICES as the main forum for advancing and coordinating international marine science in the North Pacific. Thank you.

Dr. Huh called upon Dr. Makoto Kashiwai to speak on behalf of the Japanese Government.

Honorable Vice-Governor of Prymorye, Deputy Chairman of the Russian State Committee of Fisheries, distinguished delegates, and PICES scientists:

It is a great pleasure for me to be here as a part of the Japanese delegation to attend the Eighth Annual Meeting of PICES. On behalf of the Japanese Government and the Japanese marine science community, I would like to express our sincere thanks to the host, the Russian Government, and the Local Organizing Committee. As the result of their devoted efforts, we are here to accomplish PICES activities.

I would like to take this opportunity to make remarks on my expectation from, proposal to, and request for PICES.

First, my expectation from PICES. PICES is addressing the scientific questions on Climate Change and Carrying Capacity. This problem has a larger scientific scope that can be covered by any single discipline of marine science and has larger geographical scale than can be covered by any single country. Therefore, we need intergovernmental and interdisciplinary cooperation. I believe PICES was established to realize such cooperation and has been developing to strengthen such a function. Thus, I would like to expect PICES to continue to advance as a problem-solving organization rather than a big organization intending to cover larger number of discrete disciplines in marine science.

Second, my proposal to PICES. It is my pleasure to inform you that the Japanese Government proposes to hold the next Annual Meeting in the city of Hakodate. Hakodate is the sister city of Vladivostok, with a beautiful bay area, sightseeing spots and hot springs. You will never be disappointed by visiting Hakodate.

The scientist who was wishing most to invite the next Annual Meeting to Hakodate was Prof. Kiyotaka Ohtani. He had been a member of the FIS Committee since the first Annual Meeting. I feel very sad to inform you that we lost Prof. Ohtani in the middle of September. But I am sure that his hope is almost coming true. A "potential" local organizing committee for the next Annual Meeting has already been established in Hakodate, and two officers from Hakodate staff are observers at this Annual Meeting to understand its structure and arrangement. Therefore, I would like to propose all of the participants here to promise me to come to Hakodate and attend the Ninth Annual Meeting of PICES.

Third, my request to PICES scientists, and especially young scientists. I would like to request that young participants, especially from non-English speaking countries, do not think of

PICES Annual Meetings only as a place to present their papers. It is a place to commit and contribute to the scientific activities of PICES. The scientific sector of PICES is designed to receive your input. Therefore, I would like to request that you make positive participation in the meetings of scientific committees, working groups, CCCC-IP, and to encourage you to input your comments and ideas. Thank you for your attention.

Dr. Huh called upon Mr. Hai-Qing Li, to make a statement on behalf of the Chinese Government.

Mr. Chairman, the honorable Vice-Governor of Prymorye, Deputy Chairman of the Russian State Committee of Fisheries, distinguished Delegates, experts, ladies and gentlemen:

First of all, the Chinese delegation would like to join all previous speakers in congratulating the opening of the Eighth Annual Meeting of PICES in the beautiful city of Vladivostok. PICES, under the able chairmanship of Dr. Hyung-Tack Huh, has made remarkable progress over the past year in advancing the good of this Organization, and particularly in the promotion of cooperation among its member countries and with other organizations in various aspects of marine scientific research in the North Pacific Region. I am sure that with your leadership, this meeting will be a full success.

We would also like to congratulate Dr. Alexander Bychkov on becoming the new Executive Secretary of PICES. Your competence and experience will certainly benefit PICES and its member countries in pursuing our common goal. You can always count on our support in discharging your responsibilities as the Executive Secretary of PICES.

Since it is my first time to attend a PICES meeting, I would like to tell you how happy I am to join you and hopefully contribute to the work of PICES. I look forward to cooperating with all of you on various matters during the meeting.

Mr. Chairman, the Chinese Government attaches great importance to marine affairs and marine science in particular. China is playing an active role in such international marine scientific organizations as IOC and SCOR. China highly values the importance of PICES in fostering the marine scientific research in the North Pacific region and will continue to contribute to the work of PICES to the extent possible.
Taking advantage of this opportunity, I would like to thank the PICES Secretariat in providing various support and service to the member countries of PICES, including in particular the Chinese scientists.

We would also like to thank the Government of Russia, the Governor of Prymorye, as well as our local organizer, the Pacific Research Institute of Fisheries and Oceanography (TINRO-Center), for their hospitality and excellent arrangements for the meeting. Finally, I wish the meeting a full success. Thank you.

Dr. Huh called upon Dr. Jin Yeong Kim to make a statement on behalf of the Republic of Korea.

Mr. Chairman, distinguished Delegates, Local Organizing committee members, ladies and gentlemen:

It is a great pleasure for me to have the opportunity to be here as part of the Korean delegation. On behalf of my Government, Korean delegation and scientists, I would like to thank Russia and PICES for inviting us to participate in the Eighth Annual Meeting. We appreciate, particularly, the very good work of the Secretariat, Executive Secretary, the Local Organizing Committee, and Dr. Hyung-Tack Huh, the Chairman.

PICES has made important progress since 1992. It was indeed encouraging to see that PICES has progressed from activities focused on reviewing scientific issues to its current efforts to develop cooperative scientific programs addressing vital marine science issues. Thus, we are proud of the progress that has been made through PICES symposia, workshops, and conferences to ensure the sustainable use of the renewable resources of

the North Pacific Ocean.

Korean scientists have studied long-term variation in the marine ecosystem and conservation strategies for fisheries resources through oceanographic observation and living marine resources research since 1915. Recently the GLOBEC study program has been adopted in Korea as a model for our study of climate change and carrying capacity.

With regard to the program for this Annual Meeting, we are pleased to see that PICES is addressing GLOBEC topics including fishery management, climatic change, carrying capacity, scientific visualization to marine ecosystem analysis, modelling and prediction of physical processes. All these topics are important for effective conservation of the North Pacific Ocean.

Korean scientists will be highly supportive of cooperative studies promoting and coordinating marine science in the North Pacific Ocean. These activities promise to be important in the development of PICES for sustaining marine living resources in the 21st century.

The Korean delegation wishes all participants at the Eighth Annual Meeting of PICES success in their scientific undertakings.

Dr. Huh called upon Dr. Vera Alexander to speak on behalf of the U.S. Government.

Mr. Chairman, honorable Vice-Governor, honored guests, distinguished Delegates, and colleagues:

It is a pleasure to have this opportunity, on behalf of the United States delegation, to express sincere gratitude to our Russian hosts for welcoming us here and providing such an outstanding venue to the Eighth Annual Meeting of PICES. We have now completed the circle – PICES has met in each and every member nation, and in doing so, has advanced an agenda of cooperative planning for North Pacific marine research hitherto unprecedented. PICES' tenth anniversary approaches. Are we now a mature organization? I believe that we can say yes, as we have developed traditions, modus operandi, ways of relating to each other and getting things done. PICES has made tremendous progress during its short existence. PICES has learned from ICES and other international marine entities, but yet is unique. PICES has its own spirit, which will move the organization forward.

We cannot deny that there are scientific problems in the North Pacific which can only be solved by international cooperative research on a number of scales, in time, space and manpower. I see the PICES planning process as successfully approaching the scientific questions, which we must answer. The problems engendered by widespread changes in the ocean/atmosphere environment will inevitably affect all people in all places on earth. The North Pacific Ocean environment is inadequately studied and is so vast, that in light of global considerations, ocean research in the PICES area is critical to all nations. But it is especially important to the PICES nations.

We are looking forward to this meeting and to the progress which will be made. Once again, thank you to our hosts on behalf of the United States delegation.

Dr. Huh called upon Dr. Lev N. Bocharov to provide a few words on behalf of the Russian Federation.

Dear Mr. Chairman, Honorable Vice-Governor, Organizing Committee and distinguished Delegates, ladies and gentlemen:

It is a great honor for me as the Russian delegate to PICES to represent my country at the PICES Annual Meeting. This is the Eighth Annual Meeting of PICES, but the first one on Russian territory.

First of all, I would like to use this opportunity, and on behalf of the Russian Government and all Russian scientific quarters interested in profound studies of the World Ocean, to welcome you to Vladivostok, which is the biggest scientific center

in the Russian Far East.

I would also like to note especially the PICES Secretariat's efforts on the meeting arrangements and to thank its members for their huge and fruitful work. I wish to express a hope for further cooperation between the Secretariat and Local Organizing Committee in order to finish the Meeting's marathon with good results. On behalf of all Eighth Annual Meeting participants, let me convey the deepest thanks to the Governments of Prymorye Region and Vladivostok for the great assistance they rendered to TINRO-centre, as the main local organizer of this meeting.

Our country has always paid great attention to ocean studies. That is why the creation and increasing activity of PICES is very appreciated in Russia. Unfortunately, not all Russian participants could take part in the PICES meetings and conferences because of economical difficulties. In this respect the PICES support of such scientists who do not have enough financial ability to participate in PICES creative activity, is invaluable. In this context the Vladivostok Meeting is of great importance because it provides equal chances to all Russian scientific organizations.

For the people of the Russian Far East, it is even more important. There is no one Russian region where the economic prosperity and social stability depend so much on ocean resources and sea transportation.

It is also necessary to note that only the integrated results of the international scientific research activities in the field of the marine ecosystem and environmental capacity make more and more realistic the long-term forecasting in the condition of marine biological resources.

PICES is the international scientific organization which provides to the scientists constantly increasing opportunities. We also welcome the cooperation of PICES with other international marine scientific organizations.

The main results of PICES activities will become obvious in the 21st century. But even now the many positive sides of such activities have made themselves notable. One of them is the opportunity of close and unconstrained contacts. I hope the Annual Meeting in Vladivostok will not be an exception and the results of this meeting will be useful to all participants. The scientists of six countries can revive and develop mutual contacts, strengthen friendship and continue scientific dialogue on a wide scope of science disciplines.

Autumn is the best season in Prymorye. The Annual Meeting participants should not only work, but also spend some free time to know our city better.

In conclusion let me once again wish success to the PICES Annual Meeting in Vladivostok. Thank you.

Dr. Huh thanked Vice-Governor Vladimir Stegny, representative of the Russian State Committee of Fisheries, Mr. Alexander Chistyakov, and all the delegates for their remarks and spoke on behalf of PICES.

Honorable Vice-Governor of Prymorye, Deputy Chairman of the State Committee of Fisheries for the Russian Federation, distinguished Delegates, ladies and gentlemen:

I would like to begin my remarks by thanking our hosts, the Russian Federation, and the State Committee of Fisheries for their hospitality in hosting this meeting, and the Pacific Research Institute of Fisheries and Oceanography (TINRO-Center) for their hard work in organizing the Eighth Annual Meeting of PICES.

I am very much delighted that the Eighth PICES Annual Meeting is held for the first time in the Russian Federation, in this beautiful city of Vladivostok, the capital of Prymorye and the center of all ocean-related scientific as well as commercial activities in the Far-Eastern Russia. We have gathered, from all directions of the Northern Pacific, here in Prymorye, "a land attached to the sea where the winds of all oceans meet".

As one of those who have been privileged to attend most of the previous PICES meetings, I am especially delighted to take part in this year's meeting, eye-witnessing the advancement of the PICES activities. Since the first annual meeting in 1992, PICES has steadily grown and expanded its activities through the workshops, symposia and publications. PICES has been a faithful apparatus in fulfilling its mission of promoting and coordinating marine science research and disseminating relevant information and data on the Northern Pacific Ocean among the marine scientists in the region.

PICES has been effective and successful in fostering enhanced communication among scientists of different countries and various disciplines, in identifying research priorities and in building up the research network, and in facilitating collaborative marine research in the North Pacific Ocean. It has been able to produce a rich array of scientific papers and publications, and to increase understanding that could be applied to problems such as the conservation and allocation of resources, protection of the marine environment, and prediction of the impacts of climate change, etc.

However, the process of transferring the scientific findings to users has not been well elaborated yet. There is no adequate international system to assess and monitor the state of the marine environment. As yet it is not possible for anyone to state unequivocally what the status of many parts of the Pacific is, how serious the threats are, if any, and what specifically should be done about them. I believe that an international organization such as PICES can make a major contribution toward the advancement of scientific knowledge that could serve for a better understanding and management of our oceans. Therefore, I sincerely hope that PICES will continue to establish effective links for collaborative efforts by countries of this region.

PICES is a young organization, but it has been recognized for its achievement not only by member countries, but also by other international organizations such as IOC, ICES, SCOR, NPAFC, etc. We should strive to strengthen its ties with other international scientific organizations and programs and continue to serve as a focal point for integrating research programs in the North Pacific Ocean.

This year we have an exciting program of scientific sessions and workshops with many interesting topics such as climate regime shifts, physical processes in the subarctic North Pacific, coastal eutrophication and harmful algal blooms, fishery management, population dynamics of planktons, GOOS, GLOBEC and many more. I hope that everybody will take full benefit by actively participating in the sessions of this meeting.

Before closing my remarks, I would like to mention on the parting of Prof. Kiyotaka Ohtani of Hokkaido University, Japan. Prof. Ohtani had been deeply involved in PICES activities as a member of Working Group 5 on the Bering Sea, and served as one of co-editors for the new book "Dynamics of the Bering Sea". I hope you would join me in offering our sincere condolence to his passing.

In closing, I am confident that the PICES Eighth Annual Meeting will be another fruitful meeting providing us with new visions, ideas, and challenges toward the new ocean era. I hope you will find everything to your satisfaction, and that your meetings be enriched and successful. I wish you an enjoyable and memorable stay in Vladivostok.

Dr. Huh then introduced Ms. Patricia Livingston, the Science Board Chairman, to review PICES' scientific accomplishments.

The work of PICES is most visible in the annual science meetings that it organizes. However, the PICES Annual Meeting is just one way that PICES accomplishes its scientific purposes. The main scientific purposes of PICES are to:

Promote and coordinate marine scientific research in the northern North Pacific and adjacent seas

especially northward of 30 degrees North;
Advance scientific knowledge about the ocean environment, global weather and climate change, living resources and their ecosystems, and the impacts of human activities;
Promote the collection and rapid exchange of scientific information on these issues.

PICES as an organization has set up a structure to accomplish these goals. We have four Scientific Committees organized around the four broad disciplinary areas of:
Biological Oceanography (BIO)
Fishey Science (FIS)

Marine Environmental Quality (MEQ)
Physical Oceanography and Climate (POC).

In addition, PICES has a Technical Committee for Data Exchange (TCODE), and a Scientific Program for Climate Change and Carrying Capacity (CCCC), which has its own science and implementation plans. These committees and programs hold business meetings at the Annual Meeting that are open to the broad scientific community for input into the scientific sessions that will be held the next year or beyond, and to proposals that would benefit the scientific community, such as reviewing progress in their field or accelerating advances. Working Groups, workshops, and cooperative work with other programs are some of the ways these advances or reviews can be made. We have developed several ways of communicating the results of our scientific efforts.

One of the primary ways that PICES scientists exchange scientific information is at our Annual Meetings. These meetings are designed to promote the presentation of interdisciplinary research results and innovative trends in research within the disciplines. Working Groups and scientific programs may also hold workshops just prior to these Annual Meetings. Unlike many other scientific meetings that focus on a particular discipline, PICES is relatively unique in the Pacific with its focus on integrating knowledge across the marine science disciplines.

PICES scientists are increasing their collaborations with scientists in other programs. The Beyond El Niño meeting that is planned for the spring of 2000 is the first large co-sponsored meeting in which PICES has taken the lead. PICES and most of the major international fishery organizations of the North Pacific, are working together to examine the effects of the very strong El Niño of 1997-1998 and the interannual, decadal, and interdecadal scales of variability in the Pacific and the possible implications for fishery production and management.

PICES scientists have made significant advancements in the ways they communicate their research results to the scientific community. The results of the 1998 Science Board Symposium on the ecosystem dynamics of the eastern and western gyres of the subarctic Pacific are now published in the peer-reviewed literature in a special issue of Progress in Oceanography. Similar special volumes are planned for the results of this year's Science Board Symposium and for next year's Beyond El Niño Conference. The efforts of the Bering Sea Working Group of PICES has led to the publication of a new book on the Bering Sea (Dynamics of the Bering Sea). This book represents a true international collaboration to update and present our knowledge of this shared sea. Three PICES Working Groups (WG 8 - Practical assessment methodology, WG 11 -Consumption of marine resources by marine mammals and birds, and WG 12 – Crabs and shrimps) have finished their work and will publish the results in the PICES Scientific Report Series this coming year. PICES continues to promote the rapid exchange of information through its Scientific Report Series, PICES Press and the data inventories and other information located on the PICES web site (http://pices.ios.bc.ca)

Some truly collaborative fieldwork is now being conducted and planned by the PICES scientific community. This year, a Practical Workshop was held in Vancouver Harbor by scientists of MEQ Working Group 8 on Practical Assessment Methodology. Scientists from each of the PICES member countries were able to attend. This

Practical Workshop has set the stage for these scientists to do future collaborative work in the area of marine environmental quality. Similarly, POC Working Group 13 (CO2 in the North Pacific) also held a multi-national Technical Workshop this year. Their intercalibration exercise for laboratory measurements of CO2 was recognized by the IOC/JGOFS Advisory Panel on Ocean Carbon Dioxide as contributing to the high quality of North Pacific CO2 measurements in the future, which will allow multinational synthesis and lead to improved understanding of carbon cycle processes. The PICES-GLOBEC Climate Change and Carrying Capacity Program (CCCC) was successful in obtaining funding from the North Pacific Marine Research Program to perform a two-year study to initiate continuous plankton recorder (CPR) monitoring in the North Pacific. The next challenge will be to find a way to maintain this monitoring as a long-term effort.

PICES has several directions for its future scientific efforts. Proposals are being examined on ways to improve our Annual Meeting structure so that it is more focused on integrating across the scientific disciplines and in encouraging the participation of young scientists. We need to find ways to promote more interaction with regional and international programs of the most interest to PICES scientists. In particular, there are many regional programs in the North Pacific that involve several PICES nations. PICES has an opportunity to bring its ecosystem perspective to these regional programs and provide assistance in coordinating research in these areas. There are many large international programs in the marine science area and PICES will be focusing its efforts on cooperation with those that are in the best interest of the PICES scientific community and of greatest benefit to PICES member nations. One of our biggest challenges still lies in promoting and coordinating international research efforts in the open North Pacific. The initiation and continuation of collaborative research efforts in this area will benefit all PICES nations that border this important area. Finally, providing scientific results that are useful to marine policy makers of the North Pacific is our ultimate goal.

Ms. Livingston then called upon Dr. Richard Addison, former Chairman of the Marine Environmental Quality Committee (MEQ), to brief the 1999 MEQ Practical Workshop.

The MEQ Practical Workshop (planned and developed by Working Group 8) was held in the laboratories at West Vancouver (Department Fisheries and Oceans), BC, Canada between May 22 and June 8, 1999. The objectives of the Workshop were to bring together scientists from all member countries to work together on a common issue of marine pollution and, in doing so, to compare different approaches used in member countries. The Workshop was modelled on previous workshops organized by ICES and IOC, and it was recognized that in addition to addressing the general issue of harmonizing approaches to the assessment of marine pollution, there would be a cultural benefit of having scientists from member countries working together and sharing sampling equipment, samples and analytical data.

The Workshop took the form of a two-week practical study of various aspects of pollution in Vancouver Harbour and the surrounding areas. As a general introduction, participants spent a day outlining their national approaches to addressing marine pollution problems. There followed an intensive field program in Vancouver Harbour, which focused on sampling benthos and sediment (involving scientists from all member countries); benthic flatfish sampling (involving scientists from Canada, USA, Japan and Russia); and sampling inter-tidal algae and animals (involving scientists from Russia, China, Japan, Korea and Canada). In all, 22 scientists participated in all or part of the Workshop. The sampling approaches and subsequent analyses were selected to cover both chemical and biological measurements, since one of the underlying aims of the Workshop was to relate these two types of measurements. In some cases, analyses of samples were carried out at West Vancouver and in other cases, samples were shipped to the participants' home laboratories for analysis.

It is too early to summarize much of the data

emerging from the Workshop as analyses are still being carried out, but we can already anticipate some of the outcomes. For example, measurements of the frequency of "imposex" in inter-tidal molluscs made during the Workshop by Dr. Horiguchi (Japan) and Mr. Li (China) will extend a time-series of such measurements made previously in Canada, and which will contribute to a better description of the spatial and temporal trends in this effect of TBT-based anti-fouling paints. Comparison of molecular and pathological responses of benthic flatfish to various organic pollutants (made by Canadian and US scientists) will provide further support for the application of these techniques in the assessment of marine pollution. However, perhaps the greatest benefit of the Workshop was the improved understanding and communication among participants, and the opportunities that were identified for future collaboration among member countries.

Dr. Addison took the opportunity to thank the Workshop organizers, particularly Dr. Colin D. Levings, the local host at West Vancouver, and Dr. John E. Stein and Ms. Carla Stehr from the NMFS Laboratory, in Seattle, all of whose hard work and dedication had made the Workshop a success.

Ms. Livingston introduced Dr. Vyacheslav P. Shuntov, of the Laboratory of Applied Biocenology, Pacific Research Institute of Fisheries and Oceanography (TINRO-Centre), to give the keynote lecture. The following is the full text of the lecture.

Keynote lecture: "Review of Research into Macroecosystems of the Far-Eastern Seas: Results, Objectives, Doubts"

The history of Russian research in the Far Eastern Seas is about one hundred years long. In the beginning there were geographical, hydrographical, zoological and bio-geographical investigations followed by two periods of intensive research development – at the end of the 1920s and during the 1950s. During both periods, biological (including ecological) studies were significantly intensified, mainly due to the requirements of the expanding Soviet Union fishing industry. Despite obvious progress in ecological research, (e.g. the famous research vessel "Vityaz" cruises and long-term TINRO-VNIRO Bering Sea expeditions that started in 1958), these cannot be called ecosystem research programs in the strictest sense. Even a well-known book of P.A. Moiseev "Biological Resources of the World Ocean" (1969) contained no calculations of total biological or fish production in the Far Eastern seas. Yet such calculations had been done for most of the World Ocean regions, based on a general knowledge of carbon and energy transformation across the trophic web. Generally, there were insufficient data on many ecosystem components in Far Eastern seas, especially for the lowest trophic levels. The situation changed significantly during the 1980s. The logic of step-by-step scientific research and necessity of knowledge of biological function resulted in the successful development of complex research in Japan Sea bays conducted by the USSR Academy of Science and TINRO. The aquaculture boom during those years gave additional incentives to initiate such research.

By the 1980s, the need to strengthen traditional biological research with an ecosystem approach became evident, especially in view of multiple failures in fisheries forecasts, and the shift of Russian commercial fishing operations into its Exclusive Economic Zone in 1977. Managing bioresources by fisheries regulation alone demanded a more detailed knowledge on biological structure, productivity, and regular trends in ecosystem functioning including interactions among species and among groups of aquatic organisms. As a result, a new long-term line of research into macroecosystems of the Far Eastern seas was formed in TINRO in the beginning of the 1980s. The lack of researchers in the field of biological production, and in the lowest trophic level components, as well as the lack of sufficient knowledge of the principles of biocenosis structuring, limited the scope and constrained objectives during research planning. It's a pity to speak about this, because from the beginning of the 1980s we managed to arrange

tens of expeditions with only a limited list of objectives. The research potential was partly increased by some hydrochemists and hydrobiologists from VNIRO and the Academy of Science, who participated in TINRO expeditions. Some information on lower trophic levels was collected by academician's expeditions in limited areas. For some reason it is rather difficult or even impossible to extrapolate those data to larger regions. I mentioned such prosaic items in order to show that there are still many "bottlenecks" in working out ecosystem research subjects.

Nevertheless, regular ecosystem (bioceno-logical) research in the Russian Far Eastern seas started nearly 20 years ago, and as a result our knowledge of the nature of the Far Eastern seas has changed and lead to the following set of observations and questions:

1. I suppose, the most important finding is that biological and fish productivity in the Russian Exclusive Economic Zone (EEZ) is significantly higher than it had been assumed before. For years, the Atlantic Ocean was assumed to be more productive. Moreover, it was well known that many commercial stocks decreased as a result of comparatively moderate fishing pressure during the 1950s–1960s (by 1960, the total catch within the Russian EEZ amounted to only 1.1 million metric tons).

As a result of numerous bottom and pelagic trawl surveys, which covered the entire Russian EEZ area down to 1000 meters depth, the total biomass of fish and large invertebrates from the 1980s to the beginning of the 1990s was roughly estimated to be 90-100 million metric tons. Rather unexpectedly, small mesopelagic fishes comprised almost half of the total assessed biomass. At the same time, special research data analyses of various animal groups, and some retrospective estimates made it possible to quantify the highest trophic levels. The present abundance of whales in the Russian EEZ (including residents and migrants) is about 100–120 thousand individuals (the initial estimate was approximately two times higher), plus about 250 thousand small dolphins. The number of resident marine birds is approximately 26 million individuals.

Even the first rough estimates of food consumption required at the highest trophic levels showed an obvious discrepancy between the assessments and lower trophic level biomass and primary production. At peak levels during the 1980s in the Bering and Okhotsk seas, walleye pollock alone consumed about 350 million tons of zooplankton, 11 million tons of squid, and 30 million tons of small fishes. It is hard to imagine such an impressive rate of trophic interrelations. All these facts challenged our methods of data collection and processing of phytoplankton, zooplankton, bacteria and, partially, benthos. Of course, the main difficulty here was (and is) the low catch efficiency of small plankton (straining through the net), and macroplankton avoidance. This problem has a certain history, and has been given no rest to aquatic biologists for a long time. It is worth noting that estimates of primary production of the World Ocean have increased in the last 30 years, as methods were improved. According to the joint TINRO-VNIRO expeditions (papers published by Dr. V.V. Sapozhnikov and co-authors), the yearly production of phytoplankton in various areas of the Bering and Okhotsk Seas lies in the range of 260-350 g/m3. This data is close to my earlier estimates of 430-450 g/m3 for these seas, though in this work total production of phytoplankton, macro seaweed and phytobenthos-periphyton was assumed. These are 2-3 times higher than most of the known estimates.

Not long ago Dr. Yu. I. Sorokin and his colleagues from the Institute of Oceanography of the Russian Academy of Sciences showed that the biomass and production of bacteria and protozoa in the Far Eastern seas are among the most productive in the World Ocean. These organisms play a major role in ecosystem functioning. On the one hand, species of the so called microbial loop (or detritus chain) make the trophic pathways longer, but on the other hand, they provide a more stable and significant source of food for larger plankton and for the early life-history stages of nekton and nektobenthos.

In order to adjust for the sampling bias in estimating macroplankton biomass, we began to use correction factors for catch efficiency and time of sampling. Such a simple practice resulted in substantial changes in our view of the structure and biomass of plankton communities. The revised estimates of zooplankton biomass appeared to be 2-3 times higher (400-460 g/m3 for the Okhotsk Sea and Pacific side of Kuril Islands, and 230-260 g/m3 for the Bering Sea, Japan Sea and Pacific side of Kamchatka). The predominant group was macrozooplankton (70-80%), not micro- or meso-plankton. It is doubtful, whether the situation is different in other areas of the World Ocean. Hence, speaking about biota alone, the scale of biological production in marine ecosystems is much larger than it seemed before. I think there is no need for additional comments to explain importance of this general conclusion, though one problem is worth noting.

As mentioned above, by the beginning of the 1960s, the total catch within the present Russian EEZ reached only 1.1 million tons but we are confident that the stock abundance of the dominant species had decreased by that time due to fishing pressure. During the 1980s the total catch was 4-5 million tons, which is in good agreement with the higher estimates of abundance of nekton and benthos. The intriguing point is that when the catch was 1 million tons, stock abundance was decreasing, but when the catch was 4-5 million tons stock abundance was growing. Of course, in the 1970s–1980s the main harvested species were walleye pollock (Theragra chalcogramma) and sardine (Sardinops melanostictus), but this fact does not explain the matter. This suggests that the susceptibility of species and communities to anthropogenic factors, including fishing, changes with time. Within this context the vulnerability of organisms was higher during the 1940s–1960s, lower during the 1970s–mid- 1990s and probably lower during the 1920–1930s.

2. Such comparisons bring us to the problem of cycles in natural processes with a period of about 40-60 years. With particular attention to these cycles, I don't deny smaller cycles, e.g., those connected with El Niño or the North Pacific oscillation. Nevertheless, I do not think that any significant change in biota is the result of ocean climate change or cosmophysical factors. I believe in the idea of systematic processes in nature, but I can also accept that these changes are the result of synchronous impact of random events.

The 40–60 year cycles are observed in climate-oceanological dynamics, and as a consequence in population, species and biocenosis dynamics. This is favored by rather long duration of these cycles, which could probably be regarded as small epochs, or ages. Everything connected with 40-60 year cycles is an interesting and disputable issue, requiring assessment of current situation with reference to the past and future events. Here we cannot proceed without even passing comments on global warming. It is bound to the "greenhouse effect", especially as there are unfeasible statements that the biomass of walleye pollock in the Eastern Arctic can reach 15–20 million tons providing yearly catch of 5 million tons due to anthropogenic global warming in the foreseeable future (Patin, 1997, "Fisheries", No. 3). These figures sound optimistic, though it should be kept in mind that most of predicted consequences of global warming are rather disturbing. I do not think that the "greenhouse effect" has an absolute effect on global climate. I also do not support the idea of oceanic depletion as a result of ozone shield exhaustion. I cannot identify these ideas as a twentieth century hoax, but rather consider them as extreme interpretations, that are not supported by sufficient arguments.

I would like to recall that different types of cycles are characteristic of the Earth's climate. During the post-glacial period there was a long period of climatic optimum, then the less significant warm Viking age. The so-called lesser glacial period ended almost 150 years ago. In view of this fact, I think that the 20th century is the beginning of next warm period similar to the Viking age. It is intrinsic that events within such period are multidirectional with shorter cycles. I pay special

attention to the above mentioned 40-60 years cycles, which I considered at first as simple alternation of warm (1920-1930s, 1970-mid-1990s), and cold periods (1940-1960s, end of 1990s). Changes in biota, especially in pelagic communities, seemed to correspond to these periods, judging by dynamics in abundance ratio for walleye pollock and herring (Clupea pallasi) in the northern boreal areas, and sardines and Japanese anchovy (Engraulis japonicus) in the southern boreal areas.

Curiously, the temperature background during 1920 - 1930s was generally lower than during the next two decades. During this period, a northward expansion of not only distinctly southern species but also the entire biota communities toward high latitudes was observed. The southern boundaries of cold-loving species and biotic communities moved in the same direction. No similar expansion was observed during the recent and more significant warming, though southern species appeared frequently in the northern areas. It is worth noting that the Japanese anchovy was found in its northernmost and coldest area, Ayano-Ionsky region, for the first time during the Okhotsk Sea research in the summer of 1998. Apparently, this event and the catch of a young swordfish (Xiphias gladius) in the southern Okhotsk Sea in the summer of 1985 have a common background. It is characteristic that strong changes in nekton communities of the Far Eastern seas occurred in the beginning of the 1990s at high temperature background. At that time, multiple migrations of sardines into Russian waters stopped, walleye pollock abundance decreased considerably, while herring, Japanese anchovy, and common squid (Todarodes pacificus) abundance increased. These facts suggest: firstly, that the trend (decreasing or increasing) and duration of water temperature changes played a leading role in these species changes, and not simply the absolute temperature (within a certain limit). Secondly, that a temperature change is evidence of more important processes, particularly changes in dynamics of other, apparently more important complex characters, such as of water exchange rate between the Far Eastern seas and the Pacific Ocean, as well as water dynamics in general, and atmospheric transfer (zonal or meridional).

During the period from 1940 to 1960, no progressive global temperature rise was observed. Sometimes the temperature even decreased. Presently, I think that the temperature rise has already stopped in the modern 40-60 year cycle. Significant positive anomalies persisted up to 1998, but winter, spring and summer periods of 1999 appear abnormally cold on this warm background.

Until recently, it was evident that the biological and fish productivity of the Far Eastern seas increased during warm periods. Such periods have more stable climatic and oceanological conditions. In the beginning of the 1990s, the nekton biomass in Russian waters decreased by nearly 15 million tons. By the middle of the present decade it decreased by 25-30 million tons (walleye pollock, pilchard, northern smoothtongue – Leuroglossus schmidti). By this time the number of cold-loving "alternative" nekton species increased by about 5 million tons (Pacific herring, Atka mackerels – Pleurogrammus spp., Pacific saury – Cololabis saira, common squid). Thus, there was an obvious trend towards decreasing production in Russian waters, and there is no reason to expect that such trend will change in the next few years. Changes were also observed in the plankton communities. In the beginning of the 1990s the percentage of predatory plankton abruptly increased up to 50-60% of total meso- and macrozooplankton biomass. By 1995, the percentage of predatory plankton retained its "normal" level, 20-25% of total biomass.

Unfortunately, thereafter large-scale observations on planktonic communities were conducted only in the Okhotsk Sea where zooplankton abundance decreased abruptly in 1997 and 1998. Relationships between zooplankton abundance and fish biomass, as well as total amount of food consumed by nektonic animals indicated that there was low food availability (Table 1).

Table 1. Interannual abundance (x106 t) of some pelagic community indicators in the northern Okhotsk Sea.

Index	1986 – 1988 (Summer)	1997 – 1998 (Summer)	1999 (Spring)
Nekton biomass	9 – 12	7 - 8	6.5
Zooplankton biomass	140 – 180	73 - 90	182
Nekton daily diet	0,5 – 0,6	0,32 – 0,47	0,29
Zooplankton / nekton 2 month diet	7 – 9	3.2 – 3.8	11.7

It seemed that these recent observations fully corresponded to the conclusion that a less productive period has begun. But in the spring of 1999, the plankton quantity sharply increased to a level more typical of the 1980s, mainly due to an increased abundance of euphausids and copepods. When compared to 1998, the fish feeding rate significantly increased: 3-7 times for walleye pollock, and 1.5-2 times for herring. It is interesting that similar changes had occurred in the Navarin-Anadyr area of the Bering Sea during the previous year. The zooplankton quantity increased thereby almost 3 fold, to 6x106 t in summer, 5x106 t in autumn during 1980s, and 22x106 t in summer, 15x106 t in autumn in 1998. On the other hand, walleye pollock quantity decreased from 3.5x106 t down to 1.2x106 t during that period. The annual food consumption remained approximately the same: 15.5 and 14x106 t. The feeding rate of pollock in the Bering and Okhotsk Seas increased significantly. These data suggest that there could be striking differences in taking advantage of one trophic level potential over another in relation to general production rate. We can also suggest that there is a sufficient resilence in a trophic structure of oceanic communities.

I am not sure if these observations were episodic, i.e. simple interannual dynamics, or whether they are part of a large-scale trend. But this draws attention to some rather disturbing conclusions that there is a critical ecological situation in the Bering Sea (PICES Press, Vol. 7, No. 1, 2). There have been some negative consequences of abnormal warming – coccolithophorid blooms, increased mortality of birds and mammals, decreasing abundance of salmon and other fishes. I can understand such worries, though to my mind there is too much unnecessary drama, and no crisis at all. I assume that similar events have occurred before, and will take place in the future. Moreover, as I already mentioned, plankton abundance in the Bering Sea sharply increased in 1998. But what is more important to note is that natural communities are not rigidly integrated systems. That is why some species can easily get in and out of them without any serious consequences in their long-term dynamics. Such soft bonds in communities and ecosystems are evidenced by a variety of cycles in dynamics of populations and species abundance. Therefore, an anomaly (high or low) does not necessarily result in the "falling domino principle". In my opinion, the chess analogy is more suitable here, where there are many variants under restricted rules. The main point is not to confuse these multiple situations with a global trend, as is frequently done.

Increasing zooplankton abundance, first in the Bering Sea, and then in the Okhotsk Sea suggests that there is an order to the events in the North Pacific. If events also move from east to west as a rule, then other comparisons arise. Recent declines in the reproductive rate and abundance of walleye pollock shifted from the Gulf of Alaska and eastern Bering Sea in the late 1980s to the western Bering Sea, and then to the Okhotsk Sea in the mid 1990s. The same situation was observed in reproduction rate of some marine birds. An increased mortality of birds, particularly kittywake (Rissa tridactila) in American waters was observed in the 1980s, but not until the 1990s in Asian waters. The wave of high abundance of predatory plankton moved from east to west in the 1990s and stopped in the Okhotsk Sea.

The disturbing negative trend in North American salmon abundance has not been observed in Asian

stocks yet. At least in 1999 fishing for salmon was as fruitful as during the previous decade, but I believe that negative trends will appear in the near future. There are probably more examples, but all of them point to the significance of the North Pacific Subarctic Gyre system as a background. The eastern Bering Sea is closely connected with this gyre system through water exchange. The circulation continues through the western Bering Sea down to east Kamtchatka and the northern Kuril regions, and then into the Okhotsk Sea. This is a probable route of expansion for some anomalies.

As I already mentioned discussing the ecological crisis in the Bering Sea, the biota in adjacent areas may not necessarily react in the same way and with the same profile. A common forcing may result in different biological responses in these regions. I consider this as evidence of an underestimated "provinciality law". The biocenosis environment, i.e. the composition and structure (mainly trophic) of communities is of great importance as well. It can either intensify, or on the contrary, quench many processes, providing the so called "chess situations". This is demonstrated in Table 2, where the main areas of Russian waters (data for the entire Bering and Japan seas are presented) are ranged according to abundance of nutrients and main groups of marine animals.

Table 2 shows that hydrochemical prerequisites during generation of first food are used in various regions differently. There are also certain differences in utilizing of energy by various trophic levels. It makes those areas rather specific, with certain peculiarities in ecological capacities. Such a comprehensive ecosystem parameter determines differences in cyclic events in various areas. Since ecological capacity is the main integral ecosystem character it deserves additional consideration.

Table 2. Areas ranked according to abundance of nutrients, plankton and marine animals groups.

No.	Nutrients	Phyto-, bacteria, protozoa	Zooplankton	Benthos	Fishes and commercial invertebrates	Mammals, birds
1	Kur.*, E.Kam.	Okh. S.	Okh. S.	Okh. S.	Ber. S.	Ber. S.
2	Kur., E.Kam.	Ber. S.	Kur.	Ber. S.	Okh. S.	Okh. S.
3	Ber. S.	E.Kam.	Ber. S.	E.Kam	Kur	Kur
4	Okh. S.	Kur.	E.Kam.	Jap. S.	Jap. S.	E.Kam.
5	Jap. S.	Jap. S.	Jap. S.	Kur.	E.Kam.	Jap. S.

* Kur. – Pacific side of the Kuril Islands; E.Kam. – Kamchatka-Kommandor, the Pacific Ocean; Ber. S. – Bering Sea; Okh. S. – Okhotsk Sea; Jap. S. – Japan Sea.

3. Ecological capacity of the habitat is the ability of an environmental complex to provide conditions for reproduction and normal vital activities for a certain number of organisms. Ecological capacity is characterized by the amount of biomass which can make density factor working. Generally speaking, it is worth noting that the term "ecological capacity" has many interpretations – from general system bioproductivity values, down to species and populations abundance levels. It appears as though we deal here with a situation that is similar to a great variety of interpretations of the term "ecology". In any case, it is impossible, and there is no need to narrow the use of this term in the "legal" sense.

Some indirect observations can indicate ecological capacity limits. For example, for a long time I paid much attention to the observation that there

is less plankton in the Bering Sea than in the Okhotsk Sea per unit area, though the fish abundance is higher in the former. Consequently, competitive relationships are stronger in the Bering Sea. Therefore, the dynamics of walleye pollock and herring abundance here are strongly counter-tied. The upper limit of walleye pollock abundance in the Bering Sea was attained during the 1980s. In my opinion, it reached 25 million tons at that time and despite the fact that the warm 1980s were more favorable for pollock reproduction and more than enough spawners took part in reproduction, the reproduction efficiency and total abundance decreased approximately 3-fold due to density.

Feeding mainly on plankton and small nekton, walleye pollock has a pronounced effect on other community components, especially during peaks of abundance. It was clearly observed in the Okhotsk Sea where, during the peak of abundance in the 1980s, pollock consumed 4.5 million tons of squid and 12 million tons of small fishes annually. By the mid 1990s the biomass of large pollock decreased 3 fold, while the biomass of small nekton (Pacific stout sandlance – Ammodytes hexapterus, northern smoothtongue, capelin – Mallotus villosus) increased 4-5 fold, at least in the epipelagic layers in the northern Okhotsk Sea.

It is easy to provide more specific examples of factors limiting ecological. They have a direct bearing on the widely discussed problem of ecosystem regulation by " bottom-up control" and "top-down control". Not long ago these two mechanisms were opposed to each other in regard to priority. It became evident, that the combination of predator pressure and the availability of resources are widely distributed, as well as their unidirectional influence. Returning to walleye pollock, I would like to review some of my previously published calculations for the Okhotsk and Bering seas. In the 1980s the total catch of walleye pollock in the entire North Pacific was 6-7x106 t, including 3.8x106 t in the Okhotsk and Bering seas. Predators consumed 3.2x106 t in the Okhotsk Sea and 6.9 x106 t in the Bering Sea annually. This is "top-down control". From the other side, the most important argument for the "bottom-up control" is the alternation of long-standing periods of increased and decreased biological production that shows up at various trophic levels. But initially such alternations are determined by dynamics of atmospheric and oceanographic processes with the same regularity.

I would like to note that the concept of ecological capacity and dynamics has an applied importance. It is closely related to rational use of nature, including aquaculture in a wide sense. In my opinion, the introduction of a new species into natural communities means falling into a sticky cobweb of resilient trophic interrelations. Trophic connections depend very much on relation between species ecological potential and the resistance of environment.

Recognizing both the reality and the scale of "top-down control" stimulates the necessity to address the issue of harvesting marine mammals. I pay special attention to it because of wide-ranging "green" opinions on this subject. It is well known that commercial use of lower trophic levels (up to zooplankton) and benthos is quite difficult technically. Protectionist attitudes prevail in utilizing upper trophic levels nowadays. This is "emotional ecology" which considers "lawful" only catching of middle trophic level representatives such as fishes, squids, crabs, etc. I doubt whether such selectivity is an example of rational use of nature. Hunting marine mammals is thus not only possible but perhaps even necessary, with due consideration, or course, to recent negative lessons from global poaching.

Returning to limiting factors and regulation of abundance and biomass in ecosystems, I would like to especially note that this complicated problem is not limited to the problem of top-down and bottom-up control. I think there is sufficient evidence of control by various physical factors, e.g., water temperature. This is quite clear from data presented in Table 3.

Table 3. Density (g/m2) of plankton, benthos, nekton, and nektobenthos concentrations in the northern Okhotsk Sea in 1997.

Groups of animals	North-western Okhotsk Sea	North-eastern Okhotsk Sea
Zooplankton	129	124
Zoobenthos (averaged over years)	300	430
Nekton	5.2	17.4
Bottom fishes	1.8	6.6
Commercial invertebrates (crabs, shrimps, buccinidae, etc.)	0.7	1.6

It is well known that the eastern Okhotsk Sea is much warmer than the western side. Moreover, the northwestern shelf looks like an arctic basin in its climate and biological conditions. The northwestern and northeastern parts of the Okhotsk Sea are not contrasted with each other any more in terms of hydro-chemical conditions of biological productivity. Indexes of primary production, as well as zooplankton and benthos biomass are similar in these two regions. Low temperature in general does not limit their development. As for upper trophic levels, the biomass of pelagic and bottom animals (except marine mammals) is several times higher in the northwestern Okhotsk Sea, which has milder temperature conditions (Table 3). The main limiting factor is the low water temperature, especially the lenses of water with negative temperatures that exist during the whole summer period. It is well known that a large number of fish species and commercial invertebrates are really cold-loving and are attracted by cold waters regarding in their distribution. But their ecological potential is much lower than that of temperate (boreal) species, which serve as a source for fishery in the temperate North Pacific. Henceforward, it is not surprising that those parts of the Okhotsk Sea which are under oceanic influence, as well as Bering and Chuckchi seas, are the most favorable for fish.

In conclusion, I would like to express some general considerations. Applied problems, such as those in fisheries and aquaculture, give a strong impetus to develop our knowledge and research activities in the ocean and its seas, though many people are simply interested in creating new knowledge.

One of the "ultimate applied goals" of long-term research in the Russian Far Eastern seas is to develop large-scale managed fisheries, including fishing and aquaculture. This concept includes conservation, particularly the idea "for us, for children and for grandchildren". Taking into account the current situation it seems Utopian, although there is an evident need to establish desirable, but perhaps unreachable, objectives.

Russians are not deprived of at least one thing. We have no atolls with palms growing, and the Southern Cross does not appear above our cold seas. At the same time, bioproductive potential of the Russian Far Eastern Seas is very large, and there are many commercial species of high value.

Today we know much more about our seas than 10-15 years ago. The ecosystem approach of our research tells a lot, though our knowledge about structure and functioning of ecosystems is still insufficient. We cannot evaluate the scale of events we are dealing with. Evaluation and interpretation of those events are often hypothetical, as I have mentioned above. The three basic scientific items of my report: production hydrobiology, biocenology and trophology, - present various possibilities for improvement of views and concepts in these fields of research. We always should remember that "Only one who keeps going will reach his destination".

It is well known that data collecting alone does not always lead to new steps in knowledge, and

sometimes it looks like a roundabout. New ideas and concepts, which can aim research in a certain direction, are necessary. As for the Russian Far Eastern seas, reliable estimates of abundance of marine organisms have appeared only recently. As for the lower trophic levels, there is almost a complete lack of available data, especially on production and trophic relations. That is why even sheer data collecting is worth doing for the immediate future in this field.

Today our applied fishery science deals with macroecosystems of the Russian Far Eastern seas, including total assessments of biota structure and functional relationships among members of communities. In this connection, I think there are certain problems in other areas of the North Pacific. It is hard to imagine serious progress in ecosystem research without fundamental academic research and certainly without coordinated or synchronous international programs which cover large oceanic areas. Those marine areas present an enormous scene for tremendous and sometimes very intriguing dramatic performances.