

**NORTH PACIFIC MARINE SCIENCE ORGANIZATION
(PICES)**

ANNUAL REPORT

FIFTH MEETING

NANAIMO, BRITISH COLUMBIA, CANADA

OCTOBER 11 - 20, 1996

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AGENDA

FIFTH ANNUAL MEETING October 11 - 20, 1996



Opening Session

1. Address of welcome was given by Ted McWhinney Member of Parliament for Vancouver Quadra and Parliamentary Secretary to the Minister of Fisheries and Oceans.
2. Remarks by representatives of contracting parties.
3. Remarks by the Chairman.
4. Announcements.
5. Keynote lecture by Prof. Timothy R. Parsons. *Taking Stock of Biological Studies in the Ocean.*

Governing Council

1. Preliminary report on administration.
2. Relations with other international organizations and observers from such organizations.
3. Membership and observers from other countries.
4. Election of Chairman.
5. Appointment of Executive Secretary.
6. Rule change to allow past Chairman to serve as an ex officio participant of Council.
7. Report of Finance and Administration Committee.
 - a) Audited accounts for financial year 1995
 - b) Estimated accounts for financial year 1996
 - c) Budget for financial year 1997
 - d) Forecast budget for financial year 1998
 - e) Trust Fund
 - f) Working Capital Fund
 - g) Home Leave Relocation Fund
 - h) Other funds held
 - i) Appointment of Finance and Administration Committee Chairman
8. Report and recommendations of Science Board.
9. PICES Perspectives.

10. Future meetings of the Organization and subsidiary bodies, including time and place for the 7th and 8th Annual Meetings.

11. Any other business.

Access for cooperative research.

REPORT OF OPENING SESSION

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The meeting of October 14 was called to order by the Chairman, Dr. Warren S. Wooster, who welcomed all delegates, observers and researchers to the Fifth Annual Meeting. Dr. Wooster called on Mr. Ted McWhinney, Member of Parliament for Vancouver Quadra, Parliamentary Secretary to the Minister of Fisheries and Oceans, to make a statement on behalf of the Canadian Government.

It is a pleasure to convey to the 200 marine scientists here assembled from the member countries of this Organization - China, Japan, Russia, South Korea, and the United States and Canada - greetings from the Prime Minister of Canada, Jean Chretien and also our Minister of Fisheries and Oceans, Admiral Fred Mifflin. The fact that the inaugural meeting of this Organization, in 1992, was held in Victoria, B.C., and that Canada, as host country, is now receiving this follow-up Annual Meeting in Nanaimo, B.C., testifies to the Canadian Government's awareness of Canada's new historical role as a Pacific Rim country, and also to the importance that Canada assigns to relations with our neighbour countries who share a Pacific littoral: relations that extend not merely to trade and commerce but that also include cultural and academic-scientific exchanges and the acceptance of a common responsibility for the safeguarding of the natural resources of our common Pacific region, with the oceans and the abundant fisheries ranking at the top of these conservation imperatives.

Canada, as a country that shares three oceans, - the Atlantic, the Pacific, and the Arctic - has always been a leader in the movement to "internationalize" the duty of protection of the oceans and ocean fisheries resources, the more so because our special relation with the Arctic has made us sensitive to its delicate ecosystem and the need for extra vigilance in its behalf. In 1970, we enacted, through our national Parliament, an Arctic Waters Pollution Control

Act that was avant-garde in international law terms. Though it drew upon the Conservation protocols attached to the proceedings of the Second United Nations Conference on the Law of the Sea (1958-1960), it broke new ground in its assertion of a municipal (national) law power to act affirmatively on behalf of these new international law imperatives.

It was in the same spirit that, in 1995, in the course of Canada's so called "Turbot War" with Spain and Portugal, designed legally to contain and limit extravagant overfishing by the vessels of those two countries of an endangered species that threatened to follow the North Atlantic cod into near extinction, Canada asserted a municipal (national) law power, in implementation of the new international law conservation imperatives, to reach the fishing vessels and crews of other countries, operating just outside our national territorial waters and contiguous waters and maritime zones and have consequences harmful for our international law rights and for those of the World Community at large. Acceptance by Canada of the right, if not the duty, to act affirmatively in protection of the new international law norms has meant an embracing of what an eloquent delegate to the Third United Nations Conference on the Law of the Sea (1970-1982), Ambassador Pardo of Malta, called the concept of the Oceans and their resources as the Common Heritage of Humankind.

Canadian diplomats, and I may cite here especially Ambassador Allan Beesley, who was born in this province of British Columbia and who now lives here in professionally active retirement, were part of a "Ginger" group at the marathon sessions of the Third United Nations Conference already referred to; and the Treaty signed at Kingston, Jamaica, in December 1982, reflects their energy and also their idealism which sometimes (happily, in retrospect) seemed to go beyond their more cautiously formulated

advance official briefs. But the Canadian foreign service, with a rich intellectual tradition built by Lester Pearson, and Paul Martin Sr., and Pierre-Elliot Trudeau, as political leaders, has never believed that the obligations of the international lawyer reduced to a mere mechanical restatement of the pre-existing law, as written. We have accepted, - in the spirit proclaimed by Myres McDougal of Yale University, the teacher of both President Gerald Ford and President Bill Clinton - that the role of the international lawyer - whether lawyer-diplomat, or judge, or parliamentarian - extends to active participation in changing and up-dating the law, so as to accord with the emerging juridical conscience of the World Community. It is a dynamic process of legal change: international law-in-the-making!

In this context, our turbot dispute with Spain and Portugal is now before the International Court of Justice at the instance of those two countries, and we will ask the international judges to strike out boldly in support of the new international law imperatives on safeguarding of endangered or disappearing species that are part of the Common Heritage. In the same spirit, face with what we regard as the State of Alaska's gross over-fishing of Pacific Coast salmon, in violation of the legal norms established by the Canada-U.S. Pacific Salmon Treaty of 1985, we have invited the U.S. Government - so far unsuccessfully - to submit this particular problem to legally binding international arbitration, or, failing that, to the jurisdiction of the International Court of Justice. We believe our position is historically right and in full accord with the enlightened trends in contemporary international law and its progressive development in accordance with the United Nations Charter mandate.

Our government's commitment extends, also, to encouraging and supporting long-range, fundamental scientific research of the sort that you are already undertaking, in your various ways, in biological oceanography, fishery science, physical oceanography and climate, and marine environmental quality. Your work

provides the indispensable empirical base to the development of the new international law on environmental protection and Conservation of the Natural Resources of the World Community. In the new Canada Oceans Act, which we expect to pass in our House of Commons before the end of October, 1996, and in our planned new Canada Fisheries Act, we provide new and more comprehensive municipal (national) legal bases for doing that. In the spirit of co-operation, in a common international endeavour, that your Organization so well represents, we invite you to encourage your own national governments to continue their commitment to science and scientific research in aid of the oceans and ocean research.

Dr. Wooster called upon Dr. John C. Davis to make a statement on behalf of the Canadian Department of Fisheries and Oceans.

Mr. Chairman, honoured guests, colleagues, I am delighted to welcome you here today to Nanaimo and the Fifth Annual Meeting of PICES. I am speaking on behalf of Dr. W. Doubleday, Head of Delegation, who will join us shortly. You have heard words of welcome as well, from the Hon. T. McWhinney, Parliamentary Secretary, for the Department of Fisheries and Oceans on behalf of Canada. This message is from the Canadian Delegation responsible for hosting the meeting here in Nanaimo.

The Local Organizing Committee has worked extremely hard to make this meeting a success and hopes that everyone will find their stay in Nanaimo pleasant and scientifically rewarding. I know how hard this group has worked and feel sure that we will have an excellent meeting as a result of their labour.

We are particularly happy to be hosting the annual PICES meeting this year because Canada is initiating its GLOBEC program in 1996. Our GLOBEC program includes an Atlantic component focused on groundfish and a Pacific component focused on salmon. The program is multidisciplinary and involves government and

university scientists from across Canada. We hope that the Pacific component of Canada's GLOBEC program will complement the GLOBEC programs of our partners in PICES and realize the potential of the PICES CCCC program framework.

The North Pacific may be entering a period of rapid change in biological productivity. More information on the climate of the North Pacific and a better understanding of the forces causing climatic variation is urgently needed, both for fisheries conservation and for planning marine and coastal development. We in Canada hope that PICES can and will unite scientists in all relevant disciplines in all our member states to advance knowledge in this vitally important area.

In addition, all our countries around the Pacific Rim face major challenges and opportunities with respect to marine science. We are facing population growth, a global food supply crisis and major changes in our coastal environments in the coming years, all of which will pose significant challenges to marine science and coastal resource use planning. The scientists involved in PICES will play a major role in these issues and it is most important that we exchange information and engage in cooperative programs to address common problems and issues.

Finally, it is very fitting that PICES is meeting here in Nanaimo, as this city has been the site of marine science work for nearly 100 years. The Pacific Biological Station of the Department of Fisheries and Oceans located here in Nanaimo was opened in 1908 and has a long history of marine science and fisheries science of which we are very proud.

We look forward to a stimulating and productive meeting, building on the links established between us at previous meetings and paving the way to strengthening future cooperation.

Dr. Wooster asked Prof. Qi-Sheng Tang, speaking on behalf of Mr. Cong-Meng Liu, head

delegate, to make a statement on behalf of the Chinese Government.

On behalf of the Chinese Government, I wish to express the pleasure, of all members of the Chinese delegation, to participate in the Fifth Annual Meeting of PICES in Nanaimo, I wish to thank our hosts from the Government of Canada, the Department of Fisheries and Oceans, and especially the Pacific Biological Station and the Malaspina University-College for their hard work which has provided us with well organized support for this meeting.

China is a big and important fisheries country in the world, and in particular, in the North Pacific Ocean and we always attach great importance to and participated in various activities in this region. In association with other member countries, China has played a positive role in the development of the organization and contributed a great deal to marine science.

Presently, the issues of environmental deterioration and energy shortage have caused global concern since they are closely related and have become a threat to the existence of human beings. The founding of PICES is designed to promote and coordinate regional research on marine science. It is very important to enhance scientific understanding and strengthen scientific collaboration between member countries on the basis of mutual benefits. For this reason, PICES should further underline the priority of research programs like the CCCC program. Therefore, I hope all member countries will sincerely cooperate with each other, improve their efforts in marine science research and work together to protect and properly develop and utilize the resources so as to contribute to the development of mankind.

Finally, I wish the meeting every success.

Dr. Wooster asked delegate Dr. Satsuki Matsumura to speak on behalf of the Japanese Government.

Thank you Mr. Chairman for your nice introduction, on behalf of Japanese participants and Government of Japan, I am honored to have the opportunity to make these remarks.

Since the First Annual Meeting was held in Victoria, member countries have shared holding the Annual Meeting and PICES has steadily expanded year by year. The activities of the many Committees and Working Groups seem to have progressed over the years. The basic research in the North Pacific Ocean science has become stronger. After holding the Annual Meeting among the founding Member Countries, this Fifth Annual Meeting has returned again to Vancouver Island. This means PICES has grown.

During the four years, the technical oceanography has progressed extremely well. Satellite use for remote sensing for example, has been used to make many marine observations and collect data over the whole ocean. Japanese Earth Observation Satellite "ADEOS" was successfully launched on August 17th. It has two oceanographic sensors named OCTS and NSCAT, both of which are now working very well. It means that, in the very near future, we can expect to develop basin scale primary productivity maps each week. Many ocean biologists interested in satellite data are working to build up primary productivity algorithms using data from ocean color, temperature and sea surface wind which are collected by ADEOS. Many inter-national ocean science organizations and projects are expecting to use the data from the Japanese satellite. The earth observation program of Japan, which is led by the Science and Technology Agency (STA) and the National Space Development Agency (NASDA), will make the data available for all earth environmental scientists. STA is planning to install many marine observing buoys over the North Pacific. This buoy system will be deployed by the new large (8,000 ton) research vessel "Mirai".

A physical and biochemical circulation study on the North Pacific must be one of the goals of

PICES. I hope the buoy system, satellite system and other traditional methods using research vessel fleets will contribute to PICES activities and the new data sets will be used by all member countries and scientists who are working at saving the marine environment, especially in the North Pacific.

Finally as a newcomer to PICES meetings, I hope every one enjoys this meeting and would like to give many thanks to members of local organizing committee for their efforts.

Thank you for attention.

Dr. Wooster asked Dr. Jang Uk Lee to speak on behalf of the Republic of Korea Government.

First of all, on behalf of my Government, I would like to express my sincere thanks to the Government of Canada for hosting the Fifth meeting of PICES and the PICES Secretariat which prepared all the documents so nicely. Moreover, my special pleasure in attending in this meeting is doubled because I am not only directly involved in this meeting but also have the opportunity to be here in this very attractive coastal city of Nanaimo for the first time.

I would like to emphasize, Mr. Chairman, that there is not any doubt that PICES has made great progress in the exchange of scientific information and knowledge in terms of ocean and fisheries resources among scientists from contracting parties and others interested in these fields since the formation of PICES in 1992.

As we are all well aware, the North Pacific Ocean is one of the world's most productive waters for living marine resources. In fact, the leading species in the world's fisheries are from the Pacific and it is also known that most of the potential living resources biomass has recently started to follow a declining trend.

In this sense, Mr. Chairman, ocean scientific research and related information are vital to better understand the trends of abundance in living resources in relation to changes in

environmental conditions. Needless to say, this will only occur through participating in active research and sharing our mutual scientific information. My government has put great effort into conservation and management of living marine resources with emphasis on rational utilization and development by coastal countries in the fisheries sector.

Mr. Chairman, my government is interested that this Fifth Annual Meeting of PICES is successful and my delegation is ready to cooperate with scientists attending to make a successful meeting. I would like to inform you that, my government established the Ministry of Maritime Affairs and Fisheries in August this year so that marine and fisheries policies could be carried out more effectively, in the 21st century, than in the past years. I am very pleased to announce that my government is now ready to host the next PICES Annual Meeting and we invite you to come to Korea about this time next year.

Once again, my delegation would like to give our special thanks to the members of the organizing committee for their dedicated effort and also my deep appreciation goes to all present at this meeting for a most warm welcome you have given the Korean delegation.

Thank you very much for your attention.

Dr. Wooster asked Dr. Alexander Rodin of the Russian Federation to say a few words on behalf of his Government.

On behalf of the Government and the State Committee for Fisheries of the Russian Federation I welcome you to the Fifth PICES Annual Meeting!

I extend my gratitude to the Canadian Authorities and the Secretariat of the Organization for the invitation and preparation for this meeting.

Russia, with its coasts facing the Pacific Ocean and the peoples populating it, are very interested

in utilizing the ocean resources, particularly biologic resources. The food problem, in our view, may to a great degree be solved through proper exploitation of the biologic resources of the Ocean. With that in mind, one must not only consider the resources but also the condition under which they exist must be studied. We can speak about rational exploitation of riches (resources) of the Ocean only on a serious scientific basis.

Therefore, I would like to emphasize that we shall support the goals and objectives of PICES and we shall participate in its programs. We stand for working towards good cooperation between all member countries of PICES. Our delegation is ready to work at the Fifth Annual Meeting.

I wish every success for the fruitful work of all of you at this meeting.

Dr. Wooster called upon Dr. Vera Alexander to provide a few words on behalf of the U.S. Government.

Mr. Chairman, distinguished delegates, ladies and gentlemen, I am very pleased to be here today at the start of the Fifth Annual Meeting of PICES, the North Pacific Marine Science Organization. This is the second meeting which has been held in Canada, and this is significant and appropriate because Canada has played a major role in the formation and direction of PICES, since the earliest meetings during which the concept was introduced through the establishment of the Secretariat in Sidney, British Columbia and into the present. I thank our Canadian hosts for their welcome.

There has been a change in the delegation from the United States, and I wish to introduce to you Dr. James Balsiger, who is the new delegate from the United States Government, replacing Dr. William Aron, who has recently retired. I look forward to working with him.

PICES has been a success! The two main areas of success that I perceive have been the fostering

of enhanced communication among scientists and the identification of research priorities for the North Pacific Ocean which require a multi-national approach. It is significant that the numbers of such research problems are multiplying as PICES conducts its work through the various Committees and their Working Groups. This is good and appropriate. However, now we must turn our attention to the implementation of such research programs. There must be a commitment to the multi-national efforts which are developed. The extent to which this will happen will determine the effectiveness of PICES in advancing our knowledge of the North Pacific Ocean.

I look forward to an enjoyable and productive meeting. Once again, thank you to our Canadian hosts.

Dr. Wooster thanked the representative of Canada and the delegates for their remarks and spoke on behalf of PICES. At this Fifth Annual Meeting, when the organization is four and a half years old, PICES can look back with satisfaction at what has been accomplished until now, and forward with confidence at what should be done in the next few years. We are six nations strong and have engaged the active participation of hundreds of scientists from across the northern North Pacific. Our meetings offer a rich array of scientific papers and our publications are gaining acceptance as valuable contributions. We are tackling the continuing problems of data exchange and monitoring as well as considering possible new research efforts in the Bering Sea and in the Japan/East Sea, along with giving new attention to the roles of marine mammals, sea birds, and crabs and shrimps in the marine ecosystem. And we have initiated a research enterprise, the Four Seas (CCCC) program, that engages a prime scientific question of our time, the nature of climate variations and their effects on marine ecosystems.

Despite this record, not bad for such a young organization, there are problems we must resolve if this progress is to continue. I have set

out some of these in a perspectives paper you will all have seen. The biggest deficiency that I perceive is in the area of participation where significant segments of the marine science community are not involved, either because they haven't heard of PICES, or because their agencies or universities have not been brought in at the national level, or because travel funds are not available to them. In some ways, the awareness problem is the easiest to resolve, since it is largely up to our own ingenuity to design scientific programs and activities of broad interest, in which scientists will strongly desire to engage. The problem of interagency cooperation and coordination is one that must be faced at the national level, and we can only urge that it be recognized and solved at that level. The funding problem is not disconnected from the interagency problem if the costs of participation can be shared among interested agencies. To the extent that members expect PICES to support participation of individuals, for example junior scientists and invited experts, the Organization will need much larger resources than it has been granted so far. Participation in Annual Meetings is important because of the opportunities for exchange of information and ideas, the stimulation of collective thinking, and the potential to set the scientific agenda of the organization through meetings of the Scientific Committees. Working Groups and Technical Committees usually meet between sessions or just before the Annual Meeting, and these bodies are unable to carry out their assigned tasks if appointed members are unable to participate. One might assume that Member States who approve establishment of these bodies and appoint scientists to them would recognize their responsibility to ensure participation of their appointees, but this has not always been the case. Perhaps the advance and spread of technology will help to alleviate this problem - for example, a "virtual" Technical Committee on Communications has been proposed that would work primarily by electronic means - but I am old-fashioned enough to believe that the need for face-to-face interaction will not disappear. Remember the predictions of "paperless" offices!

You can't blame the Chairman and the Secretariat for getting bogged down in the operational details of the Organization, but we must not forget that the ultimate purpose of PICES is to promote scientific understanding of the northern North Pacific Ocean. I have seen grand top-down schemes invented by administrators and imposed on scientists - at first, the International Decade of Ocean Exploration was such a scheme - but I am a strong believer in the bottom-up approach which the PICES structure of Scientific Committees and the Science Board is meant to foster. This is how the CCCC Program and other activities, such as those in the Bering Sea, Japan/East Sea, and the Okhotsk Sea have arisen.

The goal of advancing scientific knowledge of the PICES area and of its living resources is established in the ICES Convention. Clearly our founders contemplated not only the increased understanding of our planet as a cultural advance, but also the gaining of knowledge that could eventually be applied to problems faced by Governments, such as the conservation and allocation of resources, protection of the marine environment, or prediction of the impact of climate change. The Convention (Art. V.1.d) lists among the scientific functions "to consider requests to develop scientific advice pertaining to the area concerned". However the process of transferring of scientific findings to user entities has not yet been well elaborated. It may work successfully within some member states, but an international organization such as PICES can make a major contribution to the transfer among its members and organizations that serve them. We have not yet been successful in establishing effective links with potential user organizations such as fishery commissions, but the effort must be continued if PICES is fully to serve its purpose.

We must keep in mind that PICES is not PISCES! It is not a fishery science organization, it is a marine science organization. And the set of scientific problems that face us, centered around the effects of climate variations and human activities on marine ecosystems certainly

engage all of the marine science disciplines. Approaches to this set of problems in PICES member laboratories go well beyond those represented at our meetings and in our Committees and Working Groups. If we are to see significant progress in your lifetime, we must find a way to link all of these efforts in a common approach. There is a challenge that should keep PICES busy well into the next century!

Dr. Wooster introduced Prof. Timothy Parsons to give the keynote lecture. Prof. Parsons addressed the subject of Taking Stock of Biological Studies in the Ocean describing a holistic perspective of the last 150 years of studies in ocean biology that reveals two distinct scientific activities. The first involved largely descriptive studies and was characterized by many international expeditions from the "Challenger" in 1870 to the Indian Ocean Expedition of the late 1960s. These studies ended in what Carlton Ray (1970) called the "Marine Revolution". This was caused by the need for biologists to pay much more attention to practical problems in fisheries, pollution, undersea mining and in particular the biology of the 200-mile economic zone which was established by many nations in the 1970s. The biology of the oceans moved from largely descriptive ecology into the field of dynamic processes, holistic models, new methods for collecting data, industrial aquaculture and networking of different national and international organizations. Further progress in the biological sciences is needed in these areas, particularly in determining the carrying capacity of the sea and the ecological consequences of removing marine species of fish from the oceans as part of the annual industrial harvest. These problems are only likely to be solved through new methodologies and from a consideration of entire ecosystems, which are often different to that expected from the sum of the determinate parts.

Reference: Ray, C. 1970. Ecology, law and the "Marine Revolution" Biol. Conserv. 3:9-17

REPORT OF GOVERNING COUNCIL MEETINGS

The Governing Council met on October 14, 16 and 20, under the Chairmanship of Dr. Warren S. Wooster. The Executive Secretary, Dr. W. Doug McKone, served as rapporteur.

All Contracting Parties were represented at the three sessions (Endnote 1). The Chairman of the Science Board, Dr. Makoto Kashiwai was in attendance during part or all of each session.

At the first session, the Chairman welcomed the delegates and noted that for this meeting Prof. Qi-Sheng Tang and Mr. Lian-Zeng Chen were representing Mr. Cong-Meng Liu and Prof. Yu-Kun Xu of the People's Republic of China, Dr. Jang-Uk Lee was representing Mr. Kyu-Seok Park of the Republic of Korea and Mr. Kazumi Hagino was representing Mr. Teruyoshi Inagawa of Japan. The Chairman reviewed the agenda and proposed the order in which to take up the various items. This report summarizes the treatment of each agenda item during the course of the three sessions.

Agenda Item 1. Preliminary Report on Administration

The Executive Secretary summarized the activities of the Secretariat during the previous year (Endnote 2).

Agenda Item 2. Relations with Other International Organizations and Observers from such Organizations

Letters of invitation to attend PICES V were sent to the agreed list of Organizations and the following sent observers:

International Council for the Exploration of the Sea (ICES): Dr. Michael R. Reeve
North Pacific Anadromous Fish Commission (NPAFC): Dr. Irina Shestakova
Scientific Committee on Oceanic Research (SCOR): Dr. Kenneth L. Denman

Agenda Item 3. Membership and Observers from Other Countries

No non-member countries sent observers to this meeting. Dr. Wooster remarked that some interest in membership was expressed by Mexican scientists a few years ago but that there has been no follow up.

Agenda Item 4. Election of Chairman

The Executive Secretary, Dr. McKone, held the election for Chairman of Council in accordance with the Rules of Procedure. Dr. William G. Doubleday of Canada was elected. The delegates congratulated Dr. Doubleday on his election. Dr. Doubleday expressed his thanks for the support given by Council members.

Agenda Item 5. Appointment of Executive Secretary

Council approved the Finance and Administration Committee recommendation to extend the term of the Executive Secretary for one year until December 31, 1998. Editorial changes will be made to the description of the position and it will be reviewed at the next Annual Meeting for advertisement to be filled by January 1, 1999 (Decision 96/A/3).

Agenda Item 6. Rule Change to allow past Chairman to serve as an ex-officio participant of the Governing Council

Council agreed that the immediate past Chairman should be invited to serve as an ex-officio participant of Governing Council. Funding for his participation in Annual Meetings will be paid from interest accrued in the Working Capital Fund. Council agreed that a Rule change was not required for this purpose (Decision 96/A/5).

Agenda Item 7. Report of Finance and Administration Committee

The Finance and Administration Committee met under the Chairmanship of Dr. John C. Davis who presented the report to the Governing Council (see F & A Report for text). The report was approved by Council.

Agenda Item 7a. Audited Accounts for Financial Year 1995

With the recommendation of the Finance and Administration Committee, the Governing Council accepted the audited accounts and agreed to continue with Flader and Greene Chartered Accountants as auditors for another year. (Decision 95/A/1)

Agenda Item 7b. Estimated Accounts for Financial Year 1996

The estimated accounts from October 1 to December 31 were reviewed and accepted by the Finance and Administration Committee and Council.

Agenda Item 7c. Budget for Financial Year 1997

Upon the recommendation of the Finance and Administration Committee, Council approved the 1997 budget at the same level as for 1996, CDN \$509,000. (Decision 96/A/2)

Agenda Item 7d. Forecast Budget for Financial Year 1998

The forecast budget for 1998 was revised by the Finance and Administration Committee to reflect the changes in the 1997 budget (Decision 96/A/2). No decisions concerning the 1998 budget were made by Council.

Agenda Item 7e. Trust Fund

The Finance and Administration Committee reviewed the paper on this subject prepared by the Executive Secretary and recommended further consideration of necessary rule changes and guidelines. Council agreed that the Executive Secretary should develop a proposal

on these matters for consideration at PICES VI. (Decision 96/A/1)

Agenda Item 7f. Working Capital Fund

The status of the Working Capital Fund was reviewed. No action was taken by Council on this matter.

Agenda Item 7g. Home Leave Relocation Fund

The status of the Home Leave Relocation fund was reviewed. No action was taken by Council on this matter.

Agenda Item 7h. Other Funds Held

The Executive Secretary reported on the state of the other funds held on behalf of members. Council welcomed the offer of the United States to contribute the approximately CDN \$43,000 remaining in this account to support participation of Chinese and Russian scientists in future meetings.

Agenda Item 7i. Appointment of Finance and Administration Committee Chairman

Council appointed Dr. John L. McGruder as the Chairman of the F & A Committee for a period of two years.

Agenda Item 8. Report and Recommendations of Science Board

The Chairman of Science Board, Dr. Makoto Kashiwai summarized the report of the Board's meeting on October 15 and 19 and presented its recommendations. Working Group 5 met during the year, Working Groups 8, 9, 10, 11, 12, TCODE, and the REX, BASS and MODEL task teams met on October 11 and 13 and the IP/EC met in the afternoon of October 13. A very successful Nemuro Workshop on *Conceptual/Theoretical Studies and Model Development* was held in June 1996. The Workshop Report has been reviewed by the relevant Scientific Committees and Science

Board. Council approved recommendations concerning PICES-GLOBEC CCCC Program (Decision 96/S/1), publications (Decision 96/S/2), inter-sessional meetings (Decision 96/S/3), monitoring (Decision 96/S/4), cooperation with SCOR (Decision 96/S/5) and PICES perspectives (Decision 96/S/6). Details are given in Appendix 1.

The Science Board also approved a scientific program for the Sixth Annual Meeting (see Science Board Report).

Agenda Item 9. PICES Perspectives

The PICES Perspectives papers were reviewed by the Finance and Administration committee and the Science Board and Council. Council agreed that PICES Members should be encouraged to establish an interagency coordinating committee to facilitate the coordination of broad participation in PICES activities within each member country (details see Endnote 3 a, b and Decision 96/S/6).

Agenda Item 10. Future Meetings of the Organization and Subsidiary Bodies, Including Time and Place for the Sixth and Seventh Annual Meeting

Council accepted the Republic of Korea's proposal to host PICES VI October 17-26, 1997. The place is still to be determined (Decision 95/A/3). Council also agreed that the 1997 meeting will be of the same duration and structure as the 1996 meeting. The 1998 PICES VII meeting will be tentatively hosted by the USA in Alaska and the 1999 PICES VIII will be hosted by the Russian Federation in Vladivostok. Both of these meetings will be at about the same time of year as previous meetings (i.e. mid to late October).

Agenda Item 11. Any Other Business

Access for cooperative research

In light of Science board support for Recommendation 6 of the Vladivostok

Workshop (see p. 27 of the 1995 Annual Report), the United States submitted the following statement and recommendations:

As scientific investigations are developed under the auspices of PICES, the stage will be reached when research vessels will be working at sea on these investigations. The cruises will be elements of agreed scientific programs and are likely to involve scientists from several of the PICES member states. Dimensions of the oceanic phenomena being investigated are determined by natural processes, and these phenomena are likely to extend across boundaries of national jurisdiction, thus requiring permission from coastal states for access to carry out research. The United Nations Convention on the Law of the Sea makes special mention (Art. 247) of marine scientific research projects carried out under the auspices of an international organization, stating that a coastal State that belongs to such an organization shall be deemed to have authorized the project to be carried out in conformity with the agreed specifications if that State approved the detailed project when the decision was made by the organization for the undertaking of the project, or is willing to participate in it, and has not expressed any objection within four months of notification of the project by the organization to the coastal State. Application of this provision should be considered by PICES when cooperative projects have been designed. At the present time cooperative studies in the Japan Sea/East Sea are being planned by PICES Working Group 10. On-going research in that area has already been impacted by restrictions on access for marine scientific research, and successful conduct of the research being planned by WG 10 will depend on such access being granted. In view of these facts, it is recommended that:

These following recommendations were agreed to by Council (Decision 96/A/8):

1. Member States of PICES affirm application of Art. 247 to cooperative projects being developed under the auspices of PICES.

2. Working Groups present their research plans to the Science Board for approval and forwarding to the Governing Council for endorsement by the Organization.
3. Working Groups developing specific field phases of cooperative research programs identify elements of those programs where questions of research access arise. (96/A/8)

At the close of the Governing Council Dr. Doubleday, called on all members of the Governing Council to join with him in warmly thanking Dr. Wooster for his outstanding service to PICES over many years. He praised Dr. Wooster for leading PICES through its first years and establishing a strong and vital scientific program. The Governing Council unanimously applauded the contribution of Dr. Wooster.

Appendix 1

A. Decisions

96/A/1: Council agreed to the following actions:

1. *Auditor.* Accepted the audited accounts for 1995 and agreed to continue with Flader and Greene as auditor for another year.
2. *Trust Fund.* Council instructed the Executive Secretary to propose a draft a Rule change to include regular contributions to the Trust Fund, develop guidelines as to how the funds would be used, and propose a process for determining candidates for the use of funds.

96/A/2: Council accepted the financial statements for the audited accounts of 1995 and the estimated accounts of 1996 and agreed to the following actions:

1. *1997 Budget.* The budget of \$509,000 was approved.
2. *Forecast 1998 Budget.* The forecast budget for 1998 was reviewed and will be further considered during PICES VI.

96/A/3: Executive Secretary

Council approved a one-year extension to the contract of the Executive Secretary to December

31, 1998. Council will review the job description of the Executive Secretary at PICES VI for advertisement in late 1997 and 1998.

96/A/4: Finance and Administration Committee Membership and Chairman Council approved changes in Financial Rules 15 and 18 as follows:

Rule 15

The Finance and Administration Committee shall consist of one member and one alternate from each Contracting Party. The Executive Secretary shall be an ex officio member of this Committee without the right to vote. The Council's Vice-Chairman should attend the meetings of the Committee without the right to vote. The Chairman shall be appointed by the Council from among the Committee's members for a term of two years and shall be eligible for reappointment only once for a successive term. A Chairman of the Committee who is a Delegate shall not function as such during the time of Chairmanship, and the appointing Contracting Party shall have the right to appoint another person to serve as a Delegate. At each ordinary meeting of the Council the Finance Committee shall examine:

Rule 18

(ii) delete "and" at the end.

(iii) (a) meetings of the Science Board may be attended by persons other than the members only on the invitation of the Chairman of the Council,

(b) meetings of the Finance and Administration Committee may be attended by persons other than the members and alternates only on the invitation of the Chairman of the Council, and;

(iv) all Delegates, Alternate Delegates, experts, advisors, observers, and any person attending the meeting of the

Council may attend meetings of any of the Committees or Groups of the Council, except in cases where participation in meetings of a Committee or Group has been limited by the Council.

96/A/5: Past Chairman

Council approved that the past Chairman shall be invited to serve in an ex-officio advisory capacity and attend the Annual Meeting of Council for the period during which the incumbent is Chairman of Council. The associated travel costs are to be paid from interest accrued in the Working Capital Fund.

96/A/6: Attendance at important meetings

Council authorized the Chairman and the Executive Secretary, at their discretion, to approve travel costs of selected scientists, at PICES expense, to attend important meeting on behalf of PICES.

96/A/7: Detailed travel

Council instructed the Executive Secretary to prepare as detailed proposal for travel expenditures for the proposed budget year to circulate with the proposed budget 90 days before the Annual Meeting. At the same time detailed travel expenditures for the current year should be provided.

96/A/8: Access for cooperative research

1. Member States of PICES affirm application of Article 247 to cooperative projects being developed under the auspices of PICES,
2. Working Groups should present their research plans to the Science Board for approval and forwarding to the Governing Council for endorsement by the Organization, and
3. Working Groups should identify scientific field phases of cooperative research programs and identify elements of those programs where questions of research access arise.

96/A/9: Future Annual Meetings

Council accepted the proposal of the Republic of Korea to host the Annual Meeting in Korea October 17-26, 1997. The place is to be determined. The U.S.A. will host the 1998 Annual Meeting in Alaska and the Russian Federation will host the 1999 Annual Meeting in Vladivostok. The dates and places for these two meetings are to be determined at next years Annual Meeting.

96/S/1: PICES-GLOBEC CCCC Program

- a. The MODEL Task Team should convene a workshop in California in early 1998 to (a) develop vertical profiles for nitrate in the open North Pacific, and (b) compare lower trophic level physiological process models.
- b. The REX Task Team should convene a workshop immediately prior to PICES VI to (a) identify and prioritize desired retrospective and process oriented research programs needed for regional comparisons to be made, (b) discuss standardization of plankton sampling methods, (c) identify key species within the 10 REX regions, (d) identify methods for monitoring their distribution and abundance in selected regions.

96/S/2: Publications 1996-1997

The following reports are to be published:

- a. Working Group 5 Report in the 1996 Annual Report;
- b. Working Group 9 Reports 1 and 2 in the 1996 Annual Report;
- c. The report of the Workshop on Conceptual/Theoretical Studies and Model Development, reports of REX and BASS Task Teams in the PICES Scientific Report Series.

96/S/3: Inter-sessional meetings

The following inter-sessional meetings are to be convened:

- a. WG 10 (Circulation and ventilation in the Japan Sea / East Sea and its adjacent areas) should meet immediately after the CREAMS (Circulation Research of East Asia Marginal

- Seas) International Workshop (January 31-February 2, 1997, Fukuoka, Japan);
- b. WG 12 (Crabs and shrimps) should meet for 4-days (June 1997, Nemuro, Japan);
 - c. MEQ Practical Workshop on Methods to Assess Pollution Impact in Jiaozhou Bay should take place for approximately two weeks (May/June 1997, Qingdao, China).

Travel costs for Working Group and Workshop participants should be borne by Member States.

96/S/4: Monitoring

WG 9 should explore ways to implement their recommendations to establish ecological moorings and to use a cable to monitor the Kamchatka Current.

96/S/5: Cooperation with SCOR
 PICES should participate in SCOR - WG 105 on *The Impact of World Fisheries Harvests on the Stability and Diversity of Marine Ecosystems* and designates the Chairman-elect of FIS, Dr. Chang-Ik Zhang, to participate on behalf of PICES.

96/S/6: PICES perspectives

An interagency coordinating mechanism should be established in each Member Country to facilitate the coordination of broad participation in PICES activities (see item 1 Future perspectives for PICES),

Endnote 1

Participants

Canada

William G. Doubleday (delegate)
 John C. Davis (delegate)
 Dan Goodman (advisor)

China

Qi-Sheng Tang (alternate delegate)
 Lian-Zeng Chen (alternate delegate)

Japan

Satsuki Matsumura (delegate)
 Kazumi Hagino (alternate delegate)

Republic of Korea

Hyung-Tack Huh (delegate)
 Jang-Uk Lee (alternate delegate)
 Deok Bae Park (advisor)

Russian Federation

Alexander Rodin (delegate)
 Sergey E. Dyagilev (delegate)
 Boris N. Kotenev (advisor)
 Lev N. Bocharov (alternate delegate)
 Gennady V. Goussev (advisor)

U.S.A.

Vera Alexander (delegate)
 James W. Balsiger (delegate)
 John L. McGruder (advisor)
 Dorothy Bergamaschi (advisor)
 William L. Sullivan, Jr. (advisor)
 Mark Wildman (advisor)

Others

Warren S. Wooster (Chairman, PICES)
 W. Douglas McKone (Executive Secretary)
 (Rapporteur)
 Alexander Bychkov (Assistant Executive Secretary)
 Makoto Kashiwai (Chairman, Science Board)

Endnote 2

Report on Administration for 1995

Council, Committees and Working Groups

1. Payment of National Contributions

All financial contributions are due by January 1 each year. The People's Republic of China (May 23) and the Republic of Korea's fees (July 9) paid their fees very late.

2. National Delegations

a. Dr. Takashi Sasaki has moved to a new position and has been replaced by Dr. Satsuki Matsumura, Director, Research Planning And Coordination Division, National Research Institute of Far Seas Fisheries, as Japanese delegate to Council.

b. Dr. William Aron has retired and Dr. James Balsiger, Director, Alaska Fisheries Science Center, National Marine Fisheries Service, NOAA, has replaced him as U.S. delegate to Council.

3. Committees and Working Groups

a. Members of the new Working Groups 10, 11 and 12 have been appointed and meetings of these groups are being held at PICES V.

b. Changes to existing Committees and Working Groups are:

Biological Oceanographic Committee

Japan: Dr. Atsushi Tsuda replaces Dr. Tsutomu Ikeda

Physical Oceanography and Climate Committee

Japan: Dr. Masahiro Endoh replaces Dr. Takeshi Uji

Russia Dr. Vyacheslav Lobanov replaces Dr. Alexander Bychkov

Technical Committee on Data Exchange

U.S.A.: Dr. Thomas C. Royer replaces Dr. James H. Swift

Russia: Dr. Igar Rostov replaces Dr. Glennady Yurasov

Dr. Nickoly Rykov newly appointed

Implementation Panel

U.S.A.: Dr. Patricia Livingston replaces Dr. Robert Francis

Working Group 9

Russia: Dr. Sergey Sterkhov newly appointed

c. A very successful Nemuro CCCC Workshop on Conceptual/Theoretical Studies and Model Development was held in June, 1996. The report of the discussion and recommendations will be presented at this Annual Meeting.

4. Observers

Invitation letters were sent to inter-Governmental and non-Governmental organizations on the standing list. Organizations that accepted our invitation are:

International Council for the Exploration of the Sea (ICES): Dr. Michael R. Reeve

North Pacific Anadromous Fish Commission (NPAFC): Dr. Irina Shestakova

Scientific Committee on Oceanic Research (SCOR): Dr. Kenneth L. Denman

5. Travel and Representation at Other Organization Meetings

a. Dr. W. Doug McKone and Ms. Christina Chiu attended meetings for PICES V arrangements at PBS in Nanaimo (Jan. 10, Jan. 29 and Aug. 1).

b. Dr. W. Doug McKone traveled to the People's Republic of China, Republic of Korea, Russia and the United States to interview candidates for the position of Assistant Executive Secretary (Jan. 30-Feb.10).

- c. Dr. Sangbok D. Hahn attended the IOC/WESTPAC III Meeting in Tokyo (Feb. 26-Mar. 1)
- d. Dr. Makoto Kashiwai attended the Interim Scientific Committee for Tuna and Tuna-like Species in the North Pacific in Tokyo (May 7-10).
- e. Dr. W. Doug McKone and Ms. Christina Chiu attended the Pension Society Meeting in Washington DC (May 21-23).
- f. Dr. Warren S. Wooster, Dr. Makoto Kashiwai, and Dr. W. Doug McKone and Ms. Christina Chiu from the Secretariat attended the CCCC Workshop in Nemuro (June 24-28).
- g. Mr. Robin Brown attended the Workshop for Environmental Data for Fisheries Science in Monterey (July 16-18).
- h. Dr. Bruce A. Taft and Dr. W. Doug McKone attended the PORSEC meeting in Victoria (August 13-16).
- i. Dr. Makoto Kashiwai attended the ICES Annual Meeting in Copenhagen and Reykjavik (Sept. 27-Oct. 4).

Communication

1. Publications

- a. The Secretariat spent a great deal of effort editing the Vladivostok Report for publication this year.
- b. List of publications produced so far this year:
 - i. The Annual Report was published and circulated in early February to all PICES members, international organizations and libraries.
 - ii. A poster for the Fifth Annual Meeting was distributed in early February.

- iii. PICES Press newsletters were circulated in early February and late July.
- iv. The First Announcement for the Fifth Annual Meeting was distributed in early February.
- v. A PICES Handbook was published and distributed to Council and F & A members.
- vi. The 1996 PICES Directory was distributed to all PICES members in early February and updated again and distributed in September.
- vii. Scientific Reports #4 (Science Plan/Implementation Plan - Report of the PICES-GLOBEC International Program on Climate Change and Carrying Capacity) and #5 (Modelling of the Subarctic North Pacific Circulation) were published and distributed in March.
- viii. The Final Announcement for the Fifth Annual Meeting was distributed in early June.
- ix. Scientific Report #6 (Proceedings of the PICES Workshop on the Okhotsk Sea and Adjacent Areas) was published and distributed in September.
- x. A program and a volume of abstracts for the Fifth Annual Meeting were prepared for circulation at the Annual Meeting.

2. Electronics Communication

A PICES Home Page (<http://pices.ios.bc.ca>) was created during the year and the Secretariat is continuing to develop it. The Secretariat also continues to monthly distribute a list of future meetings in marine sciences to more than 900 scientists.

Secretariat Matters

1. Administration/Financial

The Secretariat has converted the mailing list to a database system for more efficient handling and processing. It has improved the access time and allowed for better planning and organizing for the Fifth Annual Meeting as well as for other uses that will make our operations more efficient. The current mailing system is being reviewed and we will experiment with undertaking our own mail out instead of using the Department of Fisheries system. The objective is to have better financial control than we currently have.

2. Space, Facilities and Equipment

No changes in space requirements have developed over the last year. There is still the

outstanding commitment made by the Government of Canada to undertake an upgrade of part of the space they provide to office standards. Discussions have been held but there has not been an agreement on when the facilities would be upgraded.

3. Staffing

In April, Dr. Motoyasu Miyata completed his contract as Assistant Executive Secretary and returned home to Japan to the University of Tokyo. In May Dr. Alexander Bychkov, from POI, Vladivostok, was hired and he started a three-year contract as the new Assistant Executive Secretary.

Endnote 3

a. PICES Perspectives

As PICES approaches its Fifth Annual Meeting and the election of a new Chairman, it seems appropriate to consider what lies ahead. The Organization has the principal coastal states in the northern North Pacific as its members, has enlisted the support and involvement of several hundred marine scientists in those countries, has organized important scientific meetings, and has initiated projects of cooperative science in the region. What will the future bring? Are there new opportunities over the horizon, and are there problems whose solutions could advance the seizing of such opportunities?

The problems lie in the following three principal areas: participation, structure, and interactions.

Participation

1. Agency participation: Within the member countries, different agencies have the principal responsibility for interaction with PICES.

Often, fishery agencies have the lead, but in many countries weather/climate and environmental matters are handled by other departments, and important universities fall outside the purview of the national government. The lead agencies often seem not to represent the interests of other parties or to coordinate PICES interactions with them. In fact, few countries have effective interdepartmental coordination mechanisms.

Solution: An interagency coordination mechanism should be established in each member country whereby the participation in PICES activities of all interested parties can be arranged.

2. Appointed scientists: In each PICES country, some 25-30 scientists are formally involved in PICES affairs, as appointed members of scientific and technical committees and of working groups and analogous bodies. Although some of the work of these bodies is conducted by correspondence, their main

activities take place at meetings, especially during the annual meetings. While it is obviously important for these scientists to attend, unfortunately national funding for such participation is often not provided, and the work of the bodies is thereby seriously impaired. This is particularly a problem when the lead agency is reluctant to support other than its own people.

Solution: In budgeting for PICES, member countries should provide for the costs of participation of appointed scientists in PICES activities. These costs are likely to exceed the annual national contribution to the PICES budget.

3. Other scientists: The scientific program of PICES Annual Meetings should attract the interest of scientists beyond those appointed to committees and working groups. In most countries, only a small fraction of the marine science community is now involved with PICES. The Organization is unlikely to achieve its objectives without much broader links with that community. The mistaken perception that PICES is a fishery organization may discourage some, but the principal impediment is funding. In principle, each country should support participation of its own scientists, but funds are often not available, especially for participation of junior scientists.

Solution: Member countries should recognize their responsibility to ensure participation. If the Trust Fund is to be used to support otherwise unfunded scientists, it should be augmented and regularly replenished. Procedures for selection of recipients must be agreed.

Structure

1. Scientific Committees: At its first meeting, PICES established four standing Committees (BIO, FIS, MEQ, and POC) to provide a disciplinary home for scientists and to give them a voice in the governance of PICES through representation on the Science Board. The Committees have the responsibility not only to

oversee scientific sessions and develop programs for the next annual meeting, but also to review progress in their field and to propose actions that would accelerate advances. While each Committee has 18 appointed members (three from each country), it has always been hoped that all scientists at an Annual Meeting would participate in their work. An active Committee should work by correspondence between Annual Meetings, so that actions to be taken could, where possible, have been fully considered in advance. In practice, intersessional activities and participation in committee meetings have been limited.

Solution: Committee Chairmen should take the lead in developing committee programs through correspondence, and action should be taken to attract broad interest in committee meetings. [These actions are being taken for PICES V]

2. Technical Committees: In recognition of the continuing need for a body to deal with PICES data problems, a standing Committee, the Technical Committee on Data Exchange, was established. There are other areas where standing Committees may be needed, e.g., monitoring. The Implementation Panel of the CCCC Program will be required for five years or longer. The relationship of such bodies to the Science Committees and the Science Board remains to be defined.

Solution: The Science Board should review the need for such committees, their terms of reference, and their membership, as well as their relationship to the Science Committees and the Science Board. Recommendations on this should be forwarded to the Governing Council.

3. Working Groups: Working Groups have been established for specific purposes and with finite lives (2 - 3 years). Reports are expected at the end of their work, and the groups may evolve into other groups or into standing committees. The constraints have not been widely understood, with some groups expecting their work to go on indefinitely. In most cases,

participation of appointed members has been limited.

Solution: The Science Board should prepare specific guidelines for the function and duration of Working Groups. [Participation problems are considered above.]

Interactions

1. Fishery Commissions: While PICES has no responsibility or authority for fishery management, marine scientific research in general, and specific programs such as CCCC, can contribute to the rational use of marine resources and hence to the work of commissions with management responsibility. Existing and developing commissions have broad research mandates, and no clear jurisdictional lines have been drawn. National policies often differ from organization to organization. The resulting confusion threatens the development of PICES programs such as CCCC and impedes the transfer of information to the commissions.

Solution: Consistent national policies towards marine science organizations should be established. Jurisdictional conflicts should be resolved, and cooperative opportunities should be identified in memoranda of understanding with PICES.

2. Advisory activities: When plans for PICES were being developed, it was assumed that advisory activities in the fields of fisheries and environmental quality would be developed, in analogy with those performed by ICES. While the PICES Convention (Art.V.1.d) provides for that possibility, political and geographical realities have prevented it from developing. If the members were ultimately to decide on an active advisory role for PICES, there would be important budgetary and structural implications.

Solution: Members should include the possibility of a PICES advisory role in considering cooperative opportunities between PICES and fishery commissions. The Secretariat should analyze the budgetary and structural

implications for PICES of its assuming an active role in providing advice to member countries and to regional international organizations.

3. Cooperation with international research programs: Existing international research programs, bilateral and multilateral, regional and global, deal with questions that fall within the broad scientific mandate of PICES. However, within countries, participating agencies are often different from those that interact with PICES so that the activity appears to be unrelated. The difficulty is not a lack of control by PICES, but the loss of opportunities for effective collaboration.

Solution: International research programs related to ongoing activities and interests of PICES should be identified and listed. Opportunities for collaboration with these programs should be sought, first among agencies at the national level and then by PICES.

Opportunities for PICES, in addition to advisory activities mentioned above, fall in the areas of support services, for example in communication, exchange of information and data, and monitoring, and in research itself, as exemplified in the CCCC program. Ideas concerning these opportunities will be discussed in a subsequent note.

W. S. Wooster, Seattle, July 17 (rev. July 23), 1996

b. Communication Perspectives

Effective communication is important to PICES because the work places of participants are widely scattered. They work in several languages but communicate internationally in English. Except at meetings, where special effort is required to ensure effective oral presentations, communication is increasingly by electronic means. Thus it is important that PICES employ the developing technology in the most effective way to meet its goals and objectives.

Communication needs range from low frequency - archival reporting and data base management; - to mid frequency (MF) - distribution of news; - to high frequency (HF) - real-time exchanges. Methods differ among these:

LF: now, printed, distributed by post; future, distributed electronically. In the case of data bases, access is increasingly by electronic means.

MF: now, printed and mailed, increasingly electronic and fax; future, distributed electronically.

HF: now, e-mail and fax; future, e-mail (and fax?)

Problems that characterize these frequencies include publication delays, high costs, and uncertain print orders (LF); stale and incomplete news (MF); difficulties with equations and graphics (HF). Many communications problems arise because the response time of correspondents is often much slower than that of available technology. With the increasing use of electronic means of communication, problems also arise because the technology is not universally available and is not standardized, leading to mismatches in hardware and software. While the Secretariat has been diligent in trying to provide the necessary services, there has not

yet been a systematic effort to determine customer requirements and problems.

A goal is that every PICES participant be able to communicate freely and quickly with any other and have ready access to required information - archival, data base, and news. To facilitate achievement of this goal, there should be established a Technical Committee on Communications (TCCOM), to work primarily by electronic means, with the following terms of reference:

1. Consider ways whereby participation in PICES activities might be enhanced through an expanded communications network.
2. Determine the communication requirements of PICES participants and identify the present problems in meeting those requirements.
3. Review existing electronic communication practices and procedures within PICES.
4. Survey the electronic communication capabilities in member states.
5. Review technological developments of utility to PICES communications.
6. Develop a communication plan to meet the requirements of PICES participants and of the Organization, within the constraints of present and soon-to-be-available technology, together with estimates of anticipated costs.

REPORT OF SCIENCE BOARD

The Board met on October 15 (17:30-18:30) to review the order of the agenda and 19 (08:30-17:00). (See Endnote 1 for participants.)

The Chairman Dr. Makoto Kashiwai called the meeting of the 19th to order and set out the task before the Board. The Board reviewed the findings and recommendations of the Scientific Committees, TCODE, Implementation Panel for the CCCC Program and Working Groups 5 and 9; discussed implementation of decisions from 1995; discussed and recommended relationships with other organizations; discussed future perspectives for PICES; made arrangements for future activities; planned a science program for the Sixth Annual Meeting; and made recommendations to Council. Dr. Kashiwai noted that the Chairman of the FIS Committee will have completed his term of office after this meeting when the new Chairman will officially become a member of the Board.

Reports and recommendations of the Scientific and Technical Committees and the Implementation Panel

Reports of the Scientific Committees and the Implementation Panel were presented by their chairmen and are summarized below (see reports for the full text):

Fishery Science Committee (FIS) - Prof. Qi-Sheng Tang

Dr. Chang-Ik Zhang (Korea) was elected by acclamation to succeed Prof. Qi-Sheng Tang as Chairman of the FIS Committee. The Committee discussed the CCCC recommendations for 1997, and recommended that FIS be more closely connected to CCCC activities. FIS recommended that WG 12 hold a inter-sessional meeting of 4-5 day in an Asian country (to be decided). FIS made recommendations concerning PICES

representation in SCOR-WG 105 activities. In connection with its scientific program, PICES should develop close relationships with regional fisheries committees.

FIS recommended that a joint topic session on "Models for linking climate and fish" for PICES VI be developed with BIO.

Physical Oceanography and Climate Committee (POC) - Prof. Paul H. LeBlond

The Physical Oceanography and Climate Committee met on October 17 and 18, 1996. Reviewing on-going business, POC first noted the need for an update on the oceanography of the Okhotsk Sea, especially in the light of recent work in the area. It is recommended that a workshop on the Sea of Okhotsk be held in the summer of 1998.

POC noted that most of the recommendations of WG 7 were being considered by TCODE and WG 9. Regarding the need for high resolution bathymetry for accurate modeling, it was recommended that a letter be drafted by the Chairman of POC for release of available data.

WG 10 Co-Chairmen, Drs. Christopher N.K. Mooers and Sang-Kyung Byun reported on progress, which was held to be very satisfactory. POC supported their plan for a workshop in Fukuoka in January 1997. A final report is to be ready for the PICES VI meeting. The PICES VI POC topic session will focus on "Circulation and ventilation of marginal and semi-enclosed seas" and will be co-convened by Drs. Mooers and Byun; it will also include a presentation on the progress of NEAR-GOOS.

POC supported the plans of CCCC task teams REX and BASS and the plan for a model workshop, with the proviso that the latter include the participation of recognized modellers.

Biological Oceanography Committee (BIO) - Prof. Patricia A. Wheeler

The Biological Oceanography Committee met on October 17 and October 18. New members were introduced; the committee recommends the re-appointment of Dr. Tsutomu Ikeda (Japan) and retention of Dr. Timothy R. Parsons (Canada) as committee members. The Committee requests the appointment of Dr. George Hunt (WG 11 Co-Chairman) to REX and Dr. Linda Jones to MODEL to maintain close connection of BIO with CCCC Task Teams. Dr. Hunt provided a summary report of the first WG 11 meeting. The Committee supports WG 11's request for a 5-day workshop prior to the PICES VI.

BIO discussed WG 9 recommendations and strongly endorses the recommendations for ecological moorings in the subarctic gyres (with retention of sampling at Station P) and also endorses annual reports on the status of the subarctic Pacific. BIO recommends the translation of figure legends and table headings for the Russian publication on Biological and Fisheries Aspects of the Okhotsk Sea.

BIO recommends two co-sponsored special topics for PICES VI: "Harmful Algal Blooms: Causes and Consequences" (with MEQ) and "Micronekton and their predators: Distributions, dynamics, and sampling problems" (with FIS).

Marine Environmental Quality Committee (MEQ) - Dr. Richard F. Addison

The MEQ Committee discussed and endorsed the report of WG 8. Following Prof. Ming-Jiang Zhou's offer to host a practical workshop at the Institute of Oceanology in Qingdao, WG 8 had developed a scientific workplan during 1996 for the workshop. Approximately 4 scientists from each of the PICES member countries will spend about two weeks working at Qingdao on assessing pollution in Jiaozhou Bay (Qingdao Harbour). Details of the workplan are appended as Annex 5 to the WG 8 Report. The cost of the Workshop will be approximately \$70,000; the

MEQ Committee recommended that PICES contribute \$30,000 support and the balance would be found elsewhere.

The MEQ Committee reviewed the scientific presentations at its sessions and noted the large percentage of "no shows" — about 30% of speakers who submitted titles and abstracts to the scientific sessions did not attend the Annual meeting.

The Committee discussed proposals for the scientific sessions at PICES VI. Three sessions are planned: one jointly with BIO on "Harmful Algal Blooms: Causes and Consequences"; a second on "Environmental Impacts of Aquaculture", and a third for contributed papers. Members agreed to nominate convenors within a short time.

Technical Committee on Data Exchange (TCODE) - Mr. Robin Brown

TCODE met prior to and during the PICES V meeting and reviewed progress on items from PICES IV as well as additional requests that arose during PICES V. The Committee presented short reports on the Inventory of Long Time Series to the four Scientific Committees and received support for the continued expansion of this database. In addition, some other areas of interest were birds, sea mammals and contaminant entries for the inventory of long time series, inventories of real-time data sources, climatologies and useful software and analysis tools.

PICES-GLOBEC Implementation Panel Report for the CCCC program - Dr. Yutaka Nagata and Dr. Warren S. Wooster

The CCCC Workshop on Conceptual/Theoretical Studies and Model Development was held in Nemuro, Japan on June 23-28 1996. During that workshop, meetings also took place of the Implementation Panel and its Executive Committee and of the MODEL, REX and BASS Task Teams. A report of the Workshop has been completed and should be published in the

PICES Scientific Report series. The Task Teams developed work plans, as detailed in their reports, and further discussions held by the IP/EC, and Task Teams during the present meeting led to recommendations concerning future workshops and symposia.

Working Group Reports

PICES currently has six Working Groups tasked to meet specific objectives. The Board reviewed the WG reports and recommendations. Summaries of WG reports follow:

WG 8. Practical Assessment Methodology (MEQ)

The Working Group met immediately prior to PICES V. The objective of the meeting was to review and refine the draft workplan for convening a Practical Workshop in Jiaozhou Bay, Qingdao, China, in early 1997, aimed at harmonizing approaches among PICES countries when assessing ecological impacts of pollution. (See Endnote 2 in the Report of the Marine Environmental Quality Committee for the full report.)

WG 10. Circulation and Ventilation in the Japan Sea/East Sea and its Adjacent Areas (POC)

The Working Group met immediately before PICES V to set out the task in accordance with the terms of reference. The Working Group developed a number of tasks to be undertaken and set out a tentative schedule for their accomplishment. (See Endnote 2 in the Report of the Physical Oceanography and Climate Committee for the full report.)

WG 11. Consumption of Marine Resources by Marine Birds and Mammals in the PICES Region (BIO)

The Working Group met immediately prior to PICES V to develop strategies to meet the goals set out in the terms of reference. A set of

regions of interest were defined within the PICES area and the Working Groups agreed to construct a tabulation of the populations of marine mammals and birds found in the area, dates of residency, energy demand, food habits and food consumption. (See Endnote 2 in the Report of the Biological Oceanography Committee for the full report.)

WG 12. Crabs and Shrimps (FIS)

The Working Group met immediately prior to PICES V. The terms of reference were reviewed and proposed changes were developed. The Working Group will develop a list of organizations and key scientific expert along with their field of interest from each Member Country. Each Working Group member was asked to bring, to the next meeting, previous published material on stock status, recent population abundance trends, and what is known or hypothesized about the causes of these fluctuations. (See Endnote 1 in the Report of the Fishery Science Committee for the full report.)

Inter-Committee (Science Board) Working Group Reports

WG 5. Bering Sea

The Working Group met in July to discuss the final report of the Group and discuss the status of the Bering Sea review volume book that is being prepared for publication. The Working Group proposed the development of a broad outline for research in the near future, in the Bering Sea, and more specific development of two areas of focus on dominant physical phenomena in the Bering Sea and the biological consequences of these phenomena. (See Endnote 2 for the full report.)

WG 9. Subarctic Pacific Monitoring

The Working Group met immediately before PICES V. Based on the seven possible monitoring initiatives outlined in their first report of the Working Group, three categories of programs were discussed; new initiatives;

continuing programs; and programs that are not yet ready for commencement of monitoring. (See Endnote 3 for the full report.)

Implementation from Decisions PICES IV

- a. Participation at Scientific Meetings (95/S/3, 4)

Science Board reviewed the value of circulating draft agendas to participants at registration and recommends that this practice be continued in future years. Science Board noted that participation in some Committee meetings can be improved. In scheduling meetings, business and scientific meetings should be spread out to allow participants to attend meetings of their choice.

For participants to have better knowledge of what papers will be presented in scientific sessions, the Secretariat is encouraged to set a deadline two weeks before the Annual Meeting for speakers and poster presenters to confirm whether they will be able to attend.

- b. Implementation Vladivostok Workshop Recommendations (95/S/3, 1)

Science Board strongly supports the United States' proposal, concerning joint investigations in member countries' waters

- c. Geographic Features of the Okhotsk Sea Region (95/S/3, 1)

Prof. Yutaka Nagata and Dr. Vyacheslav Lobanov will co-ordinate the development of the list of geographical features of the Okhotsk Sea region, including bays, straits, and currents, in all Member States languages. Upon completion, the Secretariat

will make the list available to all those who wish a copy.

- d. WG 3 inventory completion (95/S/6)

Korea and Russia will provide the Secretariat with a list of their scientists studying pelagic fishes.

- e. Application PICES guidelines (95/S/9)

Guidelines were reviewed and it was agreed that the Secretariat should continue to send them to successful oral and poster presenters for PICES VI. Committee Chairmen should encourage convenors to keep presentations within time limits.

Relations with other organizations

- a. SCOR WG 105 The impact of world fisheries harvests on the stability and diversity of marine ecosystems.

Science Board agreed that Dr. Chang-Ik Zhang, the Chairman-elect of FIS, will represent PICES in the SCOR WG 105.

- b. Co-sponsorship of ICES Symposium on the Role of Physical and Biological Processes in the Recruitment Dynamics of Marine Populations.

Dr. Dan Ware will continue to represent PICES on the Scientific Advisory Committee for this ICES Symposium.

- c. Scientific Committees will aid the Secretariat to identify Organizations and Programs whose activities are of interest to PICES in order to form a closer working relationships with them.

MODEL Workshop 1998

Science Board recommends that the MODEL Co-Chairmen seek the participation of experienced modellers in the Workshop in addition to users of the results of models.

High Resolution Bathymetry

Science Board recommends that the US delegation contact the appropriate U.S. Agencies to obtain access to high resolution bathymetric data in the PICES region, for use in the PICES scientific program.

Future perspective for PICES

Science Board discussed the following recommendations for future perspectives for PICES:

1. In order to enhance the involvement of the national marine science community in PICES, members should undertake to ensure that all interested agencies and programs, both government and academic, have the opportunity to participate actively in relevant PICES activities.
2. Members should recognize their responsibility to support participation in PICES activities of their scientists, especially those appointed to scientific and technical committees, working groups, and analogous bodies as well as others who can contribute to PICES scientific programs.
3. The Science Board should review the need for standing technical committees, their terms of reference, and their membership as well as their relationship to the Science Committees and the Science Board and should forward recommendations to the Governing Council.
4. The Science Board should prepare specific guidelines for the function and duration of Working Groups.

5. The Secretariat, with the help of PICES Committees and Working Groups and of contacts in its member states and in international organizations, should identify and list national and international research programs related to ongoing activities and interests of PICES. Opportunities for collaboration with these programs should be sought, first among agencies at the national level and then by PICES through its Committees and Working Groups.

Science Board supported the principle that members recognize their responsibility to provide for the cost of participation of appointed scientists in PICES activities (see item 2). Science Board agreed to undertake items 3 and 4 and agreed to assume responsibility for item 5 with the Secretariat.

Committee Membership

Science Board recommends the following:

1. Re-appoint Dr. Tsutomu Ikeda (Japan) to BIO and retain Dr. Timothy Parsons (Canada) on BIO.
2. Appoint Dr. George Hunt (Co-Chairman of WG 11) to REX and Dr. Linda Jones to MODEL.

Biological and Fisheries Aspects of the Okhotsk Sea (printed VNIRO, Russia)

The Secretariat will contact Dr. Boris N. Kotenev to obtain the Russian figure legends and table headings from this book so that they can be translated into English. These will be made available.

Study Group

PICES should create a Study Group with members Dr. Makoto Kashiwai, Dr. Alexander Bychkov and Mr. Robin Brown to review PICES communications needs and practices. This Study Group will report to Science Board at PICES VI.

Sixth Annual Meeting

The Sixth Annual Meeting will be held in Pusan, Korea in 1997. The program will include sessions of invited and contributed papers organized by the indicated committees on the following topics:

- (Science Board) BASS Symposium: *Ecosystem dynamics in the eastern and western gyres of the subarctic Pacific* (invited papers only). Co-Convenors: Richard J. Beamish (Canada), Suam Kim (Korea), Makoto Terazaki (Japan) and Warren S. Wooster (U.S.A.)
- (POC) *Circulation and ventilation of marginal and semi-enclosed seas*. Convenors: Sang-Kyung Byun (Korea) and Christopher N.K. Mooers (U.S.A.).
- (BIO & FIS) *Micronekton and their predators: Distributions, dynamics and sampling problems*. Convenors: Richard D. Brodeur (U.S.A.), Kouichi Kawaguchi (Japan) and Qi-Sheng Tang (China).
- (FIS & BIO) *Models for linking climate and fish*. Convenors: Michio J. Kishi (Japan), Jang-Uk Lee (Korea) and Patricia Livingston (U.S.A.).
- (MEQ) *Environmental impact of aquaculture*. Convenor: Dong-Beom Yang (Korea).
- (BIO & MEQ) *Harmful algal blooms: Causes and Consequences*. Convenors: Roderick Forbes (Canada) and Jae-Hyung Shim (Korea).

Future Meetings

- January 1997: WG 10 Meeting (Fukuoka, Japan)
- May-June 1997: MEQ Practical Workshop (Qingdao, China)
- June 1997: WG 12 Meeting (Nemuro, Japan)
- Immediately prior to PICES VI:
WGs 8, 9 and 11
TCODE

CCCC/IP/EC, MODEL, REX
and BASS

REX Workshop

Early 1998: MODEL Workshop (California, U.S.A.)

June 1998: Okhotsk Sea Workshop (Nemuro, Japan)

SCIENCE BOARD RECOMMENDATIONS

Discussion of Scientific Committee, Working Group and the Implementation Panel reports along with other issues considered led to a set of Recommendations for presentation to Council for approval (see Appendix to Council minutes, Decisions of Council).

Scientific Program

An interdisciplinary session was organized by the Science Board. The following papers were presented and Dr. Shoshiro Minobe won the Best Presentation Award for this session.

Methods and findings of retrospective analysis. Co-Convenors: Drs. Kimio Hanawa (Japan), Steven R. Hare and Robert C. Francis (U.S.A.)

J. Anderson

Climate indicators and salmon survival.

T. Baumgartner

Reconstructing long-term histories of small pelagic fishes of the California current.

R.D. Brodeur, B.W. Frost, S.R. Hare, R.C. Francis & W.J. Ingraham Jr.

Interannual variation in zooplankton biomass in the Gulf of Alaska and covariation with California current zooplankton biomass.

W.G. Clark & S.R. Hare

Decadal scale historical changes in Pacific halibut average weight-at age.

C.C. Ebbesmeyer, R.A. Hinrichsen & W.J. Ingraham Jr.

Timing and consequences of the spring and fall wind transitions along the west coast of North America

- B.P. Finney
Variations in Alaskan sockeye salmon abundance during the past 500 years determined from sediment core analysis
- K. Hanawa
Retrospective analysis of the southern most position of the first intrusion of the Oyashio.
- W.J. Ingraham, Jr. & C.C. Ebbesmeyer
Five decades of surface current variability in the Gulf of Alaska and Bering Sea constructed with the OSCUR model - It's time for some new indices of flow.
- N. Mantua, S.R. Hare, Y. Zhang, J. Wallace & R.C. Francis
A Pacific decadal climate oscillation with impacts on salmon.
- S. Minobe
An oscillation of a period 50-60 years over the North Pacific.
- R.H. Parrish
Wind stress, wind curl, and circulation changes in the North Pacific, 1881-1993

- J.J. Polovina
The spin-down of the subarctic and subtropical gyres in the North Pacific, 1987 to 1995, observed with the parallel ocean climate model. A response to global warming or a 20-year cycle?
- Y. Sakurai
Detection of regime shift in climate change based on annual variability in distribution and catch rates of stagnant and migrant fishes in northern Japan.
- D.M. Schell
Baleen isotope ratios provide a decadal record of changes in primary productivity in the Bering Sea.
- G.T. Shen
Corals as climate recording systems.
- D.W. Welch
Patterns of scale growth in British Columbia Pacific salmon, and its relevance to the "Climate Change and Carrying Capacity" problem

Endnote 1

- Makoto Kashiwai
(Chairman, Science Board)
- Patricia A. Wheeler
(Chairman, BIO Committee)
- Qi-Sheng Tang
(Chairman, FIS Committee)
- Richard F. Addison
(Chairman, MEQ Committee)
- Paul H. LeBlond
(Chairman, POC Committee)
- Chang-Ik Zhang
(Chairman-elect, FIS Committee)

Participants

- Other
- Robin Brown
(Chairman, TCODE)
- Warren S. Wooster
(Chairman, PICES)
- William G. Doubleday
(Chairman-elect, PICES)
- W. Doug McKone
(Executive Secretary, PICES)
- Alexander S. Bychkov
(Asst. Executive Secretary, PICES)
- Gennady V. Goussev (Russia)
- Boris N. Kotenev (Russia)
- Satsuki Matsumura (Japan)

Endnote 2

Working Group 5: Bering Sea Final Report

This report was developed out of deliberations of the Bering Sea Working Group at the July 1996 meeting. It contains elements that were in proceedings from earlier meetings, but were further refined in July 1996. It also contains new sections.

In attendance at the meeting were: Prof. Vera Alexander, Prof. Tsutomu Ikeda, Dr. Thomas R. Loughlin, Dr. Loh-Lee Low, Prof. Yoshiaki Maita, Prof. Haruo Ogi, Prof. Kiyotaka Ohtani, Dr. James E. Overland, Prof. Albert V. Tyler (Chairman), and Prof. Terry E. Whitledge.

This report is organized into four sections:

1. A proposal of Bering Sea research concepts for the PICES Organization.
2. Some Principal Scientific Questions on Bering Sea ecosystem function.
3. Preliminary proposals for at-sea and laboratory research activities.
4. Update on the Bering Sea Review volume.

SECTION 1

A Proposal of Bering Sea Research Concepts for the PICES Organization

The Working Group proposes development of a broad outline for research in the near future in the Bering Sea, and more specific development of two areas that focus on dominating physical phenomena in the Bering Sea, and the biological consequences of these phenomena. These two areas each involve aspects of all of the Principal Scientific Questions that the WG developed at an earlier meeting. These questions were further refined at the July 1996 meeting but not changed in their basic precepts.

The subsequent development of the specified research areas is expected to evolve in a way to make use of strengths of other existing programs. Two areas of research will be outlined below in this report. WG 5 also proposed successor Working Groups that would

begin the process of detailed planning for the new research. For the purposes of this report, these groups will be called: (1) the Bering Sea research compilation Working Group, (2) the Bering Sea research implementation Working Group.

The duties of the new Bering Sea research compilation working group would be to find the scope of the research plans of national agencies and universities. The developing new research pressed forward by PICES must in some sense match the scheduling of the existing agency and university programs that will be carried out regardless of the plans supported by PICES. In that way, PICES supported research may be able to draw on the cooperative help of these research efforts. The new Working Group would compile an annotated list of existing and developing programs that will be underway during the next few years, along with information of cruise planning, lab studies, and satellite data analysis with objectives, dates, geographic areas. The aim of the compendium would be to assist in planning the proposed Bering Sea research program. The group would coordinate with TCODE and WG 9 on monitoring. The compendium would contain greater detail than the National Programs listed in PICES Scientific Report No. 4. WG 5 was advised in a preliminary manner about existing programs by JAMSTEC, the Oshoro Maru of the University of Hokkaido, the programs of TINRO in Russia, the work in the eastern Bering Sea by the U.S. National Marine Fisheries Service, and the cruise plans of the RV ALPHA HELIX out of the University of Alaska Fairbanks. During its July 1996 meeting only a few details and specifics were available. We propose the following: 1) the new working group meet once, 2) participants come to the meeting with specific assignments or plans of key universities and government agencies for laboratory and at-sea research programs that will be pursued in the light of existing national

interests and funding. 3) the working group would then develop a report that includes a compilation and explanation of these efforts. New PICES supported research could not afford to lose any possible use of these programs for its new directions and would likely be able to “piggy-back” its research efforts on these existing efforts. Updating of the compendium might be a planned activity of an on-going task group.

The second working group suggested by WG 5 is a research implementation Working Group. The purpose of this second group would be to follow up WG 5 and the Bering Sea research compilation working group to develop an implementation plan for a Bering Sea project. This group should coordinate with the REX Task Team of the CCCC’s Program. The outline of a project called, *Bioclimatology of the Bering Sea*, will be given below.

WG 5 proposes that either one of two focal areas be developed as a PICES sponsored research project. These areas are: (1) Research on water-mass exchange, advection and mixing in the Bering Sea and the influence on bio-productivity, or (2) Research on sea ice dynamics and its influence on bio-productivity. The research problems suggested by WG 5 are detailed in Principal Scientific Questions 2, and 3 (attached). In addition, each focal area links to

the other Principal Scientific Questions (Questions 1 and 4). A general conceptual model has been developed to encompass this research (Fig. 1).

The research problems of the two focal areas are not independent of one another, and are intended as research topics that can serve to generate well-knit research proposals. The suggestion by WG 5 is to focus the research programs on one of two major physical phenomena, and how these phenomena influence bio-productivity, predator-prey relations and fisheries. The work should be carried out as integrated, process-oriented projects that answer questions of decadal-scale changes in physical, chemical, biological and fisheries events. The Bioclimatology Model can be expanded regarding specific forcing functions, physical-chemical responses, and ecological relationships (Fig. 2). The conceptual summary is that meteorological dynamics of atmospheric pressure change, wind and temperature (A) develop changes in sea ice formation (B), including ice residence-time and distribution, and simultaneously to influence water-mass advection and exchange (C). Both B and C in turn influence, in unique sets of processes, primary (D) and secondary productivity (E) and sensitive stages of megafauna of use to humans (F). Topics D, E, and F, of course, have interactions that are not given on this chart.

RESEARCH ON BIOCLIMATOLOGY OF THE BERING SEA

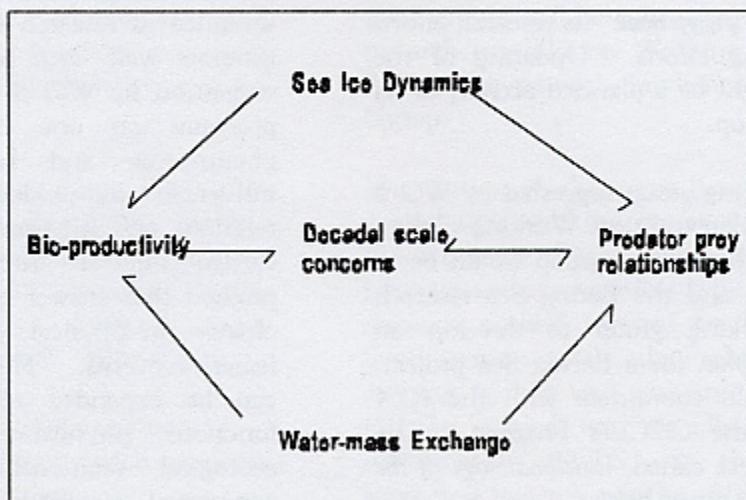


Figure 1. Bering Sea General Model for research planning

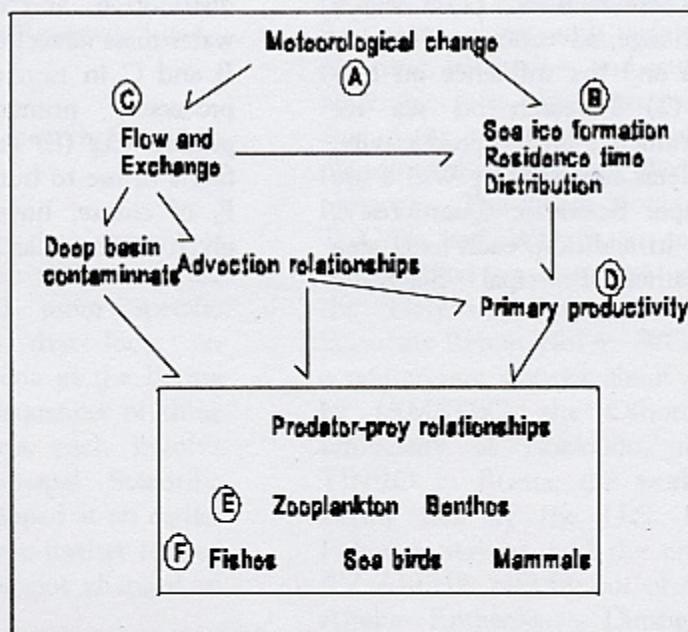


Figure 2. Summary of forcing functions and interactions for research planning

SECTION 2

Some Principal Scientific Questions on Bering Sea Ecosystem Function

Introduction

WG 5 proposes a series of research questions that it considered important for understanding the environmental and ecosystem functions of the Bering Sea. The purpose of the questions is to provide a focus for cooperative inter-national research in the region. As research progresses, it may be desirable to add additional questions or to refine the existing questions.

The WG agreed on three points which provided a common perspective for framing the scientific questions. The first point of consensus was that the abundance of animals in the Bering Sea fluctuated widely. Our work should further understanding of the nature and reasons for such fluctuations. The second point of consensus was to integrate studies of the physical and biotic environment to address biological productivity. The third point was that comparative studies of the Bering Sea and other boreal ecosystems could provide additional insights to high biological productivity in the Bering Sea.

In framing the questions, the WG noted that the identification of ecosystem emergent properties that contribute significantly to Bering Sea productivity as a whole would develop only upon taking a broad view of ecological interactions. The complexity of the system has to do with the number and intricacy of vital links that contribute significantly to ecosystem structure.

To stimulate international cooperative research in the Bering Sea, the working group posed four categories of questioning: 1) broad decadal change and accumulation in the basins, 2) the physics of water mass exchange, 3) sea-ice dynamics, 4) prey-predator relationships. These broad areas can serve to focus research on special environmental features and high biological productivity by member parties of PICES.

1. Decadal Scale Changes

1a. Mechanisms behind decadal scale change

Decadal and possibly centennial scale variability in atmospheric and oceanic physics has been observed; for example, in the surface pressure distribution, in ocean conditions such as sea surface temperature (SST), in sea level, and in sea ice extent. What are the mechanisms whereby these frequencies are determined for the North Pacific? To what extent can the variations be predicted; for example, when will a warm era begin and end? How would the projected global warming affect variability of this scale?

1b. Biological responses to physical-chemical forcing

Variability in atmospheric and oceanic condition appears to have a strong multi-decadal component which is reflected in the abundance of marine organisms including stocks of fish, shellfish, and piscivores. The physical environment appears to alternate between warm and cold eras. It is not known whether the biological sub-system, in response, changes continuously or whether the system varies between two or more quasi-stable states. An example could be an alteration in dominance of shelf production by benthic versus pelagic components of the ecosystem. In eastern boundary current ecosystems, sardine and anchovy dominance seem to alternate. In the Bering Sea, would pollock dominance be replaced by that of some other species? Climate shifts are mediated via biological processes related to survival and productivity - processes that are influenced directly by ocean physics. Mechanisms of biological response to climate change should be examined in laboratory and at-sea research.

2. Water Mass Interchange and Formation of Deep Water

2a. Interchange between the North Pacific Ocean and the Bering Sea

What are the special features of water interchange between the North Pacific Ocean and the Bering Sea through the two deep Kamchatka and Near Straits, and the shoaler straits to the east? It is obvious that North Pacific water plays an important role in the formation of Bering Sea thermohaline structure, especially to the circulation of deep water basins. The North Pacific water masses influence the thermal regime (important to the biological production) of the Bering Sea and impacts the main features and variability (annual and longer term) of Bering Sea currents.

2b. Deep basin circulation

Do lateral and vertical input processes cause the deep Bering Sea to be a significant repository for global deep water? The deep Bering Sea is the terminus of the deep circulation in the Atlantic and Pacific Oceans as evidenced by the gradients of dissolved substances. This sink of the deep ocean flow therefore receives lateral input from other deep ocean basins and also the vertical flux of materials in the open Bering Sea. The pronounced oxygen minimum and enhanced concentrations of dissolved constituents probably results from a combination of changes in physical, chemical and biological fluxes to the deep ocean basin. Perhaps the best location to study questions concerning anthropogenic materials is the deep ocean. Both lateral and vertical input processes could be concentrating contaminants such as chlorinated organics, synthetic organics and radionuclides in the bottom waters. The deep Bering Sea is an important region to investigate the possible results of changes in global ocean circulation.

2c. Interaction between Deep Basin and Shelf Waters - biological and physical

How do the differing biological regimes and transport between the Aleutian basin and the eastern and western shelves contribute to the overall production of the Bering Sea? The Bering Sea shelf has been studied intensely through several programs but the extent of interaction of shelf and deep basin waters is not

well understood. The physical transport of waters, exchange of water across the shelf break through submarine canyons and valleys, shelf break upwelling driven by winds or bathymetrically induced by flows, and the role of eddies should all be given more attention. Significant increases in primary production may result from the enrichment of nutrients through cross-shelf processes. The herbivores of the deep Aleutian basin generally are large and spawn over a February to April period, primarily independent of local phytoplankton bloom conditions. Herbivores on the shelf are small and closely linked to the blooms during May. It appears that pollock make use of both shallow and deep regions in their life cycle. How does the year to year variability in transport onto the shelf contribute to nutrient supply and larval survival? How does the year to year variability in storminess, ice cover, and air temperature regulate growth of herbivores on the shelf?

Investigation of the most intensive Bering Sea Current, the Kamchatka Current, and its relationship to water exchange with the North Pacific Ocean is recommended. The Kamchatka Current influences water mass interchange in two modes: meandering and non-meandering modes. In the meandering mode when the current moves away from the coast and does not influence coastal waters. In the non-meandering mode, it has strong influence on the onshore regime and prevents the large formations of river plumes in the Bering Sea that change vertical stratification due to weak fresh water flux from the coast. Large mesoscale eddies enhance vertical motions and change biological conditions at coastal waters. What are the relationships between the two modes, their frequencies, and other components of water balance as they relate to biological productivity?

3. Sea-Ice Dynamics

3a. Influence of ice dynamics on productivity

What are the effects of year-to-year variations in the maximum southerly extent of sea ice? Specifically, we need to know the effects on the

primary production regime, including the total production during the spring bloom, timing of the spring bloom, duration and intensity. Timing of the spring bloom as determined by sea ice is important to the allocation of nutrients between the benthic and pelagic sectors.

- i. What are the important effects of ice dynamics on reproductive biology of higher trophic level animals? Melting sea ice triggers an early and intense spring bloom, which may be important in satisfying the needs of higher trophic levels. (Note that APPRISE PROJECT clearly showed the importance of timing of the spring bloom and its intensity in the allocation of the products).

The extremely low water temperatures associated with the marginal ice zone may also inhibit spawning of the shelf species that may not be tolerant of such cold water regimes (for example, pollock).

- ii. What are the effects of ice dynamics on zooplankton grazing? Grazing at the ice edge appears to be depressed due to low temperatures and lack of overwintering animals. Cooney and Coyle (1985) found that copepod grazing is low and depressed whereas euphausiid grazing dominates. Thus, much of the primary production may sink to the bottom.

3b. Role of the ice edge in north-south retreat

All work on the ice edge system to date has been done either near the shelf break or near the stationary fronts. Further north over the eastern portion of the Bering Sea shelf, nutrient concentrations are lower and probably limited to the amount regenerated in situ or in the sediments. Here, in shallow waters, the residue of the brief, ice-edge spring-bloom may be quantitatively important to the primary production when it reaches the sediment surface. This question can be addressed by following the retreating ice (along with the ice edge bloom) northwards over the shelf. Remote sensing with

the SeaWiFS sensor can determine the position and extent of the bloom with time. The distribution and activity of phytoplankton within the water column and over the sediment can be evaluated during the ship's return southwards.

3c. Polynyas

The Bering Sea has a number of recurrent, open-water areas along the southward-facing coasts of islands and land masses. These polynyas are recognized as very important for marine mammals and birds, at a minimum providing access to water in winter, and most likely in other ways too. The larger ones, such as the polynya in the Gulf of Anadyr and the St. Lawrence Island polynya, play an important physical role. As major sites of ice formation and export, they produce saline water that is carried south and northward. These brine waters ultimately form deep water in the North Pacific and Bering Basins. This water moves through the Bering Strait to contribute significantly to the halocline of the Arctic Ocean.

While polynyas are assumed to have distinct biological regimes, this has not as yet been examined for polynyas in the Bering Sea. These wind-formed coastal polynyas differ from those found elsewhere, with the possible exception of polynyas in the Sea of Okhotsk. The western Bering Sea polynyas are found in a region characterized by high nutrient import and high summer primary production. The interaction of the winter-early spring regime with the subsequent summer regime needs to be examined in relation to the biological consequences.

4. Biology of prey-predator relationships

4a. Natural prey-predator links

- i. What are the seasonal changes in prey-predator relationships? Our present understanding of predator-prey relationships in the Bering Sea is limited to when the area is ice free. During the ice season, some top-level predatory species emigrate

south to warmer waters, e.g., gray whales, northern fur seal, while others move into the area (pagophilic pinnipeds). The seasonal prey-predator links have to be identified. Impacts of seasonal predators on prey abundance and recruitment are unknown and should be a subject of priority coordinated research.

- ii. What are the key nodal species in the food-web? From empirical directions and food web theory it is evident that a small number of species at an intermediate position in the food web seem to have an inordinate influence on ecosystem productivity. In the Bering Sea we need to identify the critical food-web nodes, and explore their extent and prevalence. Is there evidence for seasonal change in the nodes over annual production cycle? Do nodal species have properties in common other than their position in the food web? What are the causes and consequences of interannual variation in nodal species in food webs?
- iii. Surveys and data analysis are needed on non-commercially exploited fishes, cephalopods, and other macro-invertebrates. The abundances and distributions of non-commercially exploited fishes and cephalopods in the Bering Sea are not well known. Some of these species, particularly cephalopods and meso-pelagic fishes, may be important prey and crucial links to the survival of many predatory species. The status and trend of these non-commercially important species should be determined by assessment surveys conducted in conjunction with those for commercially important fish species.
- iv. Long-distance, migratory animals such as whales and seabirds enter the Bering Sea from neighboring and remote ecosystems.

Some species use the region for reproduction, others as a winter area. What role do these highly mobile animals play in the transfer of energy and materials between regions?

4b. Commercial fishing as predator

What has been the effect of commercial fisheries in the Bering Sea on high-level trophic predators, particularly marine mammals and sea birds?

- i. How does fishing change the food web? Commercial fisheries change the age structure and reduce the abundance of targeted species, even when managed exactly according to recommended, single-species exploitation rates. Secondary effects of this exploitation may occur through predator-prey interactions and may or may not have changed the availability of commercial and non-commercial prey for marine mammals and birds. As an example of cost-effective research, the WG proposes that historical survey data and food habits information be analyzed for evidence of changes in prey and its utilization.
- ii. Comparative ecosystem studies: The Bering Sea marine mammal and seabird fauna has generally declined since the late 1960's, coincident with the increase in commercial groundfish fisheries. Conversely, pinniped populations in the California current ecosystem have significantly increased during the same period, as have commercial fisheries. A comparative approach to the study of each system will identify similarities and differences between the two systems and ultimately the mechanisms that determine marine mammal and seabird abundance and trends.

SECTION 3

Preliminary Proposals for At-Sea and Laboratory Research Activities: A Bio-Climatology Program to be Considered for Sponsorship by PICES

The proposals outlined here are preliminary and are given only as an indication of the directions of planning envisioned by WG 5. Proposals are for at-sea research programs on two major physical phenomena of the Bering Sea in relation to the Principal Scientific Questions, and biological productivity. Fleshing out of the physical, chemical, biological and fisheries aspects of these proposals would possibly be a responsibility of a new Bering Sea research implementation working group.

1. Water-Mass Interchange and Formation of Deep Water

1a. Advection and interchange of water masses

This program is keyed to Principal Scientific Question 2a on Water Mass Interchange. Recommended research measures are:

- i. Pressure gauges should be deployed across the passes to measure time variability of integrated transport.
- ii. Current moorings should be placed to monitor the inflow and outflow through each of the significant passes in the Aleutian Island Chain.
- iii. Acoustic Doppler current profilers (ADCP) should be deployed in the passes to look at the detailed flow structure.
- iv. Measures should be made of the transport of zooplankton along with temperature, nutrient and zooplankton profiles.

1b. Deep basin circulation

This program is keyed to Principal Scientific Question 2b.

- i. High precision water mass identification using standard hydrographic survey instrumentation should be made. This includes a detailed water mass analysis of dissolved constituents.
- ii. Special emphasis should be placed on anthropogenic tracers such as CFC's. An accelerator mass spectrometer could be used to produce ^{14}C data. Other isotopic techniques should be considered as well for aging the residence time in the deep basin.
- iii. Additional studies should be undertaken as well to complete the elemental budgets of silicon and carbon, and to compare with circulation estimates using physical parameters.

1c. Interaction between deep basin and shelf waters - biological and physical

The objective is to explore the mechanism for nutrient supply onto the shelf of the eastern Bering Sea, including the interaction of vertical mixing on the slope and an unknown mechanism for intermittent flux onto the shelves. Measurements include the sequential deployment of drifters at the beginning of the Bering Sea slope Current and the Kamchatka Current, time series measurements of nutrients from in-situ instrumentation, and fluorescence sensors, as well as bottom mounted ADCP measurements for vertical profiles of mixing intensity.

2. Dynamics of Ice Formation and Influence

This program is keyed to Principal Scientific Question 3.

2a. To determine the timing and intensity of the spring bloom

Deploy fluorometers to measure the resulting rain of particulates from the plankton, sediment traps. These would be mounted on moorings near the ice edge and inside the ice during early spring.

2b. Research cruises to follow the retreat of the ice

Develop a sampling series to monitor particles and pigments in sea water via a fluorometer, and a flow cytometer. Carry out a phytoplankton species analysis, zooplankton grazing - dilution experiments and hydro-acoustics to determine the euphausiid distribution and abundance.

2c. Series of a stable isotope analyses

Using ^{15}N to determine the proportion of regenerated versus new nutrients.

2d. Ship-board surveys of benthic species abundances

Sample distribution of infauna species to confirm the role of sedimentation in enriching the bottom productivity.

2e. Remote sensing as an analysis of the spring bloom

Analyze changes in ocean color through satellite sensing. This work would include computer modeling of parameters estimated via at-sea sampling to validate the results of remote sensing and to interpolate the productivity field. Concurrent ship-board measurements should be carried out in the Navarin-Anadyr area and as well in the eastern Bering Sea region.

2f. Program on the role and formation of polynyas

This research would include research cruises using an icebreaker, combined with aircraft surveillance of the polynyas. The objective would be to investigate why these structures are critical to pinniped herds. Stomach contents and scat analysis would be carried out along with hydrographic surveys. Foraging ecology of the animals would be studied using electronic transponding tags to measure dive duration and depth along with physiological responses.

2g. To estimate the volume of brine water formation

Rate of brine formation is relevant because of strong concern about the effects on productivity of the annual formation of the "Bering Sea cold pool". Direct heat flux would be measured by deploying vertical thermistor chains in the water column to look for the sinking of surface cooled water.

2h. Dissolved constituents of polynyas

Carry out measures of the dissolved constituents, e.g., lindane and CFC'S. These would be sampled by in-situ pumps. The aim would be to investigate the role of the polynyas in the deposition and vertical transport of anthropogenic materials.

2i. Effect of drift ice on the cold pool

To estimate the effect of drift ice on the formation of southern part of cold pool, it would be valuable to measure the amount of drift ice coming on the southern shelf. An ADCP mounted upward on the bottom will measure thickness of drift ice and also currents. Deploying vertical thermistor chains will measure the thermal structure of the water column under the drift ice.

SECTION 4

Update on the Bering Sea Review Volume

THE BERING SEA: PHYSICAL, CHEMICAL, AND BIOLOGICAL DYNAMICS

A volume to be published under the auspices of PICES and edited by members of the PICES Bering Sea Working Group, Dr. Al Tyler, Chairman

Principal Editors:

Dr. T. Loughlin, National Marine Fisheries Service, Seattle, WA, U.S.A.

Dr. K. Ohtani, Faculty of Fisheries, Hokkaido Univ., Hakodate, Japan

DRAFT CONTENTS (October 1996)

Preface -- purpose for volume, its audience, and a short review of past volumes, workshops and symposia by T. Loughlin and K. Ohtani.

Foreword -- Warren Wooster, PICES

I. Description of Bering Sea

A. Physical Dynamics

Section editors:

Dr. S. Gladyshev, POI, Vladivostok, Russia

Dr. J. Schumacher, PMEL, Seattle, WA, U.S.A.

1. Review of the physical characteristics of the Bering Sea by Stabeno, Gladyshev, Shumacher, and Ohtani
2. On climatology and ice in the Bering Sea by Niebauer, Bond, Yakunin, and Plotnikov.
3. The Aleutian north slope flow by Reed and Stabeno.
4. Bering Sea tides by Kowalik.
5. Stratification and mixing on the Bering Sea shelf by Overland, Salo, and Kantha.
6. On water masses and vertical distributions in the Bering Sea by Luchin, Menovshchikov, Lavrentiev, and Reed.
7. Water masses and structure of the western Bering Sea shelf by Khen, and Salo.
8. Variability and influence of the physical environment on the Bering Sea ecosystem by Schumacher and Alexander.
9. On the physical environment of the Pribilof Islands by Salo, Stabeno, Schumacher, and Flint.
10. On the importance of variability and unresolved questions by section authors.

B. Chemical Distributions and Dynamics

Section editors:

Dr. T. Whitledge, Univ. Texas, Port Aransas, TX, U.S.A.

Dr. Y. Maita, Hokkaido University, Hakodate, Japan

Dr. V. Sapozhnikov, VNIRO, Moscow, Russia

11. Review of the chemical characteristics of the Bering Sea by Maita, Sapozhnikov, Whitledge, and others.

12. The influence of mesoscale eddies on the vertical structure of nutrient by Sapozhnikov.
13. The results of the World Ocean Circulation Experiment (WOCE) in the Bering Sea by Warner and Roden.
14. A silica budget and renewal process for the deep Bering Sea by Whitledge and Tsunogai.
15. The influence of contact zones on chemical properties by Maslov and others. (This chapter was deleted after the July meeting in Japan; Dr. Whitledge is searching for a replacement chapter.)
16. Variability of components of the carbonate system and dynamics of inorganic carbon by Nedashkovskiy, Sapozhnikov, Sagalaev, Isaeva, and Shevtsova.
17. Behavior of chemical substances and marine production by Shiimoto.
18. Annual variations of organic constituents in the deep basin by Maita, Yanada, and Takahashi.
19. The distribution and probable pathways of chemical contaminants by Tsyban and others.
20. Variability and unresolved questions by Whitledge and coauthors.

C. Biological Dynamics

Section editors:

Dr. R. Francis, Univ. Washington, Seattle, WA, U.S.A.

Dr. T. Ikeda, Hokkaido Univ., Hakodate, Japan

Dr. R. Beamish, Pacific Biol. Station, Nanaimo, British Columbia

21. Review of the biological characteristics of the Bering Sea by Francis, Ikeda, Beamish, and coauthors.
22. Specific size structure, numbers, and biomass of phytoplankton in shelf and open waters of the Bering Sea related to physical and chemical processes by Sukhanova, Semina, and Ventzel.
23. How do hydrophysical fronts influence phytoplankton and zooplankton community structure in shelf and shelf-break areas of

the Bering Sea? by Flint, Sukhanova, Emelianov, and Pojarkov.

24. Population ecology of walleye pollock, Theragra chalcogramma: colonization patterns in an opportunistic species by Bailey, Nishimura, Powers, Wilson and Williamson.
25. Ecology of groundfish in the Bering Sea, with special reference to food habits by Mito, Nishimura, and Yanagimoto.
26. Modeling and management of the Bering Sea Ecosystem by Francis, Bollens, and Merrick.
27. The role of ice in organizing the Bering Sea ecosystem by Wyllie-Echeverria and Ohtani.
28. Western Bering Sea groundfish by Zolotov
29. Forage fish in the Bering Sea: Distribution, abundance trends, and species associations by Brodeur, Melnikov, Walters, and Wilson.
30. Distribution and ecology of mesopelagic fishes and cephalopods by Sinclair, Percy, Balanov, and Kubodera.
31. Is northern fur seal migration dependent on oceanography? by Loughlin, Ingraham, Baba, and Robson.
32. Climate change, carrying capacity, and marine bird populations of the eastern Bering Sea by Hunt and Byrd.
33. Western Bering Sea bird ecology by Ogi.
34. The role of salmon in the Bering Sea ecosystem by Beamish and others.
35. Variability and unresolved questions by section authors.

D. Uses of the Bering Sea

Section editors:

- Dr. L.L. Low National Marine Fisheries Service, Seattle, WA, U.S.A.
Dr. V. Burkanov, Kamchatryvobod, Petropavlovsk, Russia

36. Fisheries: Past present and future by Low, Nishimura, and Zhang
37. History of Japanese groundfish fisheries in the Bering Sea by Mito, Nishimura, and Yanagimoto.
38. Petrochemical exploration and development by C. Cowles and a Russian.
39. Native uses of the Bering Sea by R. Wolfe and a Russian.

II. Synopsis of major research programs

Section editor:

Dr. V. Alexander, Univ. Alaska, Fairbanks, AK, U.S.A.

40. Introduction by Alexander.
41. FOCI by Macklin
42. APEX by Pease
43. MIZEX by Muench
44. BERPAC by Tsyban
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47. PROBES by Hood
48. PREFLA by Fukuchi
49. NPAFC by Low and Dahlberg.
50. National research efforts coordinated by Traynor.

III. Summary, conclusions, recommendations

(51) by Dr. A. Springer, Univ. Alaska, Fairbanks, AK, U.S.A.

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Appendix II. Related questions and objectives found in PICES CCCC study plan and U.S. GLOBEC Bering Sea proposal.

Endnote 3

Working Group 9: Subarctic Pacific Monitoring Report of First Meeting

I. Introduction

The first meeting of the PICES Working Group 9 was held at the Pacific Marine Environmental Laboratory/NOAA in Seattle, Washington on August 1-3, 1995. Working Group members present were Drs. Ichio Asanuma and Kimio Hanawa (Co-Chairman) of Japan, Drs. Charles Miller and Bruce Taft (Co-Chairman) of the U.S.A., Dr. Lev Bocharov of Russia and Drs. David Welch and C.S. Wong of Canada. Working Group member Prof. Qi-Sheng Tang of the People's Republic of China was unable to attend the meeting. The list of attendees is included in Appendix 1.

Terms of reference of WG 9

The primary responsibility of WG 9 is to plan "... the monitoring activities in the PICES area, including physical, biological and chemical measurements." Monitoring here is understood to be systematic and continuous measurements taken over a sufficiently long time to measure physical and chemical climate change and the related ecosystem response.

It was decided that the first WG meeting would focus on the design of an observational system to support the PICES-GLOBEC International Program on Climate Change and Carrying Capacity (CCCC). This program addresses the question of how climate change affects ecosystem structure and productivity of key biological species at all trophic levels in the open ocean and coastal regions of the subarctic Pacific. The time scales of the relevant variability ranges from interannual (El Niño) to decadal (regime shift) to centennial. Annual variability is considered to be noise which must be properly sampled so it does not become aliased into longer climate time scales.

Previous PICES Monitoring Discussions

There was a PICES-STA Workshop on Monitoring Subarctic Pacific Ocean held in Nemuro, Hokkaido, Japan on October 22-23, 1994. Seven papers were presented and a PICES-STA pre-publication document containing drafts or abstracts of the papers is available from the PICES Secretariat. The individual papers are relevant to the work of WG 9. The Workshop did not make specific recommendations on the design of a monitoring system for the subarctic Pacific.

Another source of relevant information is the report of WG 5 of the US GLOBEC Climate Change and Carrying Capacity Planning Meeting held in Seattle, Washington April 19-20, 1995 (U.S. GLOBEC, 1995). WG 5 considered the question "What are the technological impediments to measuring the effects of climate change on the carrying capacity?" They compiled a list of technologies, noting their advantages and disadvantages, which could be used in a subarctic monitoring program.

Relation to international planning efforts

The design and implementation of the monitoring program in support of PICES will coincide with the international planning efforts which will address the need for a global climate monitoring system. The Ocean Observing System Development Panel (OOSDP) has formulated "... a conceptual design for a long-term, systematic observing system to monitor, describe, and understand the physical and biogeochemical processes that determine ocean circulation and the effects of the ocean on seasonal to decadal climate changes and to provide the observations needed for climate prediction" (OOSDP, 1995). The implementation of the recommendations of the OOSDP

will be carried out under the guidance of the newly appointed Ocean Observations Panel for Climate (OOPC) (Neville Smith, Chairman). Plans for monitoring in PICES should be communicated to this Panel so that the PICES observations are well coordinated with the overall plan. It would be very difficult to obtain support at the national level for the PICES monitoring program unless it was seen to complement the Global Ocean Observing System (GOOS).

II. Existing Subarctic Monitoring Programs

In discussion of the issues of monitoring the subarctic North Pacific, a brief review of the present monitoring activities was undertaken. The list, which was created at the meeting, is not presumed to be exhaustive but could serve as a basis for producing a more complete future listing. Except for sea-level gauges, the material is organized by country supporting the monitoring. The existing sea-level gauges are dealt with in a separate section. Only programs that are presently funded, and for which there is an apparent commitment to future support, are listed.

A. Japan

1. Observations along repeat lines (coastal and offshore), *J. Fisheries Agency* (1964 --> ongoing).
Measurements: T, S, O₂, surface current, water color, plankton; 12/yr.
Location: 46 40-mile long sections normal to coastline of main islands of Japan.
2. Surveys of fishing and spawning grounds (commercially important species), *J. Fisheries Agency* (1970 --> ongoing).
Measurements: fish and plankton samples, CTD or BT; 2/yr.
Location: Japan Sea, east of Tohoku and Hokkaido, Kuroshio and adjacent areas south of Japan.
3. Meridional hydrographic sections, *J. Meteorological Agency* (1967 --> ongoing).

Measurements: T, S, O₂, CFCs, currents, nutrients, DIC, alkalinity, dissolved organic carbon and nitrogen, zoo-/phytoplankton, pH, chlorophyll-*a*, phaeophytin, water transparency and color, marine pollution; 2/yr.

Location: 137°; 155°E; sections extend from 33°N to the equator.

4. Meridional hydrographic section, *J. Maritime Safety Agency* (1984 --> ongoing).
Measurements: T, S, O₂, surface current, marine pollution; 1/yr.
Location: 144°E; section extends 33°N to equator.
5. Surveys of Kuroshio/Oyashio and Japan Sea region, *J. Maritime Safety Agency* (1956 --> ongoing).
Measurements: T, S, O₂, surface current; 4/yr.
Locations: sections normal to coast and meridional east of the islands; sections 200-300 km long.
6. Voluntary Observing Ship lines, *Science and Technology Agency* (1990 --> ongoing).
Measurements: XBT; 12/yr.
Location: south of Japan.
7. Ocean data buoy, *J. Meteorological Agency* (1970 --> ongoing).
Measurements: 13 meteorological and oceanographic variables including ocean temperature at 1, 50 and 100 m.
Location: Sea of Japan.

B. South Korea

Coastal transects around peninsula (???? --> ongoing).

Measurements: T, S, O₂, surface current, water color, plankton; 12/yr.

Locations: 40-mile sections normal to coastline.

C. Russia

At the present time there is not a Russian

monitoring program in the Subarctic Pacific. There are about 17 research cruises per year in the Bering Sea, Okhotsk Sea, and off the Kamchatka Peninsula but these cruises are designed to examine processes and not long-term climate change. There is a rich data base of climatic surveys from the past period when there were 75-80 cruises per year. Work is now being done to prepare these data for international exchange.

D. U.S.A.

General

The U.S.A. has supported deployment of Expendable Bathythermograph (XBT) probes in the subarctic Pacific during the World Ocean Circulation Experiment (WOCE). The TRANSPAC measurements (PX 26) and the observations along lines PX 37 and PX 38 have been supported since 1990. It is not yet certain yet whether support will extend beyond the end of WOCE (1997). An XBT/XCTD program is under consideration as a future component of GOOS.

Alaska

1. Fisheries observer program (1989 --> ongoing).
Measurements: adult fish and marine mammal population size and age composition (no physical data); sampling during fishing season.
Location: Bering Sea and Gulf of Alaska.
2. Recurring fishery and CTD surveys of Bering Sea (1993 --> ongoing).
Measurements: acoustic measurement of larval, juvenile and adult fish populations; CTD surveys of water properties (1/yr in spring).
Location: shelf/slope region of eastern Bering Sea.
3. Array of 3 instrumented moorings (1995 --> ongoing).
Measurements: T, S, and current profiles,

SST, wind, fluorometry; hourly data.
Location: shelf/slope region of Bering Sea.

4. Larval surveys of Shelikoff Strait (1985 --> ongoing).
Measurements: larval pollock population size; occasional CTD casts; 1/yr in spring.
Location: western end of Shelikoff Strait.
5. Instrumented ferry *T/V Keystone Tonsina* (1995 --> ongoing).
Measurements: SST, SSS; 4/yr.
Location: sea route Anchorage - Honolulu.
6. Resurrection Bay station (1970 --> ongoing).
Measurements: CTD casts; 12/yr.
Location: CTD station at 60°N, 149.5°W (246 m depth).
7. Monitoring of transport through passes in Aleutian Is. chain (1993--> ongoing).
Measurements: CTD (2/yr) ; bottom pressure gauges.
Location: Amutka and Unimak passes.
8. Alaskan Stream cross-sections (1990 --> ongoing).
Measurements: ADCP velocity section (1-4/yr).
Location: Shumagin Is. to Shelikoff Strait.

West Coast

There are no known monitoring activities in the area north of 35°N; CCOFI monitoring activities do not extend north of Monterey, California.

E. Canada

1. La Perouse Program (1985 --> ???).
Measurements: lower and higher trophic levels; ecosystem response (C, N, SiO₄, sediment traps); 4-5 plankton surveys per year at 10-15 sites; 5-8 CTD surveys per year with 4-5 CTD lines and 1-2 current-meter moorings.
Location: Continental margin off southwest

- Vancouver Island (48°-50°N, 125°-128°W).
2. Line P and Station P (1955 --> ongoing).
Measurements: T, S, O₂, nutrients, chlorophyll-*a*, pCO₂, productivity, CFCs and sediment traps; 3-4 /yr.
Location: 50°N, 145°W.
 3. *M/V Skaguran* Joint Canada-Japan VOS program (1995 --> ongoing).
Measurements: T, S, O₂, chlorophyll-*a*, nutrients, zooplankton (1996 start); 10/yr.
Location: sea-route Vancouver-Tokyo.
 4. COPRA program (1989 --> ongoing).
Measurements: zooplankton and CTD data collected at 14 stations; total of 70-100 opportunistic samples/yr.
Location: Vancouver Island - Queen Charlotte Sound area.
 5. Lighthouse and coastal station data (1935 --> ongoing).
Measurements: SST, SSS; daily data.
Location: 16 sites.
 6. Offshore buoys: (1986 --> ongoing).
Measurements: SST, air T, wind velocity, atmospheric pressure; hourly data.
Location: 14 off west coast.

F. Sea-Level Gauges

There is a subarctic N. Pacific sea-level monitoring array of 52 *operational* sea-level gauges (see list in Appendix 2). An operational sea-level gauge is defined as having submitted data to the Permanent Service for Mean Sea Level within the last four years. Coverage is weakest in the high latitudes of the northwestern Pacific where there are only three gauges north of 45°N and west of the International Date Line.

G. Satellite Coverage

Because of atmospheric conditions not all satellite sensors are useful in the subarctic N. Pacific. In particular infra-red measurement of

SST and ocean color measurements are of limited applicability. Radar altimeter, scatterometer (wind velocity) and SSM/I wind speed measurements are presently being made from existing platforms. Altimeter measurements are useful for climate studies up to 63°N. At higher latitudes the annual signal is significantly aliased by the tides, which reduces their usefulness for climate studies. Scatterometer and SSM/I wind measurements are of good quality throughout the subarctic region. Prospects for maintaining these measurements are good, i.e., there is a sequence of planned launches of sensors through the end of the century. However, PICES should lend their support to efforts to insure continuing funding support for these vital measurements.

H. Summary

The activities, which have been singled out as components of the present monitoring of the subarctic Pacific, constitute an impressive array of measurements. The time series that have the longest duration are the sea-level measurements; 5% (21%) of the records were initiated before 1910 (1950). Hydrographic data have been systematically collected in waters adjacent to Japan since the mid-1950s. In the eastern N. Pacific Ocean Station Papa hydrographic sampling began in 1952. There is a serious lacuna of sampling in the high latitudes of the subarctic western Pacific due to the recent cessation of ocean climate measurements by the Russian far-eastern laboratories. A number of time series of measurements have been started in the mid-90s in Alaskan waters but it remains to be seen whether they will be continued long enough to contribute to climate studies.

It is often not clear what frequencies of variability can be reliably estimated from the data that are being collected. There are few long time series with sufficient time resolution to estimate the frequency spectrum and the amount of aliasing of the frequencies that could occur, i.e., interpretation of inadequately sampled high frequencies as low-frequency fluctuations. It is often difficult to use principles of array design to

guide the choice of a sampling scheme because the characteristics of the variability are not well known. Riser (1995) has presented an interesting discussion of the use of statistical techniques to design observational arrays. Wherever possible these techniques should be used to evaluate the consequences of particular sampling schemes.

III. New Monitoring Initiatives in Subarctic Pacific

The WG identified a small number of observational programs that should be considered for implementation in the subarctic Pacific. Because this was the first meeting of the WG, a full discussion of these ideas was not possible. It is also recognized that it is far from an exhaustive set of proposals. At the next meeting a careful analysis of these particular ideas will take place as well as consideration of additional ideas.

A. Time Series Measurement of Primary Productivity and Zooplankton Stocks

Time-series measurements of primary productivity and zooplankton stocks in the oceanic sector of the subarctic Pacific are required to better understand the dynamics of the interaction between changes in the physical-chemical environment and the variability of plankton populations. A long data series gathered from weatherships at Ocean Station P (50°N, 145°W) from 1952 to 1981 have given us some preliminary insights into subarctic production processes in the southern reaches of the Gulf of Alaska. The weathership data show that phytoplankton stocks are nearly constant through the year with chlorophyll levels varying between relatively narrow limits of 0.15 to 0.75 mg/m³ (Wong et al., 1995). While there is a strong annual cycle in primary productivity (measured as ¹⁴C uptake), there is not an annual cycle of phytoplankton stocks. Moreover, major nutrients (NO₃, PO₄, Si(OH)₄) are not depleted in any season. There is some understanding of how this balance between plant growth and plant loss (primarily through grazing) operates

(Miller, 1993). One of the seasonally variable features of the system is the net-caught zooplankton which are the major predators of the plants. Weathership data show annual and interannual variation; interannual differences are of the same general order (2 fold) as have been attributed to the post-1976 regime shift. There were never suitable data at Station P for showing whether variations in zooplankton stocks are related in some direct fashion to variations in primary productivity.

It is no longer considered logistically reasonable to place manned platforms at central ocean sites for oceanographic or other purposes. However, it is now possible to deploy instrumented moorings capable of providing us with well-calibrated data which are interpretable as phytoplankton standing stock, primary productivity, nutrient concentration and zooplankton biomass. Because of the severe weather encountered in the subarctic Pacific, the moorings must be large and very strongly built. High sea-states, strong winds and depths in excess of 4 km will place great demands upon the mooring technology. Nevertheless, it can be done. It would be desirable to have the time series extend over 10 annual cycles to obtain a good estimate of the annual variation. It would also be very desirable to sample through at least one climate regime shift.

Instrumented moorings can provide the following measurements:

Measurement Technology

1. wind velocity, air temperature anemometer, thermistor
2. temperature profiles thermistor chain
3. salinity at several depths temperature/ conductivity sensors
4. phytoplankton stock as chlorophyll, fluorescence probes chlorophyll/ phycoerythrin ratio
5. light field solar radiation/transmissometer
6. primary productivity indices flash fluorescence
7. zooplankton biomass and multifrequency acoustic sensor size distribution

Site selection is open to debate. However, a best single site might be either (1) Ocean Station P, because of its record of historical data, or (2) close to the center of the Gulf of Alaska dome (location of maximum shoaling of density isopleths). One of the disadvantages of locating the mooring at either of the above sites is that they are near the node of the Empirical Orthogonal Function of SST which best represents the subarctic El Niño response (Tanimoto et al., 1993). The implication is that the important El Niño signal may be a minimum there and difficult to measure. PICES will benefit more fully from monitoring moorings if they can be placed at a modest number of sites instead of just one. The proposed list of sites (below, locations plotted on Fig. 5) provides a comparison of the traditional Station P site with the peak of the Gulf of Alaska dome and a comparison of the variability in the east and west portions of the subarctic gyre (very different physical conditions). The western gyre is expected to have higher production rates and greater zooplankton biomass. A review of available data is needed to establish expected levels of chlorophyll, productivity and zooplankton biomass for the western gyre.

Eastern Gyre

Ocean Station P 50°N, 145°W

Gulf of Alaska dome 53°N, 150°W

Western Gyre 52°N, 165°E

Ideal moorings should telemeter data on a regular basis via satellite. This will keep the scientists continuously informed of their performance, thereby enabling timely repair visits. Data also must be recorded aboard the mooring in case a breakdown only involves the communications link. Because the moorings will be large, they will be navigational hazards, so they must be equipped with radar transponders, beacon lights and possible guard buoys. Their positions must be announced through notices to mariners on a regular basis. Development and testing of sensors and systems could be done on existing Canadian weather buoys moored near the 200 m isobath in the eastern N Pacific.

B. Heat Content and Freshwater Variability of Subarctic Pacific

Heat content

Measurement of the heat content of the upper ocean (vertical profile of temperature) provides a basis for determining a number of critical aspects of climate change in the ocean. Some examples of uses of these data are the description of the change of oceanic conditions which effect the distribution of organisms (particularly zooplankton), such as movements of water masses and ocean fronts and the depth and temperature of the mixed layer, the large-scale ocean circulation and propagation of Rossby waves (one of the primary responses of the ocean to atmospheric forcing). At the present time, the most practical way to monitor the heat content is by Expendable-Bathythermograph (XBT) measurements from Voluntary Observing Ships (VOS). The TOGA/WOCE XBT/XCTD Program Planning Committee (TWXXPPC) has undertaken to design and maintain a global VOS program to monitor the heat content variability of the world oceans on climate time scales.

The present TOGA/WOCE XBT monitoring network includes three XBT lines in the eastern N Pacific that cut across the circulation (PX 14, 37, 38, 47). These lines are especially valuable because they provide indices of the subarctic circulation and the California Current (PX 37). It is very important that the sampling along these lines extend beyond WOCE.

A region of the northern N Pacific within the PICES area, roughly from the southern Bering Sea to about 35°N, has been monitored from the early 1970s. This monitoring activity has been supported by the U.S.A. under the "TRANSPAC" program: it has been managed by NOAA and financially supported by the US Navy. The XBT data accumulated in this program have been used to describe the large-scale thermal structure and have provided many insights into the nature of the variability. For example, Rossby wave propagation was

observed in the North Pacific Current (White, 1982), characteristic behavior of the paths of the Kuroshio and the Kuroshio Extension were described (Mizuno and White, 1983) and variability in the heat content of the Kuroshio Extension was shown to be associated with 1982 ENSO event (White and He, 1986).

Recently, considerable attention has been focused on the decadal and interdecadal changes of atmospheric and oceanic conditions. In the northern N Pacific a large change (regime shift) in the distribution of SST was observed in the mid-1970s (Tanimoto et al., 1993). This regime shift is clearly expressed in Fig. 1, which shows the pattern and time variation of the leading mode of the empirical orthogonal function (EOF) analysis for low-pass filtered SST fields with periods longer than 60 months. From an analysis of upper-ocean thermal data, primarily XBTs, it was found that there was a corresponding change in heat content (Watanabe and Mizuno, 1994) as well as a temperature decrease of North Pacific Central Mode Water (Yasuda and Hanawa, 1995). The XBT measurements show that the circulation was effected as well as the surface conditions.

Unfortunately the U.S. Navy stopped funding the TRANSPAC program in 1993 resulting in a decrease of the number of XBT measurements. In 1992 approximately 3,500 XBT probes were deployed in the TRANSPAC area. In subsequent years the number of XBTs deployed dropped to 2,000 in 1993 (Fig. 2) and 1,500 in 1994. If this trend continues, the density of observations will become inadequate for analysis of climate variability. TWXXPPC has already recommended the establishment of a TRANSPAC XBT pool similar to the TOGA XBT pool. PICES should support this idea.

Freshwater

In most of the subarctic region the density distribution is governed by the salinity distribution. Knowledge of the salinity distribution is required to provide accurate

estimates of the geostrophic transport. In addition the salinity is a very important indicator of climate change in the ocean. In the subarctic it is influenced by the interactions of ice, ocean and atmosphere. Variability of salinity influences the formation of near-surface water masses and is a key to understanding many aspects of the circulation. For these reasons the WG 9 will consider the design of a sampling program to monitor the near-surface salinity distribution in the PICES area. Deployment of Expendable-Conductivity-Temperature-Depth (XCTD) probes on voluntary observing ship XBT lines is a possible approach to obtaining these data in the eastern Pacific.

C. Salmon Scales as Measures of Productivity

The various species of Pacific salmon spend one or more years in the ocean before returning to their home rivers to spawn. Although the precise migrations of salmon through the ocean are unknown, the annual rates of growth experienced by salmon are recorded in their scales. There are large variations in the size of salmon over time (Figs. 3a, b). These time series of growth rates index changes in the productivity of lower trophic levels which, depending on the species of salmon, reflect changes in the abundance of zooplankton and squid which cannot be obtained using conventional sampling gears.

As with any index, the interpretation of the changes in growth will require care. Although the linkage of such indices to ocean productivity may not be clearly understood, they do provide a measure of something that directly effects fish productivity.

Archives of salmon scales exist in almost all Pacific rim countries, and provide the potential to develop detailed records of ocean growth dating back many years. The scale archive for Bristol Bay, Alaska sockeye salmon extends back to about 1910, well before the last period of high salmon production in the 1930s. Although most other scale archives are of more

modest length, they provide a means to index ocean productivity for the last 4 or 5 decades.

Studies of salmon scales are attractive because the relatively short life span of Pacific salmon and their precise homing ability simplifies the analysis of growth changes and provides statistical replication. However, salmon spend time in both coastal and offshore waters, and therefore integrate ocean conditions over rather large areas. The potential to use scales from other fish species should also be examined. Herring are coastal fish whose scales are readily useable, but also are rather wide-ranging. Rockfish are also coastal, and appear to be territorial and quickly return to their home territory even when displaced large distances (Carlson et al., 1972, 1995). Although, rockfish scales are difficult to age, the potential exists to measure annual rates of growth from either scales or other hard parts from fish sampled from a fixed coastal location, thereby providing an "Eulerian" measure of growth which does not confound area and time. Development of such time series would provide information on variations in ocean productivity in coastal environments similar to what the salmon time series can provide for offshore and coastal environments.

A monitoring program focussed on the growth recorded in salmon scales has several attractive features for PICES. Salmon are an important component of the fisheries of most member nations. Sampling programs already exist in most areas of the Pacific rim, and these programs can be strengthened or extended at relatively little cost. The ability to measure annual rates of growth for individual fish and individual stocks also provides a measure of statistical replication rare in oceanographic studies. Measuring approximately 80 scales per year provides a very detailed record of annual variation in growth with a statistical reliability that would be impossible to match in studies of survival. These measures of growth can then be related to changes in a wide range of oceanographic conditions, and can serve as an index of how those aspects of the productivity of

the subarctic Pacific affecting salmon growth have changed over this century.

D. Electromagnetic Measurements of Transport Through Kamchatka Strait

The circulation of the Bering Sea is cyclonic. The inflow to the Bering Sea occurs through a series of passages in the Aleutian Island Chain. The deepest passage is Near Strait where the largest inflow occurs. The outflow is through the Bering Strait ($0.8 \pm 0.2 \times 10^6 \text{ m}^3/\text{s}$; Coachman and Aagaard, 1988) and the Kamchatka Strait between the Kamchatka Peninsula and the Komandorskii Is. ($8-24 \times 10^6 \text{ m}^3/\text{s}$; PICES Working Group 1, 1995). Thus the measurement of the transport of the East Kamchatka Strait would provide a very good indicator of the intensity of the Bering Sea circulation and is a simple measure of large-scale air-sea interaction. Because the East Kamchatka Current is the western boundary current of the Pacific subarctic gyre, and the source of water for the Subarctic and Oyashio currents, these measurements also would provide information on all the components of the western Pacific subarctic circulation.

It has been shown by Larsen (1992) that the Florida Current transport can be effectively monitored with a submarine telephone cable. These measurements provide a level of temporal resolution and spatial averaging unsurpassed by any other technique. This approach could be applied to the East Kamchatka Current or other narrow components of the circulation, such as the Alaskan Stream. It has the advantages of low operating costs, low maintenance, long-term durability (20-30 years), high temporal resolution and spatial integration. Disadvantages are high initial cost, if new cable is needed, and damage to cable by fishing activity if the inshore termination extends across the continental shelf. A program of continuing but infrequent calibration is required to monitor and correct for electrode drift. PICES should evaluate the scientific benefits of knowing the variability on climate time scales of the overall intensity of the Bering Sea circulation. The cable method is the

only economical way of collecting these data.

E. Aeolian Transport of Iron into the Pacific Subarctic Gyre

PICES should consider the development of a system of observations to determine on a recurring basis the transport of iron to the subarctic Pacific. Recent research (Martin, 1991; Martin et al., 1994) strongly implicates the supply of iron as a principal limiting factor for phytoplankton productivity throughout the region, probably most strongly limiting in the east. All evidence (Donaghay et al., 1991) suggests that the main transport mechanism of iron supply to the ocean is atmospheric transport. Iron-bearing dust particles, originating from the Asian land mass, are the primary source of iron to the subarctic Pacific.

Monitoring of the iron transport will be difficult. Concomitant measurements of velocity and iron concentration would be required at an adequate number of sites. It might be possible to use wind trajectory models in combination with measurements of airborne iron to estimate the transport of iron into the oceanic realm. If the residence time of the iron-bearing particles in the atmosphere is not too long, it might not be necessary to measure atmospheric efflux at the eastern boundary. If the efflux rate needs to be measured in the eastern Pacific, the Queen Charlotte Is. might be a suitable monitoring site. Further thought is needed regarding possible approaches. Attention should be given to monitoring variability of north Asian dust transfer, evaluating of wind trajectory models, setting up appropriate sampling schemes for airborne iron over the ocean, and searching for suitable proxy variables for the iron supply rate.

F. Voluntary Observing Ship Basin-Scale Flow-Through Measurements

Voluntary observing ships crossing the subarctic Pacific can be used to obtain time series measurements of a variety of properties important to describing and understanding climate variability. Automated instrumental

packages can be used on these vessels to collect samples or to measure climate variables with minimal or no specialized technical support on board. The flow-through system takes water from the sea-chest which is continuously supplied to the automated monitoring system. In 1995 a voluntary observing ship flow-through program was begun on the Vancouver-Tokyo route under the leadership of C.S. Wong of the Institute of Ocean Sciences (Canada) and Y. Noriji of the National Institute for Environmental Studies (Japan). Measurements are being made of the following variables: T, S, chlorophyll-*a*, nitrate, pCO₂, pH, total CO₂, and in the future zooplankton abundance (beginning April 1996). Sampling frequency is 10/year.

In order to increase our understanding of subarctic variability, it is necessary to sample the north-south variability as well. There are north-south shipping routes which can be used for voluntary observing ship sampling. Two crucial lines are Alaska-Hawaii and Hawaii-Seattle. These lines would cross the N Pacific Drift at 155°W and cross the southward deflected portion of the N. Pacific Drift, which is the source of the California Current. These measurements would provide critical data for a number of subarctic climate studies. For example, the contrasting physical and biological effects of El Niño events on the central Pacific (cooling) and the northeast Pacific (warming) could be documented.

The ships would have to be equipped with a seawater intake, preferably hull-mounted on the outside of the ship near the bow, and the automated monitoring system. The modules of the monitoring system would include: seawater temperature and conductivity (salinity), fluorescence, particle counting (zooplankton biomass), continuous plankton collection on sticky "mat," nitrate, pH, pCO₂, and O₂. The shipboard data acquisition system should log GPS positions, air pressure, temperature and humidity and wind speed. Ideally the ship would also launch XBTs and XCTDs at regular intervals to obtain data on the vertical structure of the near-surface layer. The ships involved

could be the same ships doing the WOCE lines PX37 and PX38. In Fig. 4 are shown the positions of the four flow-through lines, the proposed moorings (section III A) and the JGOFS HOTS time-series station (23°N, 155°W). The time series data will contribute to the interpretation of the ship-track data which provides good spatial resolution but only coarse time resolution.

G. Surface-Velocity Measurements with Satellite-Tracked Drifters

The surface-velocity measurement program (SVP) of the World Ocean Circulation Experiment involved the design and deployment of a large number of satellite-tracked drifters. The drifter has a tethered holey-sock drag element located 15 m below the surface and measures sea-surface temperature. It also can be instrumented to measure fluorescence, air pressure and conductivity (salinity).

The SVP instrument could be used to monitor the variability of the near-surface flow field in the subarctic Pacific. For example, the eastward flow into the eastern N. Pacific (N. Pacific Drift, Subarctic Current) bifurcates west of the boundary with one portion turning north into the Alaska Gyre and the other southward to form the California Current. It has been speculated that the year-to-year variability of the velocity of the incoming surface flow, the location of the bifurcation and the relative amounts of surface water contributed to the subarctic and subtropical gyres have important ecological effects within the Subarctic Gyre/California Current system (Hollowed and Wooster, 1992). Recent drifter measurements reported by van Meurs and Niiler (1995) have shown large differences between 1987 and 1989 in the eastward component of surface flow. In Fig. 5 are shown the 250 day trajectories of 16 Argos-tracked drifters released along 145°W in 1989; in the western sector the general drift is eastward. East of 139°W the trajectories of the drifters released at the more southern latitudes show a notable southeastward trend. In Table 1 are shown the comparisons of the 1987 and 1989

geostrophic velocities in the six boxes shown in Fig. 5. The geostrophic flow is computed by subtracting the wind-driven part of the current, according to Ekman dynamics, from the measured current. It is clear that, except for the two regions closest to the coast, the 1989 currents are stronger by a factor of two than those of 1987.

A drifter experiment can be designed which will measure the climatic variability of the partitioning of water to the subarctic and subtropical gyres. This data set would describe the effects of a regime shift on the circulation and test the suggestion of Chelton and Davis (1982) that there is an out-of-phase relationship between the transports of the northern and southern deflections of water transported into the N. American boundary from the west.

The drifters are a powerful tool to study the surface circulation and should be considered as a way of monitoring the bifurcation of the flow as well as other aspects of the flow field in the PICES area.

IV. References

- Carlson, H.R. and R.E. Haight, 1972. Evidence for a home site and homing of adult yellowtail rockfish, *Sebastes flavidus*. J. Fish. Res. Bd. Canada, 29, 1011–1014.
- Carlson, H.R., R.E. Haight, and J.H. Helle, 1995. Initial behavior of displaced yellowtail rockfish, *Sebastes flavidus* in Lynn Canal, Southeast Alaska. Alaska Fish. Res. Bull., 2, 76–80.
- Chelton, D.B. and R.E. Davis, 1982. Monthly sea-level variability along the west coast of North America. J. Phys. Oceanogr., 12, 757–784.
- Coachman, L.K. and K. Aagaard, 1988. Transports through Bering Strait: annual and interannual variability. J. Geophys. Res., 93, 15,535–15,539.

- Donaghay, P.L., P.S. Liss, R.A. Duce, D.R. Kester, A.K. Hanson, T. Villareal, N. W. Tindale and D.J. Gifford, 1991. The role of episodic atmospheric nutrient inputs in the chemical and biological dynamics of oceanic ecosystems. *Oceanography* 4: 62–70.
- Hollowed, A.B. and W.S. Wooster, 1992. Variability of winter ocean conditions and strong year classes of Northeast Pacific groundfish. *ICES mar. Sci. Symp.* 195, 433–444.
- Larsen, J.C., 1992. Transport and heat flux of the Florida Current at 27°N derived from cross-stream voltages and profiling data: theory and observations. *Phil. Trans. R. Soc. Lond. A*, 338, 69–236.
- Martin, J.H., 1991. Iron, Liebig's law and the greenhouse. *Oceanography*, 4, 52–55.
- Martin, J.H., et al., 1994. Testing the iron hypothesis in ecosystems of the equatorial Pacific Ocean. *Nature*, 371, 123–129.
- Miller, C.B. (ed.), 1993. Pelagic ecodynamics in the Gulf of Alaska, results from the SUPER Program. *Prog. Oceanogr.*, 32, 1–358.
- Mizuno, K. and W.B. White, 1983. Annual and interannual variability in the Kuroshio Current System. *J. Phys. Oceanogr.*, 13, 1847–1867.
- The Ocean Observing System Development Panel, 1995. Scientific design for the common module of the Global Ocean Observing System and the Global Climate Observing System: an ocean observing system for climate. Department of Oceanography, Texas A&M University, College Station, Texas, 265 pp.
- PICES Working Group 1, 1995. The Okhotsk sea and Oyashio Region, PICES Report No. 2, L. D. Talley and Y. Nagata (eds.), North Pacific Marine Science Organization (PICES), 227 pp.
- Tanimoto, Y., N. Iwasaka, K. Hanawa, and Y. Toba, 1993. Characteristic variations in sea surface temperature with multiple time scales on the North Pacific. *J. Climate*, 6, 1153–1160.
- U.S. GLOBEC, 1995. Climate Change and Carrying Capacity Planning Meeting Report, Working Group 5 Report. U. California, Davis, in press.
- van Meurs, P. and P.P. Niiler, 1995. The temporal variability of the large-scale geostrophic surface velocity in the North East Pacific. Manuscript in preparation.
- Watanabe, T. and K. Mizuno, 1994. Decadal changes of the thermal structure in the North Pacific. *Int. WOCE Newsletter*, 15, 10–13.
- White, W.B., 1982. Traveling wave-like mesoscale perturbations in the North Pacific Current. *J. Phys. Oceanogr.*, 12, 232–233.
- White, W.B. and Y. He, 1986. Interannual variability in the heat content of the Kuroshio Extension associated with the 1982 ENSO event. *J. Phys. Oceanogr.*, 16, 309–321.
- Wong, C.S., F.A. Whitney, K. Iseki, J.S. Page and J. Zeng, 1995. Analysis of trends in primary productivity and chlorophyll-*a* over two decades at Ocean Station P (50°N, 145°W) in the subarctic Northeast Pacific Ocean, pp. 107-117. *In* R. J. Beamish [ed.], *Climate change and northern fish populations*. *Can. J. Fish. Aquatic. Sci.*, 121.
- Yasuda, T. and K. Hanawa, 1995. Temporal variability of the thermal structure in the North Pacific. Part 1: Decadal change. *J. Phys. Oceanogr.*, in review.

Table 1. Comparison of 1987 and 1989 surface geostrophic currents computed from drifter velocities and winds. The regions are defined in Fig. 6.

Region	1987		1989	
	$ \mathbf{u} $ (cm s^{-1})	θ ($^\circ$)	$ \mathbf{u} $ (cm s^{-1})	θ ($^\circ$)
1	3.4 ± 0.8	30.4 ± 13.6	6.0 ± 1.2	1.0 ± 10.1
2	1.6 ± 0.6	14.9 ± 23.6	4.2 ± 0.8	-6.8 ± 18.5
3	2.6 ± 1.0	0.0 ± 26.2	2.4 ± 0.9	0.0 ± 28.5
4	1.9 ± 0.8	15.5 ± 19.5	7.8 ± 1.0	11.9 ± 8.3
5	1.9 ± 0.9	34.5 ± 30.2	3.2 ± 1.0	7.4 ± 23.5
6	3.8 ± 1.3	33.3 ± 22.4	4.3 ± 1.6	24.8 ± 24.7
All	2.2 ± 0.4	24.2 ± 12.1	4.6 ± 0.5	6.2 ± 7.4

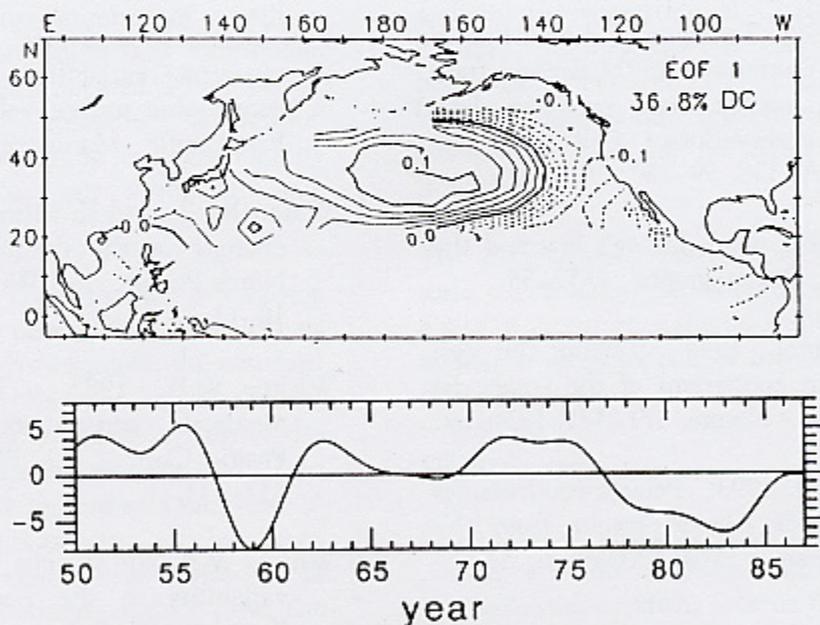


Fig. 1. Spatial and time coefficient of the leading EOF mode for low-pass filtered SST anomalies with periods longer than 60 months. After Tanimoto et al. (1993).

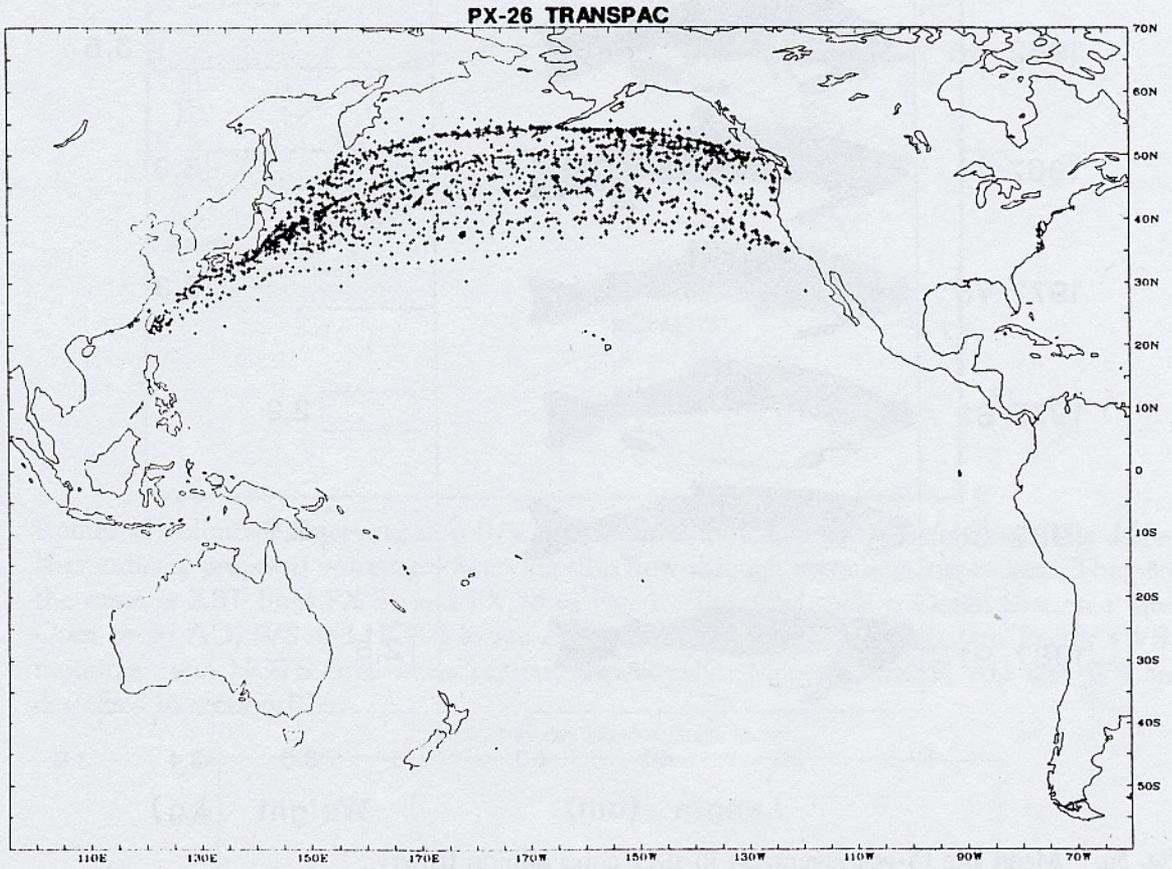


Fig. 2. XBT observational points made in 1993 in the PX-26 (TRANSPAC) area. In this year, approximately 2,000 XBTs were dropped.

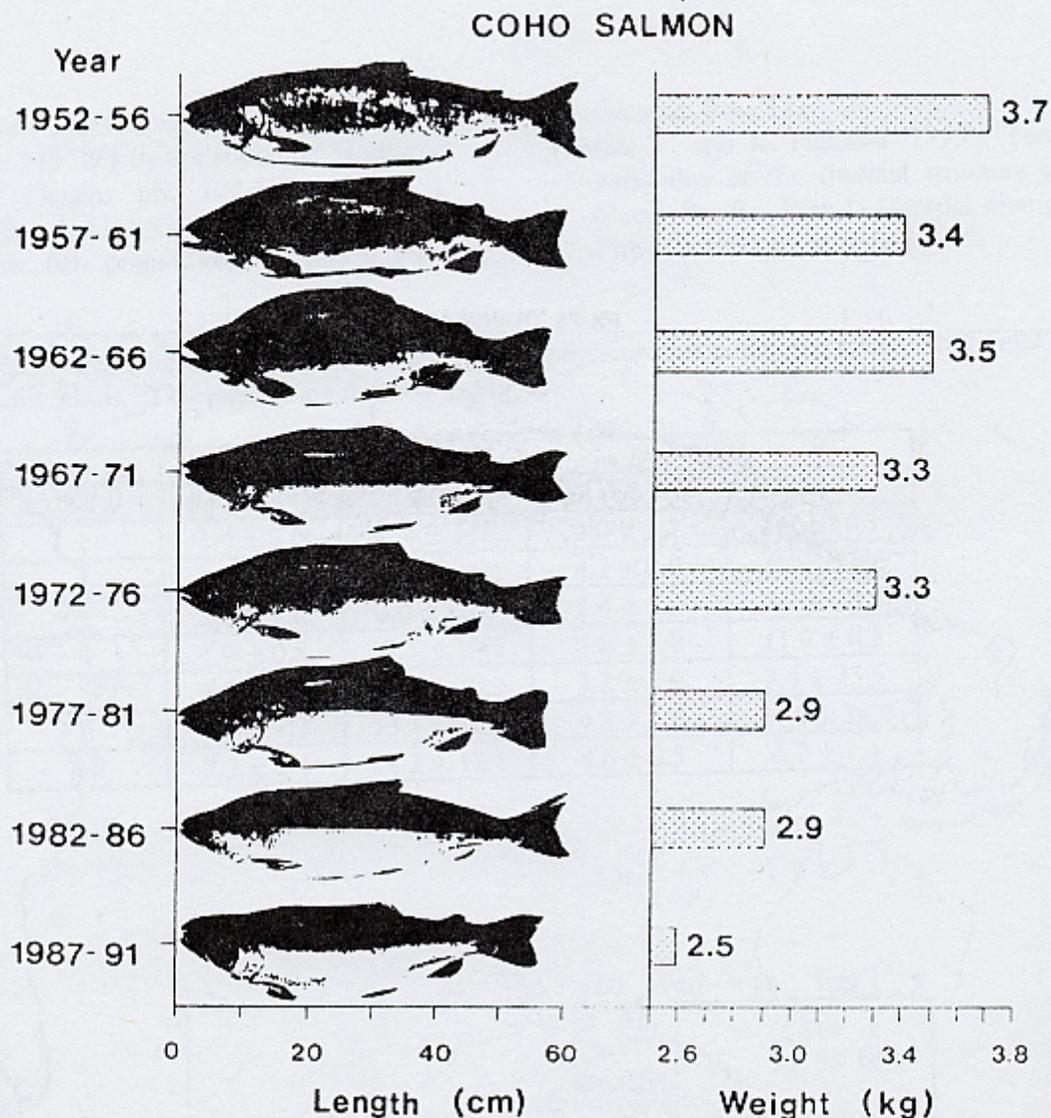


Fig. 3a. Mean size (5-year averages) in B.C. coho salmon fishery.

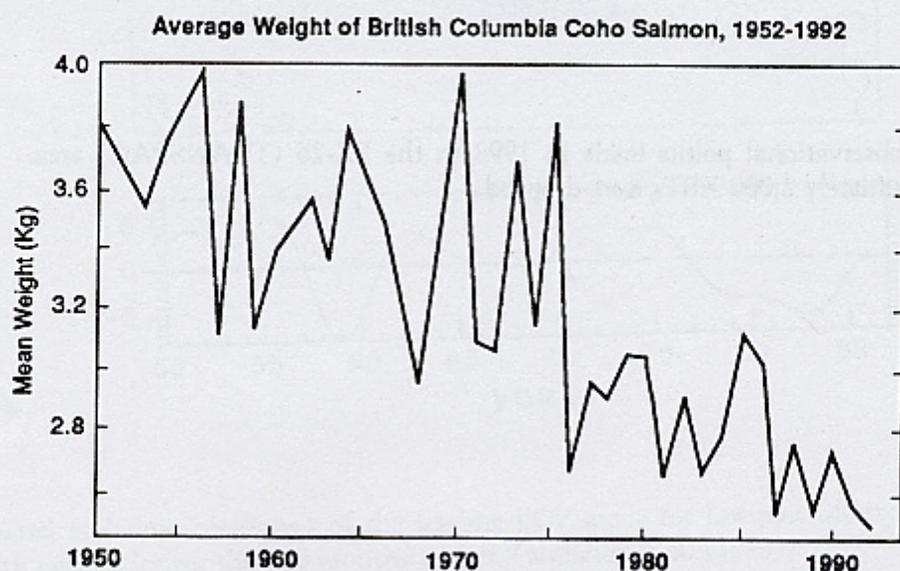


Fig. 3b. Annual variation in average size of B.C. seine-caught coho salmon.

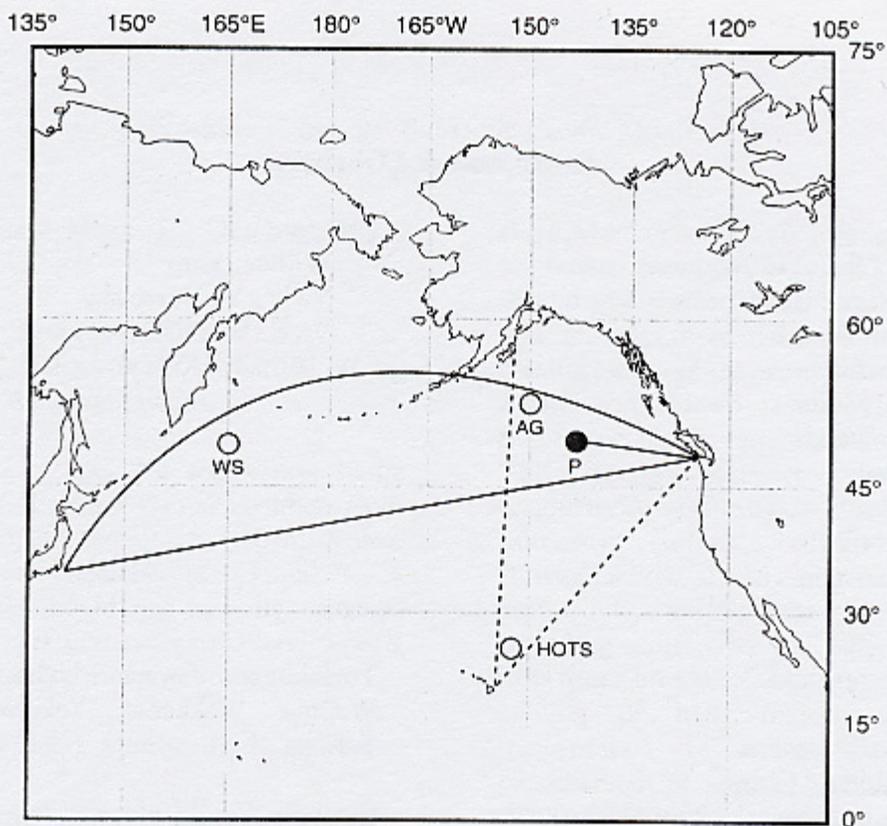


Fig. 4. Routes of volunteer observing ship R/V *Skaguran* are indicated by the solid lines. The dashed lines indicate proposed volunteer observing ship flow-through measurements routes. They are the same as XBT lines PX 37 and PX 38 in Fig. 1. The filled circle is Ocean Station P site. Open circles AG, WS and HOTS locate Alaska Gyre (AG) mooring; western Pacific (WS) mooring; and HOTS time series station, respectively. Mooring sites P, AG and WS are described in section IIIA.

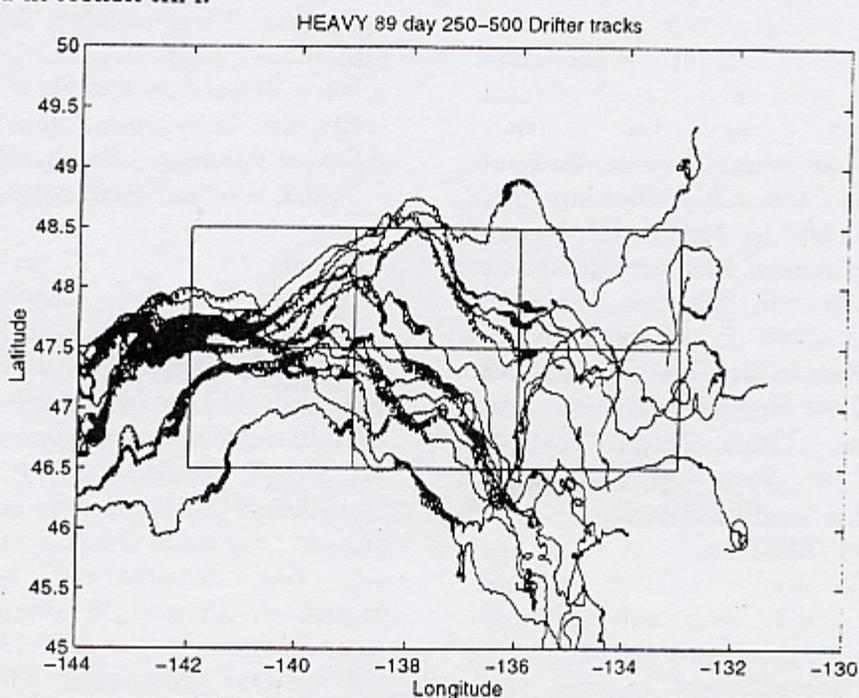


Fig. 5. Drifter tracks for the 1989 deployment (Days 250-500) (van Meurs and Niiler, 1995). Region 1 is the top left corner of the rectangle, region 4 bottom left corner, region 3 top right corner, and region 6 bottom right corner.

Appendix 1

Participants and Observers

Working Group 9

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William Karp
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Appendix 2

Sea-Level Gauges

All gauges are north of 35°N and south of the Bering Straits.

People's Republic of China

Dalian, Laohutan, Newchwang, Qinhuangdao, Shijiusuo, Tanggu, Yantai

South Korea

Anhung, Gadeog Do, Kojong, Kunsan/outer port, Pohang, Pusan, Sogcho, Ulsan, Yosu

North Korea

Wonsan

Japan

Abashiri III, Aburatsubo Aomori, Asamushi, Awa Sima, Ayukawa, Choshi-Gyoko, Esashi, Fukaura, Hachinohe III, Hakodate I, Hanasaki II, Kamaisi II, Iwasaki, Kashiwazaki, Katsuura, Kawasaki, Kushiro II, Maizuru III, Mikuni, Miyako II, Monbetu II, Muroran, Nagoya, Nezugaseki, Ofunato II, Oga, Ogi, Ominato, Onahama, Oshoro II, Saigo, Shimizu-Minato, Sibaura, Soma, Tajiri, Tappi, Tokyo II,

Tomakomai, Toyama, Uchiura, Urakawa II, Wajima, Wakkanai, Yokohama, Yokosuka, Yosioka

Russia

Nagaev, Petropavlovsk/Kamchatsky, Yuzhno/Kurilsk

United States of America

Adak/Sweeper Cove, Alameda (Naval Air Station), Anchorage, Astoria, Charleston, Cordova, Crescent City, Juneau, Ketchikan, Monterey, Neah Bay, N. Spit/Humboldt Bay, Point Reyes, Port Orford, Port San Francisco, Port San Luis, Sand Point, Seldovia, Seward, Sitka, Skagway, South Beach, Unalaska, Valdez, Women's Bay/Kodiak, Yakutat

Canada

Bamfield, Bella Bella, Campbell River, Fulford Harbour, New Westminster, Patricia Bay, Point Atkinson, Port Alberni, Port Hardy, Port Renfrew, Queen Charlotte City, Steveston, Tofino, Vancouver, Victoria

Working Group 9: Subarctic Pacific Monitoring Report of Second Meeting

Report of Second Meeting - October 11-12, 1996

Participants: Bruce A. Taft (U.S.A.) Co-Chairman; C. Miller (U.S.A.); C.S. Wong (Canada); D. Welch (Canada).

The discussion at WG 9-2 was hampered by the absence of Working Group members from the western Pacific countries (Japan, Korea, Russia, People's Republic of China). A number of issues could not be fully explored with the members present, particularly aspects of climate variability in the western Pacific.

I. Status of WG 9-1 Monitoring Initiatives

At WG 9-1 seven possible PICES monitoring initiatives were outlined. Most of our discussion at WG 9-2 was focused on the further development of these ideas and the assessment of their readiness to be forwarded to the Science Board for consideration of implementation. Summaries of our discussion of each topic follow with a few recommendations for Science Board consideration. They are divided into three categories: new initiatives; continuing programs; and programs that are not yet ready for commencement of monitoring.

A. New Initiatives

1. Ecosystem monitoring moorings

Time-series measurements of primary production and zooplankton stocks in the oceanic sector of the subarctic Pacific are required to better understand the dynamics of the interaction between changes in the physical-chemical environment and the variability of plankton populations. Analysis of the Station PAPA data has provided some insight in to the relationship between the response of the plankton communities to the atmospheric forcing (Miller, 1993). However, there were never suitable data at PAPA to show whether

variations in zooplankton stocks are related in some direct fashion to variations in primary productivity. Moored time series will provide these data. Long-term moored measurements of the wind velocity and vertical distributions (down to the pycnocline) of a number of ocean variables would be obtained. The ocean variables are temperature, conductivity (salinity), dissolved inorganic nutrients (nitrate, silicate), chlorophyll (phytoplankton stock), solar radiation, primary productivity indices and zooplankton stock. Sampling must cover the range of time scales from diurnal to decadal (regime shifts) to avoid aliasing of high frequencies into lower frequencies. Technology exists for moored measurement of most of these variables. The most serious shortcomings are in the measurement of zooplankton stocks. Acoustic methods of measurement of zooplankton concentration are currently under development but there remain serious systematic errors (pteropod problem). The optical plankton counter (OPC) developed at the Bedford Institute of Oceanography is capable of estimating the number of zooplankton by size category for a certain range of species. The state of technology is such that useful measurements of a sufficient number of the key variables can be made now and there is real promise of continuing improvement of the technology that can be incorporated into the evolving suite of measurements.

PICES ecosystem monitoring moorings should be located at the centers of the Alaska Gyre (53°N, 150°W) and the western Pacific Subarctic Gyre (52°N, 165°E). At these locations advective effects will be minimized and the moorings could be presumed to represent a large volume of water in the interior of these gyres. The oceanographic and meteorological conditions in the two sites are very different (deep pycnocline and higher primary productivity and zooplankton biomass in the west). Comparison of the biological and physical relationships in the two situations will

provide needed insight in to how the dynamics can be modified by significant changes in the parameters of the system. The BASS Task Team, in their June 1996 meeting, strongly recommended that PICES place high priority on the installation of the two ecosystem monitoring moorings. It also should be noted that the draft of the US GLOBEC West Coast Implementation Plan shows a mooring near the center of the Alaska Gyre which appears to be very similar to the PICES ecosystem monitoring mooring. PICES should encourage US GLOBEC to implement this mooring. The corresponding mooring in the western Pacific should be provided by the PICES countries.

Recommendation - PICES undertakes to implement the ecological monitoring moorings in the Alaska Gyre and western Pacific Subarctic Gyre.

2. Measurement of E. Kamchatka Current transport by undersea cable

The general circulation of the Subarctic Pacific is thought to consist of two clearly separated cyclonic subarctic gyres: Alaska Gyre and western Pacific Gyre (Ohtani, 1991). In the intervening area between the gyres (165 E to 175 W) the Alaskan Stream flows westward adjacent to the Aleutians and south of the Stream lies the Subarctic Current. Flow into the Bering Sea occurs through a series of passages in the Aleutian Arc; the largest inflow typically occurs in the Near Strait. Outflow occurs through the Kamchatka Strait (range of 8-24 Sv) and the Bering Strait (range of 0.6-1.0 Sv). The southward flow through the Kamchatka Strait is an excellent index of the magnitude of the exchange of water between the North Pacific and the Bering Sea. Variations in the amount of water that enters the Bering Sea will affect the water- mass characteristics and the residence time of water in the Bering Sea. The E. Kamchatka Current is the source of water flowing southward in the Oyashio Current. Understanding the climatic variability of the Subarctic Pacific would be greatly aided by knowing how the intensity of the Bering Sea

cyclonic circulation varies on annual, interannual and decadal time scales.

Instead of measuring the entire basin-scale Bering Sea circulation it is sufficient to measure over the 100 km width of Kamchatka Strait. The Strait is an ideal site to measure the intensity of the Bering Sea circulation with an electromagnetic cable. The technique, which has been used successfully for 14 years in the Florida Current (Larsen, 1992), resolves all the energetic time scales and gives a measure of the total (net) transport so that it is insensitive to fluctuations in the cross-stream flow structure. Under the conditions usually met in western boundary currents, the voltage difference induced in the cable by the water transport is linearly related to the transport. In the Florida Strait the *rms* error in daily volume transport is 0.7 Sv. A cable would be deployed across the deep portion of the Strait with an acoustic data link on the shallow inshore side. Data will be reported at regular intervals to a ship that visits the site. An array of current meters will have to be set in the Strait to provide a two-year calibration data set to establish the relationship between induced voltage and transport. Follow-up calibration to check for drift of the system will have to be done every three years. The cable has an expected lifetime of thirty years.

Costs (exclusive of shiptime costs) are estimated as follows: installation \$500K; moored array \$600K (one time); long-term drift calibration \$200K (every third year); and annual maintenance and data analysis \$100K.

Recommendation - PICES undertake implementation of installation of a conducting cable across Kamchatka Strait to measure transport of the E. Kamchatka Current.

B. Continuing Programs

1. Voluntary observing ship flow-through measurements program

At the present time a program of surface measurements are made on a vessel which traverses a route from Tokyo-Vancouver (RT) ten times per year. The following measurements are made: T, S, pCO₂, pH, chlorophyll-a, inorganic nitrate and silicate and total CO₂. Possibly zooplankton abundance will be added in the future. With these sections it has been possible to document recent changes (1995-1996) in the northeast Pacific, i.e. progressive westward shift with time in area of low nutrients off west coast of Canada that is associated with low salinity. It has been demonstrated that such changes cannot be documented without a basin-scale observational program with sufficient spatial and temporal coverage. The VOS program is the only way to obtain these data. North-south variability also needs to be sampled and attempts are being made to find funds and vessels to do the Hawaii-Alaska and Hawaii-Seattle routes. Setting up these lines would provide comparative data on the Subtropical and Alaska Gyres and sample the N. Pacific Drift and the southward deflected portion of the N. Pacific Drift that feeds in to the California Current. Once the ships are identified the funding will be sought.

2. Heat content and freshwater variability of subarctic Pacific.

Measurements of the heat content in the subarctic Pacific has a long history. Measurements were begun in the 1960s and there was a stable level of about 5,500 observations collected annually on east-west routes in the subarctic Pacific in the late 1980s. These measurements have been used in a number of studies that include demonstration of Rossby wave propagation in the N. Pacific Drift (White, 1982) and detection of climate change in the subarctic (Levitus, 1995). In 1993 the number of observations dropped to 2,000 annually because of withdrawal of US Navy funding. There is concern that sampling is now subcritical. A design study needs to be done to establish the sampling density that is adequate for subarctic climate heat content studies. During the next year WG 9 should establish how

this will be done. It probably should be done in the context of the design of the global XBT sampling program rather than within WG 9.

There is no VOS salinity sampling program in the subarctic Pacific. Salinity is a very important indicator of climate change; it is determined by the interactions of ice, ocean, land runoff and atmosphere. Variation of salinity influences geostrophic flow, gravitational stability and convective processes contributing to the formation of near-surface water masses. The WG should determine what is the logical way to develop a strategy for measurements of the large-scale variability of salinity. One possibility is to undertake the study itself; however, this is a major task and may lie beyond the resources of WG 9.

3. Salmon scales as measures of productivity

Salmon scales can be used to monitor fish growth. Looking at it in another way the salmon scales are indicators of the environmental conditions the fish encountered at sea. The permanent record of amount of growth achieved in different years at sea presents an opportunity to monitor high-seas climate change. Because salmon are relatively short-lived animals with high growth rates and simple life histories, variations in the ocean environment affecting growth should cause relatively large changes in body size and therefore can be readily measured. Presumably abundance of food is the critical variable affecting growth with temperature providing a second-order effect. The analysis of existing salmon scales is now underway and will continue. Further modest investments to standardize collection techniques and scale measurements should be made. Collections from additional areas should be initiated to expand the monitoring coverage.

Budget: Technician salary \$29K; Equipment purchase \$25K.

C. Programs Under Discussion

1. Role of iron in determining primary production

There is an accumulating body of evidence that the trace iron ion plays a critical role in determining the level of primary production in the ocean (see for example Martin et al., 1994).

The source of iron for the ocean appears to be the atmosphere. Iron is added to the atmosphere when aerosol content increases. Flux into the ocean occurs primarily as a result of rain. It does not appear to be possible to directly measure the flux into the ocean because the distributions of rain and aerosol over the ocean are poorly known. The WG will investigate whether there may be some time-series data on aerosol content (Fe concentration) of the air at the boundary of the N. Pacific that could be analyzed for interannual and decadal variability of the aerosol source. Measurement of iron content of ocean water is technically difficult. In the foreseeable future it will not be possible to make measurements from moorings. The WG was encouraged that IOS (Sydney) will begin to make iron measurements on the PAPA hydrographic section (3 times per year). Iron measurements should be incorporated on hydrographic sections planned in the PICES area so that a data set can be acquired which documents the time and space scales of the variability of iron.

2. Surface-velocity measurements with satellite-tracked drifters

The surface-velocity program of the World Ocean Circulation Experiment employs the use of calibrated surface drifters to measure the near-surface velocity (at 15 m). The drifters can be instrumented to measure fluorescence, temperature, conductivity and barometric pressure.

The WG will consider possible uses of drifter technology to monitor features of the subarctic circulation to describe and understand the processes of climate change. One example is the study of the relation between the eastward flow in the N. Pacific Current and the variability of the eastern boundary currents (Alaska Current, California Current). Chelton and Davis (1982)

have shown that the sea level along the eastern boundary covaries from Mexico to Alaska. This can be interpreted as evidence that the N. Pacific Drift bifurcates and the amount of water deflected north and south varies out of phase with the sea level. This interpretation seems to be at variance with the recent analysis of three years of TOPEX altimeter data (Strub, in preparation). Strub suggests that on seasonal and interannual time scales the flows of the two gyres are out of phase and seem to be unrelated to variability of the inflow from the offshore region. The WG will consider more fully the use of drifters in the monitoring program at the 1997 meeting.

II. Interaction of PICES WG 9 with Planning Process of GOOS

The WG discussed the need for some connection between our activities and the planning of the Global Ocean Observing System (GOOS). It was recognized that it will be important that PICES perspectives be considered in the formulation of the observing system. During the next year the Co-chairman (B. Taft) will investigate how this might best be done. In particular the advisability of direct PICES participation in these discussions will be considered. Written communications alone may not be effective.

III. Stimulation of Discussion of Monitoring within PICES

The WG felt that the dialogue between itself and the broad PICES community could be strengthened. It was our vision that we would be the focus of development of monitoring ideas but that input would be received from other scientists. The WG is small and most of the ideas considered so far represent the scientific interests of the WG membership. Ways to draw in other ideas need to be encouraged. One possibility to promote communication would be to have a session on the state of the Subarctic Pacific at the annual meeting. For example, there is some evidence that a climatic shift may be taking place now. It would be desirable to

follow its development or demise. The discussion of the observed changes will focus attention on how well the system is being observed. We expect that useful ideas about improving the monitoring system would arise in the ensuing discussion.

RECOMMENDATION - In planning the next PICES annual meeting, the Science Board provide a session on the "State of the Subarctic Pacific".

REPORT OF BIOLOGICAL OCEANOGRAPHY COMMITTEE



The Committee thanked Drs. D. Mackas and T. Ikeda for convening a stimulating topic session on “Regional and interannual variants in life histories of key species”.

After Committee members were introduced the proposed agenda was presented and several new items added.

Dr. Tsutomu Ikeda (Japan) commented on his replacement on the BIO Committee by Dr. Atsushi Tsuda after Dr. Ikeda's move to an academic position. We are pleased to have Dr. Tsuda on the committee, but since we only have two Japanese members at present we encourage Dr. Ikeda to investigate being reappointed to our Committee and urge PICES to support this recommendation. Dr. Timothy R. Parsons is considering withdrawing from the Committee due to difficulty in obtaining travel funds to attend PICES meetings. Dr. Parsons has been an active and important academic contributor to BIO activities and we urge that he be retained on the Committee.

The Committee and our guests discussed the new procedures for requesting extended abstracts for PICES presentations. All participants were enthusiastically in favor of continuing this procedure. Suggestions for changes include: marking extended abstracts with “not for citation without authors permission”, including an e-mail address or fax number for first author, requesting the Secretariat to make copies of extended abstracts if abstracts were submitted well in advance of the meeting, and having the Secretariat maintain a permanent file of the extended abstracts with identification (reference numbers).

Special topics for PICES VI and VII were discussed. Two topics were discussed for PICES VI: the role of micronekton and harmful algal blooms. The Committee voted in favour of “Harmful Algal Blooms: Causes and

Consequences” with a Korean and eastern Pacific co-convenor. This will be co-sponsored with MEQ and the two Committees will work together to choose conveners. Possible conveners include Wekell, Trainer, or Paul Harrison. The Committee would also like to sponsor a special session topic on “Micronekton and their predators: Distributions, dynamics, and sampling problems” for PICES VI with possible co-sponsoring by FIS. Possible conveners are Brodeur or McKinnell, and Kawaguchi, Sakurai, or Fukuyo. We proposed to consolidate the Committee meeting to one afternoon session and to use the other afternoon for a paper session. Other topics discussed for future meetings include controlling factors for lower trophic levels, higher trophic level models, marine birds and mammals, environmental effects of fishing, the role of under-appreciated (missing link) fauna, effects of timing of production, the role of micronekton, the hunger state of zooplankton, factors controlling phytoplankton stocks, and comparison of various modeling approaches applied to a common data set.

Dr. George L. Hunt gave a report on the first meeting of WG 11 (The consumption of marine resources by marine birds and mammals). The WG met on October 11-12 and assessed the quantity and quality of data available for estimating the size of populations, food habits and consumption. The data available differ greatly in quality and quantity for marine birds and mammals and for various PICES areas. The WG agreed to construct for each area, a tabulation of populations, dates of residency, energy demand, food habits and consumption. Not all cells in the table will be filled. Time periods for aggregating data will vary with species and data availability. The WG defined a set of regions within the PICES area and requests feedback from the PICES community as to the usefulness of the boundaries chosen. A number of individuals with expertise in the western Pacific were not able to attend, and

efforts should be made to ensure their future participation.

Working Group 11 will be requesting a 5-day workshop to assemble this table, discuss and revise the tabulation and to prepare their report. The Committee endorses this request as the most efficient way for WG 11 to complete their work over the following year.

Mr. Robin Brown presented an overview of the times series inventory being developed for the PICES Home Page.

BIO representation of the CCCC-IP and Task Teams was discussed. The Committee recommends that Dr. George Hunt be appointed to REX to represent WG 11 and that Dr. Linda Jones be appointed to MODEL.

Regarding the recommendations of WG 9 (Subarctic Pacific Monitoring) the Committee endorses the implementation of ecological moorings in the Alaskan and western gyres but is concerned that Station P be maintained as a site in order to have continued comparisons with the historical records. Any funding from Canada will be unlikely if the site is changed. The Committee strongly endorses the WG 9 suggestion of SB sponsoring an annual session of "Assessing the state of the subarctic Pacific".

Regarding SCOR-WG 105, the Committee recommends that Prof. Qi-Sheng Tang be appointed as the PICES representative and serve as rapporteur to BIO and FIS regarding SCOR-WG 105 activities.

The Committee received and discussed 13 nominations (7 nominees) for best BIO presentation. Two semi-finalists were selected and the Committee voted to give the award to Dr. Kaoru Nakata (National Research Institute of Fisheries Science, Yokohama, Japan) for her presentation on "Long-term fluctuations in the food availability for Japanese sardine larvae on the coastal side of the Kuroshio".

The Committee discussed two recommendations made in the Vladivostok Report. First, we strongly urge PICES to actively pursue facilitating access to EEZ zones for scientific investigations. The second recommendation was for preparation of a report on biological and fisheries aspects for the Okhotsk Sea and adjacent areas. According to our Russian committee members, preparation of this report is already in progress and should be published in 1997 in Russian with abstracts also in English. For maximum utility of the Russian publication, the Committee asks PICES to support translation of the figure legends and table headings.

PICES Perspectives were discussed. The main comment was that we should have more scientific presentations (and fewer Committee meetings) at PICES meetings.

A new Working Group on micronekton was suggested by Napp and Brodeur. A brief written description will be distributed to Committee members. The Committee is in favour of such a Working Group if it addresses the distribution and abundance of micronekton in addition to the initial suggestion which focussed on sampling protocols which permit assessment of both predators and prey. Discussion will continue by e-mail to refine the goals of the Working Group and develop terms of reference.

Written comments on the CCCC-IP report and recommendations will be passed on to chairmen of the appropriate Task Team.

Scientific Program

The following scientific papers were presented from the BIO Committee sponsored part of the program.

Regional and interannual variants in life histories of key species. Co-convenors: David L. Mackas (Canada) & Tsutomu Ikeda (Japan).

- D.E. Hay & P.B. McCarter
Effects of annual temperature variation the timing and geographic distribution of herring spawning locations in British Columbia
- L. Huato
Climate and the life history of sockeye salmon
- T. Ikeda
Life history of major zooplankton species in the southern Japan Sea (East Sea): a review
- H. Kasai, T. Kono, A. Tsuda & H. Saito
Short period variability of primary production in early summer in the Oyashio region
- K. Kawaguchi, H. Watanabe, M. Moku & A. Hayashi
The community structure of myctophid fishes and warm core ring in the transitional waters of the western North Pacific
- T. Kono, M. Kawamiya, H. Kasai & H. Saito
Influence of the stratification to the primary production of the Oyashio region using a one-dimensional model
- G.V. Khen, V.A. Snytko & E.P. Karedin
Interdecadal ice cover variations in the far eastern seas during current century and observed responses in ichthyocenosis
- K. Matsushita
How do eggs and larvae come to nursery beyond front?
- K. Nakata
Long-term fluctuations in the food availability for Japanese sardine larvae on the coastal side of the Kuroshio
- J.M. Napp, K.M. Bailey & M.K. Cohen
Adaptations of spring-spawning walleye pollock, *Theragra chalcogramma*, to the inherent environmental variability of three regions
- V.I. Radchenko
Interannual variability of Dolly varden *Salvelinus malma* (Walbaum) distribution in the deep-water zone of the Bering Sea in relation with oceanological conditions
- P.S. Rand & S.G. Hinch
Spatial patterns of salmon prey, feeding and growth in the Northeast Pacific Ocean
- A. Shiimoto
East and west changes of standing stock and size composition of phytoplankton chlorophyll-*a* in the transition domain in the North Pacific, spring and summer
- K. Taki & T. Ogishima
Distribution of *Euphausia pacifica* in the northwestern Pacific Ocean in summer
- K. Takokoro & T. Sugimoto
Role of top-down and bottom-up control on variations in plankton biomass in the subarctic Pacific
- M. Terazaki
Life history, distribution, seasonal variability and feeding of the pelagic chaetognath, *Sagitta elegans* in the subarctic Pacific
- S. Uye
Characteristics of the life history of key copepod species along a eutrophic-mesotrophic-oligotrophic transect in Japanese coastal waters
- Y.I. Zuenko, Y.U. Novikov, S.Y. Glebova, L.N. Bokhan, A.A. Batyaluk & V.N. Filatov.
Empirical prognostic model of environments development and saury migration off southern Kuril Islands

Endnote 1

Participants and Observers

Canada

Timothy R. Parsons
Kenneth L. Denman
David L. Mackas

Japan

Takashige Sugimoto
Atsushi Tsuda

Korea

Sung Yun Hong
Jang-Uk Lee

Russia

Boris N. Kotenev (17th only)

U.S.A.

Patricia A. Wheeler (Chairman)
Michael M. Mullin
Linda Jones

Observers

Ken Morgan (Canada)
Skip McKinnell (Canada)(16th only)
Hidehiro Kato (Japan) (16th only)
Tsutomu Ikeda (Japan)
Kouichi Kawaguchi (Japan) (16th only)
Akira Taniguchi (Japan) (16th only)
Shin'ichi Uye (Japan) (16th only)
Suam Kim (Korea) (16th only)
Yury I. Zuenko (Russia)
Jeffrey M. Napp (U.S.A.) (16th only)
George L. Hunt (U.S.A.)
Karl Banse (U.S.A.) (16th only)
Bruce W. Frost (U.S.A.) (16th only)
Michael R. Reeve (U.S.A.) (16th only)
Patrick J. Gould (U.S.A.)
Ken Holland (U.S.A.) (16th only)
John E. Stein (U.S.A.) (17th only)

Endnote 2

Report of Working Group 11

Consumption of Marine Resources by Marine Birds and Mammals in the PICES Region

Summary

PICES Working Group 11 met on October 11 and 12, 1996, in Nanaimo, British Columbia, Canada, to develop strategies for meeting its Terms of Reference. The Working Group assessed the quantity and quality of data available for estimating the size of marine bird and mammal populations, food habits and consumption. The data available differ greatly in quality and quantity for marine birds and mammals, and for the various PICES areas. The Working Group agreed to construct, for each PICES area, a tabulation of the populations of marine birds and mammals found in that area, dates of residency, energy demand, food habits and food consumption. The Working Group recognized that the extent to which we would be able to fill cells in the tables would depend on the data available, and would vary between regions and also between predator species and

species groups. Time periods in which to aggregate the data will vary depending on the biology of the species and the data available. The Working Group defined a set of regions within the PICES area, within which marine bird and mammal populations would be assessed. The Working Group requests feedback from the PICES community as to the usefulness of the boundaries chosen and whether we should modify the boundaries of these regions prior to developing our Tables on prey consumption by region. The Working Group requests that a five day meeting be held before the 1997 PICES meeting so that the Working Group can assemble its data and draft a Final Report. The Working Group was concerned that a number of individuals with expertise in the western Pacific Ocean were not able to attend, and that efforts should be made to ensure their future participation.

Introduction

The first meeting of PICES Working Group 11 was held on October 11 and 12, 1996 in Nanaimo, British Columbia, Canada. The purpose of the meeting was to develop approaches for estimating the consumption of marine resources by marine birds and mammals in the PICES area. Marine birds and mammals are important aspects of the marine environment for many reasons: they are the object of considerable public interest, they are important and often highly visible consumers and transferors of organic material, and they may be used to provide an indication of changes in marine ecosystems. The Terms of Reference given to Working Group 11 referred explicitly to the need to assess the role of marine birds and mammals in the consumption of marine resources. Additionally, by referring to the importance of our work for the CCCC/IP group, we understood that it would also be desirable for Working Group 11 to address issues concerning the use of marine birds and mammals as indicators of the effects of climate change on marine ecosystems.

For the agenda for the first meeting of Working Group 11, see Appendix 1.

Participation:

Canada

K. Morgan
A. Trites

Japan

N. Baba
H. Kato, Co-Chairman

U.S.A.

J. Bengston
P. Gould
G. Hunt, Co-Chairman
C. Jay
L. Lowry

Other

L. Jones, liaison with the BIO Committee

To evaluate the effects of predation by marine birds and mammals on intermediate and lower trophic levels of subarctic Pacific marine ecosystems, Working Group 11 will:

1. Obtain and tabulate available data on population sizes and prey consumption by marine birds and mammals.
2. Calculate seasonal and annual consumption, expressed as numbers and biomass, of particular marine resource species by particular bird and mammal populations.
3. Where possible, stratify the calculation as to age classes of prey and locality (local stock impacted).
4. Prepare a report for PICES describing data sources and methods of calculation, and the results, and identifying major lacunae in knowledge.

This WG is proposed by BIO Committee and BIO believes that this WG activity will contribute to the ecosystem studies contemplated in CCCC. Dr. Linda Jones will be the point of contact for BIO. It is the intent of BIO that this WG encourage communication with CCCC/IP, with overlapping membership where possible.

Decisions and Actions by Working Group 11

A. Discussion of Terms of Reference

Members of the Working Group examined the feasibility of implementing the Terms of Reference within the time-frame suggested. It was agreed that the amount of work required to address the Terms of Reference in their entirety was greater than could be completed within the time available. It was agreed that we could meet the objectives required in the first Term of Reference and that progress could be made in meeting the second and forth Terms of Reference, at least for some species or groups of species. To this end, we developed a framework for meeting the major thrust of the Terms of Reference within a two-year time period, with

the presentation of our report at the 1998 PICES meeting.

The Working Group decided that predator populations would be identified at the species level, and that consumption would be calculated, where possible, at a regional scale. Within regions, we agreed to develop estimates of predator numbers, dates of residence, and where possible, to estimate energy demands and prey consumption by prey species and by prey types (e.g., zooplankton, small fish, squid). For marine birds, if abundances are known, it will be possible to calculate energetic demands. Additionally, for many species of marine birds, prey type is known, and for some marine birds, the proportion of different prey species in the diet is also available. The Working Group recognized that for many species of marine mammals, the size distribution of individuals in the population, and in particular regions, is unknown, and that without these data, it may not be possible to calculate energetic demands with a high level of reliability.

The Working Group also recognized that for many predator species and in many regions there are insufficient diet data to permit the calculation of prey demand by prey species. However, in some cases where prey species data are lacking, it may be possible to provide information on the consumption by classes of prey type. For most prey species, size classes will be limited to broad categories, and our ability to identify age classes will be limited to categorization of fish as juveniles or adults.

The Working Group was excited about the possibility of contributing to the CCCC program by using marine birds and mammals as indicators of changes in marine ecosystems driven by climate. It was also suggested that where physical processes were responsible for controlling the flux of energy to marine birds or mammals, there was the possibility of developing predictions as to how climate change would be expected to influence marine bird and mammal populations.

B. Proposed Structure for the Working Group Report

The Working Group agreed that the core of its report will be a set of Tables detailing our knowledge of the population sizes, dominant prey species, and, where possible energy demand and prey consumption, by region, for species of marine birds and mammals in the PICES area. A draft of the proposed format and definition of terms for these tables is presented in Appendix 2. The Working Group noted that there were on the order of 100 species each of marine birds and mammals that occur in the PICES region, and that for many of these species relatively little information is available. However, in general, our knowledge of numbers, distribution and prey habits are most complete for the most abundant species, particularly in the case of marine birds, and that this bias in our knowledge will help in the development of estimates of regional flux of energy and prey to predators. Because there may be significant differences in the reliability of existing population estimates for marine birds and mammals, the Working Group agreed that it would be desirable to provide information on the quality of data and estimation techniques used to develop the report.

The Working Group spent considerable time attempting to identify sub-regions within the PICES area within which to aggregate estimates of energy demand and prey consumption (Figure 1). The Working Group chose to define areas by oceanographic features because this may provide the most ecologically meaningful framework for the comparison of regions. The Working Group seeks comment from others in the PICES community as to the appropriateness of the proposed sub-regions and on the delineation of boundaries, especially of the Oyashio/Kuroshio Current region, whose boundaries are provisionally set at 60 nautical miles offshore and the California Current, whose boundary is provisionally set at 100 km beyond the shelf break.

The Working Group also discussed the selection of an appropriate time unit in which to report the data. This issue was identified as important because some predator species are highly migratory, and may only feed in certain parts of their range. In addition, both the numbers of organisms in a region and the food habits of a predator may change over periods of weeks to months. The Working Group agreed that a monthly resolution of population distributions and consumption would be the finest scale of resolution sought, but that the final scale of resolution used in the report would be dictated by the quality of data available.

The Working Group recognized that there were several other aspects to the assessment of consumption by marine birds and mammals that were of importance, but were outside the framework of the report as presently planned. These areas include, but are not limited to, the consumption of discards and offal and the effect of these sources of food on the populations of scavenging species, nearshore consumption of prey by seabirds and other inshore foragers, and the influence of shorebirds and other intertidal and sub-tidal benthic and epibenthic foragers on the ecosystems that they exploit.

The Working Group expressed considerable interest in examining how climate change might influence marine bird and mammal populations in the PICES area. It was recognized that there was insufficient time available to explore this area fully, and it was agreed that as a first step, the Working Group would tabulate the species or populations of marine birds and mammals for which time series data are available. This tabulation would permit assessment of the species and regions in which data are sufficient for examination of responses of marine birds and mammals to the short-term climate changes that have been documented in recent decades.

C. Time Line for Completion of Tasks

The Working Group agreed to the following schedule as realistic for the production of its report:

April 1, 1997 Circulation of preliminary drafts of tabulations of predator numbers, energy demand and prey consumption by sub-region

October 1997 Meet for five days prior to the PICES Scientific Meeting in Pusan, Republic of Korea, to develop a working draft of the report

October 1998 Presentation of the final report to the Biological Oceanography Committee

D. Closing Remarks

Members of Working Group 11 were excited by the prospect of contributing to the PICES community a top-down view of ocean ecosystems. The Working Group was also encouraged by the interest of the PICES community in incorporating into studies of ocean ecosystems information concerning the ecological role of marine birds and mammals. The Working Group recognizes that marine birds and mammals integrate information over wide sections of the ocean, and often provide evidence of changes in marine ecosystems that may otherwise be difficult to detect. Thus, the members of Working Group 11 felt that it was extremely important that the PICES community include experts on marine birds and mammals when developing future interdisciplinary work within the context of PICES-GLOBEC and the CCCC initiatives. Within this context, the Working Group recognized the desirability of having closer integration with biological and physical oceanographers in the process of developing our report.

The Working Group was disappointed that a number of its members with expertise on the marine birds and mammals of the western

portion of the PICES area were unable to attend the Working Group meeting. Without their participation, it will be extremely difficult to discharge our responsibilities to PICES. The Members of Working Group 11 are concerned

about the lack of mechanisms for the support of travel for its members, particularly for individuals not associated with governmental agencies.

Appendix 1

Preliminary Working Agenda

Friday:

1. Opening remarks and background
2. Terms of Reference
3. Participants introduce themselves
4. Adoption of agenda

Saturday:

5. Review of current topics relevant to seabirds and marine mammals in respective regions or countries
6. Initial discussion on direction of WG 11
7. Data inventory and its availability
8. Assignments of tasks for the second year and inter-sessional work.
9. Other matters
10. Adoption of report

Appendix 2

Outline of Data Tables for the Report

Column Headings and the definitions:

1. Species:
2. Number of Animals in Region: Use latest reliable estimate. If population size is in flux, note information on population changes in text.
3. Residency Period: The inclusive dates within which organisms are present. The intention is to calculate bird- or mammal-days of occupancy of the region.
4. Occupancy: The bird-days or mammal-days of use of the region.
5. Body Mass (Kg): Mass should reflect the average mass of individuals present in the population occupying the region.
6. Energy Consumption: Joules individual⁻¹ day⁻¹
7. Energy demand per period: (6) x (4)
8. Major Prey Species
9. Major Prey Groups
10. Relative Importance of prey Species: Proportion by Occurrence, by number and by Mass or Volume.
11. Prey Consumption by Species: This term will require calculating the proportion of energy supplied by each prey species and then multiplying that by the total energy demand per period.

REPORT OF FISHERY SCIENCE COMMITTEE



The meeting was opened by the Chairman, Prof. Qi-Sheng Tang. Those in attendance were Drs. Dick Beamish, Jim Boutillier, Mary Downton, Steven Hare, Anne B. Hollowed, John R. Hunter, Glen Jamieson, Suam Kim, Patricia Livingston, Gordon McFarlane, Robert S. Otto, Cha-Soo Park, Deok-Bae Park, Vladimir I. Radchenko, Bill Shaw, Tokio Wada and Chang-Ik Zhang.

The Committee's response to the agenda items were as follows:

1. Election of new Chairman of FIS.
 - 1.1. Dr. Chang-Ik Zhang (Korea) was elected Chairman, beginning November 1, 1996.
2. The Committee agenda items 3 - 8 were approved.
3. Review of the Implementation of PICES IV Decisions:
 - 3.1. Review of implementation of Vladivostok Workshop Recommendations.
 - 3.1.1. Committee reviewed the document and recommendations, and complements the Working Group for an excellent job.
 - 3.2. Review and comment on three recommendations in WG 9 Report:
 - 3.2.1. Recommendation #1: PICES recommends member nations to establish ecological monitoring moorings in the Alaska Gyre and Western Subarctic.
Recommendation #2: PICES/FIS recommends member nations to investigate the possibility of installing a conduction cable across Kamchatka Strait as specified by the Working Group.

Recommendation #3: PICES/FIS supports the idea of a "State of the subarctic Pacific" session at the next PICES Annual Meeting, and sees this activity as part of the REX and BASS activities already planned for the meeting.

- 3.3. Russian and Korean member of FIS should provide names of scientists working on pelagic species in order to complete WG 3 inventory:
 - 3.3.1. Russian and Korean members agreed to provide these data one month after the meeting.
- 3.4. Discussion of how to increase participation in Scientific Committees:
 - 3.4.1. Issues discussed under this topic are listed under new business.
4. Discussion of Scientific Items of Interest.
 - 4.1. Discussion of FIS role in the CCCC-GLOBEC Program and identify the main scientific activity.
 - 4.2. Response to SCOR-WG 105:
 - 4.2.1. The FIS Committee wishes to point out to SCOR that the North Pacific is poorly represented in WG 105. The Committee recommends that the Secretariat contacts SCOR, indicating the lack of representation, and provide names of some potential participants. The Committee recommended Drs. Tang and Wakabayashi as PICES representatives to SCOR-WG 105.
 - 4.3. Review of PICES WG 12 on Crabs and Shrimps:
 - 4.3.1. The Committee approved the minutes of WG 12 and the October 16, 1996, addendum

- which indicate that an inter-sessional meeting would be held for about 4-5 days sometime between PICES V and PICES VI meetings.
- 4.4. Co-sponsorship of ICES Symposium on recruitment dynamics:
 - 4.4.1. FIS Committee noted that the symposium was already sponsored by PICES so no action by Committee was required.
 - 4.5. Discussion of holding a joint PICES/NPAFC Symposium:
 - 4.5.1. FIS Committee deferred any recommendations on item 4.5 until PICES and NPAFC have their joint meeting to discuss cooperation and integration of Science Plans in early 1997.
 5. Proposal for session topics for PICES VI and PICES VII Annual Meetings:
 - 5.1. FIS Committee approved the FIS topic for PICES VI to be "Models for linking climate and fish". Dr. Patricia Livingston has agreed to co-convene the meeting.
 6. Best Presentation Award for the FIS Session at PICES V:
 - 6.1. Several papers were nominated, a vote held, and the paper by Dr. Richard D. Brodeur et al. "The distribution of juvenile pollock relative to frontal structure near the Pribilof Islands, Bering Sea" was selected.
 7. Review of PICES Perspectives:
 - 7.1. FIS Committee reviewed the document and agreed with the views expressed.
 - 7.2. FIS made recommendations concerning PICES representation in SCOR-WG 105 (see 4.2 above). In connection with the scientific program, PICES should further develop close relationships with PICES regional fisheries committees, e.g., tuna and pollock.
 8. New Business:
 - 8.1. Schedule of PICES VI: the FIS Committee strongly recommends that all scientific presentations be given in one block of time uninterrupted by Working Group and Committee meetings. The Committee felt that the interspersing of such meetings with the scientific transactions was a disservice to those attending the meetings for their scientific content (which we wish to encourage) and discourages attendance.
 - 8.2. Albacore and Bluefin: It was suggested to the Committee that including the ecology and movements of temperate tunas (albacore and bluefin) would broaden the PICES perspective by providing another group that is keenly interested in fish ecology and ocean dynamics and provide a service to tuna-oceanographers because of the strong representation of physical oceanography in PICES. A suggestion was made that the FIS topic for 1998 might be something like basin scale changes on ocean dynamics and fish migration, which would appeal to those interested in temperate tunas as well as salmon.

Endnote 1

Report of Working Group 12 Crabs and Shrimps

Introduction

Working Group 12 was established by the Governing Council in October 1995. Interest in a working group was prompted by recent changes in the abundance of crabs and shrimps and economic consequences of these changes in the PICES region (generally north of 33° North Latitude). Working Group members were named in May and there has been limited time for organization. The primary purposes of activating the working group are to organize the Working Group and to begin implementation of the terms of reference.

Participants

Members of the working group as submitted by national delegations are as follows:

Canada

Jim Boutillier
Glen Jamieson (Rapporteur)

China

Ren Shengmin*

Japan

Yasuki Ogawa*
Hideo Sekiguchi^a
Ikuko Yoshio*

Korea

Sung Yun Hong*
In Ja Yeon*
Chang Ik Zhang*

Russia

B. Ivanov^a
V. Rodin (Co-Chairman)*
Yu Zaitseva^a

U.S.A.

David A. Armstrong

Louis W. Botsford^a
Robert S. Otto (Co-Chairman)

^a = absent with regrets; Drs. Ivanov and Sekiguchi sent written comments for consideration by the WG ; * = absent

Attendance at this first WG meeting was low (Otto, Armstrong, Boutillier and Jamieson), primarily because the WG meeting date and location were only announced about a month prior to the meeting. This problem should be resolved by announcement of the next meeting date and location well ahead of time.

Terms of Reference

The establishment of a working group on crabs and shrimps was considered by the Governing Council upon the recommendation of the Fishery Science Committee. The Governing Council used the following language in establishing Working group 12:

“Because of recent changes in the abundance of crabs and shrimps and their economic consequences in the PICES region, the Working Group is established to:

- a. Identify the persons performing scientific work on the distribution, recruitment, larval transport, migration, population dynamics, and influences of environmental conditions for crabs and shrimp in the PICES region.
- b. Identify data that are available that would assist in the analyses of factors affecting abundance trends.
- c. Review current knowledge of factors affecting abundance and survival of crabs and shrimps and identify the key scientific questions relating to the understanding of the reasons for abundance fluctuations.
- d. Exchange data on the abundance of crab and shrimp stocks in the PICES region.”

The WG discussed the Terms of Reference and **proposes the following revisions.** The WG will:

- a. consider only those crab and shrimp species important to human utilization in a commercial, subsistence or recreational sense; this can include introduced species if they are directly important or impact human utilization of any other marine species,
- b. identify organizations and key contacts from each that are performing scientific work on the distribution, recruitment, larval transport, migration, population dynamics, and influences of environmental conditions for crabs and shrimps,
- c. identify data that are available that would assist in the analyses of factors affecting abundance trends.
- d. review and exchange current knowledge and data concerning factors affecting abundance and survival of crabs and shrimps and identify key scientific questions regarding reasons for abundance fluctuations.

These changes in the Terms of Reference are proposed because of:

- a. The large number of crab and shrimp species in the North Pacific, and the resultant need to focus on just a few key species. The species identified provide an interesting array of the complex life histories and habitat requirements that may provide interesting contrasts when examining natural and/or anthropogenic causes of abundance variation.
- b. The large number of researchers involved to some extent with at least some of the identified species. The WG felt a need to restrict the scale of its mandate to allow optimal progress to be achieved.

Review of Documents

Because of poor attendance no documents were reviewed at this initial meeting.

WG members are asked to provide a list of organizations and key researchers or experts in their respective country, along with their fields of interest. Each member should provide several recent publications that provide a review of crab or shrimp species, or their fisheries. The list of species identified as important (Appendix 2) should also be amended as necessary. This information is to be provided to Dr. Otto by January 1, 1997.

Resources of crabs and shrimps

A provisional list of exploited and important species (Appendix 1) is attached.

Status of Resources

- a. Each WG member is asked to bring to the next meeting previous published material on stock status, recent population abundance trends, and what is known or hypothesized about the causes of these fluctuations. For a suggestion as to how stocks or populations of species might be grouped, see Appendix 2, which is reasonably complete for the eastern Pacific but probably incomplete for the western Pacific. Each WG member will be asked to present a brief summary of this information on relevant species within their region.
- b. Species populations worthy of being considered by the WG are to be determined by each country's representatives. Criteria by which populations may be identified include stage of population exploitation, unique management approach, differences in pattern of abundance fluctuation, and quality and quantity of data. A commentary of every population need not be presented orally, as meeting time will be limited. Emphasis should be on those populations

which show contrast and best illustrate patterns of abundance in each geographic fisheries area selected.

- c. From this information, the WG will compile a multispecies compendium as to what appears to be driving population abundance fluctuations and what research is underway or planned in member countries. From this compilation, we will then develop recommendations for PICES as to how relevant research can best be coordinated among Standing Committees and what future research is needed.

Future Meetings

- a. The WG **recommends** that the next meeting of the WG be held for 5 days immediately before the 1997 PICES Annual Meeting in Korea. It is hoped that an Asian meeting will facilitate attendance by PICES member countries not present at this meeting.
- b. Subsequent meetings will probably be held intersessionally, and at the next meeting, with more member countries hopefully present, an agenda over the life of the WG will be developed.

Appendix 1. A provisional taxonomic list of species of crabs and shrimps exploited in the PICES area (major taxon according to American fisheries Society Special Publication 17, common names per AFS or UN/FAO if possible). Question marks (?) either indicate uncertainty as to range, importance or general interest, or the need for further definition. Almost all species below have known commercial, recreational or subsistence fisheries that exploit them. * = important species to be considered by the WG.

PHYLUM, SUBPHYLUM, OR SUPERCLASS: Crustacea

CRABS *et al* :

CLASS: Malacostraca

SUBCLASS: Eumalacostraca

ORDER: Decapoda

INFRAORDER: Anomura

SUPERFAMILY: Paguroidea

FAMILY: Lithodidae

Stone and king crabs

Red King Crab

Paralithodes camtschaticus *

Blue King Crab

P. platypus *

Hanasaki King Crab

P. brevipes *

Golden King Crab

Lithodes aequispinus *

Scarlet King Crab

L. couesi *

Paralomis spp

Paralomis multispinus

Paralomis spp

Paralomis verrilli

Puget Sound king crab

Lopholithodes mandtii

INFRAORDER: Brachyura

SECTION: Oxyrhyncha

SUPERFAMILY: Majoidea

FAMILY: Majidae

Spider crabs

Tanner Crab	<i>Chionoecetes bairdi</i> *
Snow Crab	<i>C. opilio</i> *
Angled Tanner Crab	<i>C. angulatus</i> *
Grooved Tanner Crab	<i>C. tanneri</i> *
Benizuwai Tanner crab	<i>C. japonicus</i> *
Arctic lyre crab	<i>Hyas coarctatus</i>
Pacific lyre crab	<i>H. lyratus</i>
Sheep crab	<i>Loxorhynchus grandis</i>

SECTION: Cancridea
 SUPERFAMILY: Cancroidea
 FAMILY: Ateleyclidae

Horse crabs

Hair Crab	<i>Erimacrus isenbeckii</i> *
Helmut crab	<i>Telmessus cheiragonus</i>

FAMILY: Cancridae

Rock crabs

Dungeness crab	<i>Cancer magister</i> *
Red rock crab	<i>C. productus</i>
Yellow rock crab	<i>C. anthonyi</i>

SECTION: Brachyrhyncha
 SUPERFAMILY: Portunoidea
 FAMILY: Portunidae

Swimming crabs

Sand crab	<i>Portunus pelagicus</i>
Gazami Crab	<i>P. trituberculatus</i> *
Mud Crab	<i>Scylla serrata</i>

SHRIMPS

PHYLUM, SUBPHYLUM, OR SUPERCLASS: Crustacea

CLASS: Malacostraca
 SUBCLASS: Eumamacostraca
 ORDER: Decapoda

SUBORDER: Dendrobranchiata
 SUPERFAMILY: Penaeoidea
 FAMILY: Penaeidae

Penaeoid shrimps

Kuruma prawn	<i>Penaeus japonicus</i> *
Fleshy prawn	<i>P. chinensis</i>
Shiba shrimp	<i>Metapenaeus joyneri</i> *
Yoshi shrimp	<i>M. ensis</i> *
Cocktail shrimp	<i>Trachypenaeus curvirostris</i>

SUPERFAMILY: Sergestoidea

FAMILY: Sergistidea

Akiami shrimp *Acetes japonicus*

SUBORDER: Pleocyemata

INFRAORDER: Caridea

SUPERFAMILY: Pandaloidea Pandalid shrimps

FAMILY: Pandalidae

Sidestriped shrimp	<i>Pandalopsis dispar</i> *
Morotoge shrimp	<i>P. japonica</i> *
Northern shrimp	<i>Pandalus borealis eous</i> *
Humpy shrimp	<i>P. goniurus</i> *
Dock shrimp	<i>P. danae</i>
Coonstriped shrimp	<i>P. hypsinotus</i> *
Ocean shrimp	<i>P. jordani</i> *
Spot shrimp	<i>P. platyceros</i> *
Hokkai shrimp	<i>P. latirostris</i> *

SUPERFAMILY: Crangonoidea

FAMILY: Crangonidae

Northern sculptured shrimp *Sclerocrangon boreas* *

Uneven sculptured shrimp *S. salebrosa* *

? Crangon franciscorum

Appendix 2. A list of important crab and shrimp stocks in the PICES area with a provisional classification of their size, trends in abundance, utilization and degree of fishery development. Current stock abundance categories are intraspecific relative to the historical level: small (s), medium (m) and large (l). Long term trends are periodically fluctuating (P), decreasing (D) and increasing (I). Fishery types are characterized as commercial (C), recreational (R) and subsistence (S). Fishery status is characterized as closed (*), undeveloped (U), developing (D), or fully developed (F). Question marks indicate uncertainty or lacking information.

Species/stock	Abundance		Long-term Trend	Type	Status
	Historical	Current			

CRABS et al :

Red King Crab

Canada	s	s	?	C,R,S	D
S.E. Alaska	s	s-	?	C,R,S	F

Species/stock	Abundance		Long-term Trend	Type	Status
	Historical	Current			

Cook Inlet	m	s	D	C,R,S	*
Kodiak	l	s	D	C,R,S	*
S. Ak. Peninsula	l	s	D	C,R,S	*
E. Aleutians	l	s	D	C,S	*
W. Aleutians	l	s	D	C,S	*
Bristol Bay	l	s	D	C	*
Pribilof Islands	s	s	D	C,S	F
Norton Sound	s	s	?	C,R,S	F
E. Kamchatka	s	?	?	C	F
W. Kamchatka	l	m?	D?	C	F
N.W. Sea of Okhotsk	s/m	s/m	?	C	F
Kurile Islands	s	?	?	C	F
E. Sakhalin Is.	s	s	D	C	F
W. Sakhalin Is.	s/m	s	D	C	F
Hokkaido	s/m	s	?	C	F

Blue King Crab

S.E. Alaska	s	s	?	C,R,S	F
Prince William S.	s	s	?	C,R,S	*
Other G. of Alaska	s	s	?	C,R,S	*
Pribilof Islands	l	s	D	C,S	F
St. Matthew Is.	l	m	?	C	F
N. Bering Sea	s	s	?	C,S	D
Cape Navarin	m	s	D	C	F
S. Koryak Caost	m	s	D	C	F
E. Shelikhov Bay	l	m	?	C	F
N.W. Shelikhov Bay	m	m	?	C	F
St. Iona Is.	s	?	D	C	F
E. Sakhalin Is.	s	?	?	C	F
W. Sakhalin Is.	s	?	?	C	F
Hokkaido	s	?	?	C	F
Sea of Japan	s	?	?	C	F

Hanasaki King Crab

E. Kamchatka	s	?	?	S	?
S.W. Kamchatka	m	?	?	C	F
N. Sea of Okhotsk	m	?	?	?	D
Kurile Islands	s	?	?	C	?
E. Sakhalin Is.	s	?	?	C	F
W. Sakhalin Is.	s	?	?	C	F
Hokkaido	l	D	?	C	F
Sea of Japan	m	?	?	C,R	F?

Species/stock	Abundance		Long-term Trend	Type	Status
	Historical	Current			

Golden King Crab

Canada	s	s	?	C	U
S.E. Alaska	m	s	?	C	F
Other G. of Alaska	s	s	?	C	F
E. Aleutians	m	m	D?	C	F
W. Aleutians	l	l	D?	C	F
Bristol Bay	s	s	?	C	F
Pribilof Islands	s	s	?	C	F
N. Bering sea	s	s	?	C	D
E. Kamchatka	s	?	?	C,S	U
W. Kamchatka	m	s	?	C	F
N. Sea of Okhotsk	l	s?	D	C	F
Kurile Is.	m	s	D?	C	D/F
Hokkaido	s	?	?	C	?

Scarlet King Crab

Calif.- Washington	?	?	?	?	?
Canada	?	?	?	?	?
Gulf of Alaska	?	?	?	C	D
Aleutian Islands	?	?	?	C	D
E. Bering Sea	S	?	?	C	D
W. Bering Sea	M	?	?	C	U/L
N. Sea of Okhotsk	L	?	?	C	U/L

Tanner Crab

S.E. Alaska	s	s	D	C,R,S	F
Cook Inlet	m	s	D	C,R,S	F
Kodiak	l	s	D	C,R,S	F
S. Ak. Peninsula	l	s	D	C,R,S	F
E. Aleutians	s	s	D	C,R,S	F
W. Aleutians	s	s	D	C,R,S	L
E. Bering Sea	l	m	D	C	F
N.W. Bering Sea	s	s	D	C	F
S. Koryak Coast	m	?	?	C	F
Olyutorskiy Bay	l	?	?	C	F
W. Kamchatka	m/l	?	?	C	F

Snow Crab

E. Bering Sea	l	l	P	C	F
W. Bering Sea	l/m	l/m	?	C	F

Species/stock	Abundance		Long-term Trend	Type	Status
	Historical	Current			

S. Koryak Caost	m	?	?	C	F
Olyutorskiy Bay	s	?	?	C	F
E. Kamchatka	s	?	?	C	F?
W. Kamchatka	m	?	?	C	U/D
N. Sea of Okhotsk	l	m	P	C	F
E. Sakhalin Is.	l	m/l	D	C	F
W. Sakhalin Is.	s	?	?	C	F
Sea of Japan	l	m	D	C	F

Angled Tanner Crab

Canada	?	?	?	C	U
Gulf of Alaska	?	?	?	C	L
Aleutian Islands	?	?	?	C	L
E Bering Sea	?	?	?	C	L
N. Sea of Okhotsk	m	?	?	L	L

Grooved Tanner Crab

Calif.- Washington	?	?	?	?	U
Canada	?	?	?	C	U
Gulf of Alaska	?	?	?	C	L
Aleutian Islands	?	?	?	C	L
E. Bering Sea	?	?	?	C	L
W. Bering Sea	s	?	?	C	L

Benizuwai Tanner crab

Sea of Japan	l?	m?	?	C	F?
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Hair Crab

E. Bering Sea	m	m	?	C	F
Aleutian Islands	s	?	?	C	L
E. Kamchatka	s	?	?	C	U
S.E. Kamchatka	m	?	?	C	F
Kurile Islands	m	?	?	C	U/F
E. Sakhalin Is.	s	?	?	C	F
W. Sakhalin Is.	m	?	?	C	F
Hokkaido	l	m	?	C	F
Sea of Japan	m	l	?	C	F
Korean Coast	m?	?	?	C	F

Species/stock	Abundance		Long-term	Type	Status
	Historical	Current	Trend		

Dungeness crab

S. California	m	s	D,P	C,R	F
N. Calif.- Wash.	l	l	P	C,R	F
Puget Sound	m	m	P	C,R	F
Canada, WCVI	m	m	?	C,R,S	F
Canada, ECVI	m	m	?	C,R,S	F
Canada, QCI	l	m	D,P	C,R	F
Canada, Central	m	m	?	C,R,S	F
S.E. Alaska	l	m	P	C,R,S	F
Cook Inlet	m	s	D,P	C,R,S	F
Kodiak	l	s	D,P	C,R,S	F
S. Ak. Peninsula	m	s	D,P	C,R,S	F
E. Aleutians	m	s	D	C,R,S	F
E. Bering Sea	s	s	?	C	F

Sand crab ? STOCKS

FAO Area 61	1	?	?	C	F?
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Gazami Crab ? STOCKS

FAO Area 61	1	?	?	C	F
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Mud Crab ? STOCKS

FAO Area 61	1	?	?	C	F?
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SHRIMPS

Kuruma prawn ? STOCKS

FAO Area 61	1	?	?	C	F?
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Fleshy prawn ? STOCKS

FAO Area 61	1	?	?	C	F?
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Shiba shrimp ? STOCKS

FAO Area 61	1	?	?	C	F?
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Yoshi shrimp ? STOCKS

Species/stock	Abundance		Long-term Trend	Type	Status
	Historical	Current			

FAO Area 61	?	?	?	C	F?
Cocktail shrimp ? STOCKS					
FAO Area 61	1	?	?	C	F?
Akiami shrimp ? STOCKS					
FAO Area 61	1	?	?	C	F?
Sidestriped shrimp					
Calif.- Wash.	s	?	?	C	F?
N.Coast B.C.	1	1	?	C	U-F
S.Coast B.C.	m	s	D	C	F
S.E. Alaska	s	s	?	C	F
Prince William S.	1	s	D	C	F
Cook Inlet	m	s	D	C	*
Kodiak	1	s	D	C	*
S. Ak. Peninsula	1	s	D	C	*
E. Aleutians	m	s	D	C	F
Morotoge shrimp ? STOCKS					
FAO Area 61	?	?	?	C	F?
Northern shrimp					
N. Coast B.C.	s	s	I?	C	F
S. Coast B.C.	s	s	D	C	F
S.E. Alaska	s	s	D	C	F
Cook Inlet	m	s	D	C	F
Kodiak	1	s	D	C	F
S. Ak. Peninsula	1	s	D	C	F
E. Aleutians	m	s	D	C	F
E. Bering Sea	1	s	D	?	?
W. Bering Sea	s	?	?	C	U
W. Kamchatka	s	?	?	C	U
E. Sakhalin Is.	s	?	?	C	U
W. Sakhalin Is.	m	m	?	C	F
N. Sea of Japan	m?	m	?	C	U

Species/stock	Abundance		Long-term Trend	Type	Status
	Historical	Current			

Humpy shrimp

Cook Inlet	s	s	D	C	*
Kodiak	m	s	D	C	*
S. Ak. Peninsula	m	s	D	C	*
E. Aleutians	S	s	D	C	*
E. Bering Sea	m?	s	D	?	U
W. Bering Sea	s-l?	l	?	C	U-L
W. Kamchatka	S	l	?	C	U-L
S. Sakhalin Is.	s-m?	l	?	C	U-L

Coonstriped shrimp

N. Coast, B. C.	m	m	?	C,R,S	U
Cen. Coast, B. C.	m	m	?	C,R	U
S. Coast, B. C.	m	m	?	C,R	U
S.E. Alaska	s	s	?	C,?	?
Cook Inlet	l?	s	?	C,R,S	F
Kodiak	m,l	?	?	C	?
S. Ak. Peninsula	s	?	?	C	?
E. Aleutians	s	?	?	C	?
Tartar Strait	m	s	?	C	F
Peter the Great Bay	m	?	?	C	U

Hokkai shrimp Stocks ?

FAO Area 61	m?	?	?	C	?
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Ocean shrimp

Calif.- Wash.	l	?	P	C	F
Offshore, B. C.	m	s	D	C	F
Inshore, B. C.	s	s	?	C	F

Spot shrimp

Calif.- Wash.	s	?	?	C,R	F?
Canada	l	l	?	C,R	F
S.E. Alaska	l	m	D?	C,R,S	F
Prince William S.	l	m	D?	C,R,S	F
Cook Inlet	S	l	D	C,R,S	F

Northern sculptured shrimp

W. Bering Sea	s?	s?	?	C	U
E. Kamtchatka	m	m	?	C	U

Uneven sculptured shrimp

W. Bering Sea	s?	s?	?	C	U
E. Kamtchatka	m	m	?	C	U

Appendix 3

Addendum to WG 12 Minutes

Minutes of Working Group 12 (WG 12 - Crabs and Shrimps) were presented to the Fishery Science Committee (FIS) on October 16. The minutes contained a proposal for a 1997 WG 12 meeting of five days immediately prior to the 1997 PICES meeting. Following this presentation there was discussion of where and when WG 12 should meet as it appeared to the FIS that a five day meeting prior to the 1997 PICES Meeting in Korea would result in conflicts with other working groups and sub-committees. The proposed duration and timing would also, in combination with PICES, result in an overly long and hence arduous meeting for participants. FIS requested that WG 12 members that were present reconsider where and when the Working Group might meet in 1997 and present a tentative meeting schedule.

Available WG 12 members were Dr. Glen Jamieson (Canada, Rapporteur), Dr. Jim Boutillier (Canada), and Dr. Robert S. Otto (U.S.A., Co-Chairman). This group met during the afternoon of October 16 and proposed the following in order to reduce conflicts and to facilitate participation by nations in the western portion of the Pacific rim.

1. An inter - sessional meeting would be held in an Asian country (to be decided) for a period of 4 - 5 days, probably in June 1997,
2. Results of this meeting would be communicated to the Task Team on Regional Experiments (REX) at their meeting immediately prior to the 1997 PICES meeting.

3. Tentative Schedule for the WG 12 1997 meeting

DAY 1

- 08:00 - 09:00. Introductions, review of terms of reference and adoption of agenda.
- 09:00 - 12:00. Review of Canadian Crab and Shrimp stocks.
- 13:00 - 14:00. Review of USA stocks, California to Washington.
- 14:00 - 17:00. Review of USA stocks, Gulf of Alaska.

DAY 2

- 08:00 - 12:00. Review of eastern Bering Sea and Aleutian Island Stocks.
- 13:00 - 17:00. Review of Russian stocks.

DAY 3

- 08:00 - 12:00. Review of Japanese stocks
- 13:00 - 17:00. Review of Chinese stocks

DAY 4

- 08:00 - 12:00. Review of Korean stocks
- 13:00 - 17:00. Work session - synthesis

DAY 5

- 08:00 - 12:00. Work session - synthesis
- 13:00 - 17:00. Plenary session, adjournment.

REPORT OF MARINE ENVIRONMENTAL QUALITY COMMITTEE



The MEQ Scientific Committee met in two sessions during PICES V in Nanaimo, British Columbia, Canada. The first session was held from 1330 to 1730 hours on Wednesday, October 16, 1996. A concluding session was convened from 1330 to 1730 hours on Thursday, October 17, 1996.

Introduction

The meeting was opened by MEQ Chairman, Dr. Richard Addison, who welcomed all participants, and asked that each introduce themselves and their affiliations. The Chairman then proposed an agenda which was unanimously accepted, and the meeting was called to order.

Best MEQ Paper Award

This was deferred until the conclusion of the MEQ second session on Thursday 10-17-96, after which MEQ members selected the winner by closed ballot. The winner of the PICES V Award for Best MEQ Paper was Dr. Yuan Gao, Research Professor at the Institute of Marine and Coastal Sciences, Rutgers University. Dr. Gao's winning paper was entitled "Cycling of contaminants through the atmosphere: long range transport vs. regional deposition".

Presentation of WG 8 Report

WG 8 Co-Chairman Dr. Stein then reported on the progress of his Working Group, which is tasked with planning and convening an MEQ Practical Workshop in Jiaozhou Bay, Qingdao, People's Republic of China. This workshop aims to harmonize approaches among PICES countries to assess ecological impacts of pollution, by working together on a single issue. The specific goal of the workshop is to assess bioaccumulation and effects of contaminants in Jiaozhou Bay ("contaminated" site), as compared to Laoshan Bay ("reference" site).

Although markedly different in their extent and types of pollutant sources, both bays are heavily focused on mariculture and are reasonably comparable in terms of oceanographic, sedimentation, and biological characteristics.

The workshop also represents the first step leading to a much larger scale project (Phase II) in the Changjiang (Yangtze) estuary, which will be conducted along a preselected gradient in the East China Sea as a contribution to baseline data for the Three Gorges Dam Project.

WG 8 convened October 11-12, at the Coast Bastion Hotel, Nanaimo, to review current progress and draft a more specific work plan. Some of the more fundamental concepts in the research design had been previously set forth at a preliminary ad hoc meeting of North American members of MEQ and WG 8, held in Seattle June 20. The Qingdao Practical Workshop will take place in May - June of 1997, and will consist of three phases.

First, a compilation of existing data and literature specific to the Qingdao marine ecosystem will be performed. This effort is currently in progress, directed by Dr. Levings with assistance from a Chinese graduate student from Qingdao, currently studying at the University of British Columbia. Concurrent with the literature review, the variables to be measured will be finalized within the research design.

The second phase, planned to begin in May, 1997, will be a field reconnaissance survey in Qingdao, to assess the feasibility of sampling, and to validate the sampling design. The reconnaissance will also serve to confirm that all necessary equipment is available and working, to field-test the sampling gear, and to set up the laboratory. This preliminary work will continue for 1-2 weeks. Three or four MEQ/PICES scientists of varying but complementary

backgrounds will work with the Chinese in this effort. It is suggested that daily e-mail reports of the reconnaissance survey be sent out daily to all workshop participants.

The third phase, scheduled for June, 1997, will be the actual implementation of the Practical Workshop in Qingdao. Within a week following the reconnaissance survey, the sampling design will be refined as appropriate and sampling will begin.

The tentative design of the research will include the following major points:

- Jiaozhou Bay and the nearby Laoshan Bay (reference site) will be sampled cooperatively by the MEQ international team of participating scientists, with headquarters and facilities under the guidance and kind cooperation of Prof. Ming-Jiang Zhou, Academia Sinica. This cooperative sampling and analysis phase will be carried out by up to 24 participants, approximately four from each PICES member country.
- Sediment and benthic invertebrates will be the primary focus. Fish and other vertebrates will serve as a secondary focus.
- Jiaozhou Bay benthos will be sampled at 5 - 7 sites, with the center of the bay serving as an integrating site for comparative purposes. Included in the peripheral sites--at a minimum-- will be specific benthic grabs from gradients off an industrial site, an agricultural runoff site, and an aquaculture site.
- At the same time, studies of primary productivity will be conducted, via an ongoing agreement between Japan and China. Dr. Watanabe (MEQ member and WG 8 member) is coordinating this phase of the study with Dr. Harada, and Prof. Ming-Jiang Zhou.

- For performing laboratory analyses of the various samples, four possibilities were set forth:

1. As many of the analyses as possible would be performed cooperatively at the Institute of Oceanology in Qingdao.
2. On a case-by case basis, certain types of analyses might necessarily be performed at other PICES-participating laboratories elsewhere in the Northwest Pacific.
3. It may also be necessary to perform some specific analyses at other locations outside PICES laboratories, with involvement of participants as feasible, and
4. certain analyses (e.g. otolith aging) which do not require inter-laboratory cooperation could be done at any convenient time and location later on.

- Immediately following the workshop, wrap-up meetings would also be held in Qingdao.

- Data exchange and interpretation, and the formulation of preliminary results would continue through summer 1997.

- At PICES VI (October 1997), MEQ /WG8 will issue a preliminary report to PICES.

- A more complete series of review and discussion of our findings will take place at PICES VII in October, 1998.

- Final publication of the results in the scientific literature will be rigorously pursued, as appropriate.

Expected products of the Workshop will be:

1. At the minimum, an improved understanding of the impacts of pollution in Jiaozhou Bay.
2. In addition, a "synergistic" output resulting from a range of techniques and approaches applied to a single issue of mutual research interest, and

- Probably most importantly, an improved appreciation of the motivations, approaches, needs and expertise of our MEQ /PICES colleagues.

Discussion of WG 8 Report and Recommendations

Dr. Stein's presentation stimulated considerable discussion about the proposed Qingdao practical workshop.

Dr. Varanasi reminded the group that one of the original MEQ goals for this exercise - the comparison of methodologies - does not appear to be adequately stressed by the proposal. Inter-calibration and inter-comparisons among the various participating scientists and laboratories will be of great benefit in sharing techniques with all participating scientists, and will also generate data which are more quality assured. MEQ agreed that it will be important to do as much of the laboratory work as possible on location in Qingdao, while we all able to benefit from working closely with one another at a common facility.

Dr. Addison suggested that it would be best to do as much analyses as possible on site in Qingdao. Some of the tests, such as total fluorescence for total hydrocarbons, would be relatively quick and easy to do. For a few critical procedures, such as low level GC /MS analyses for certain pollutant suites, "Comet" assays, etc., it may be necessary to ship samples or sample extracts to other laboratories outside China. There was agreement that wherever possible, scientific and analytical work should be done together as a group in Qingdao. Since the goal of the Technical Workshop is the harmonization of techniques and methodologies among PICES member scientists, it is critical that the highly specialized and novel assessment techniques be conducted as a team on site, as much as possible.

It was suggested that we view the possible sampling of marine birds on an "opportunistic" basis. MEQ hopes that a limited number of

specimens of appropriate bird species birds can be sampled. This will be dictated largely by the results of the proposed reconnaissance survey, and local conditions during the study period. Dr. McCain asked about the status of our proposed sampling platform(s) in Qingdao. It was generally agreed that Prof. Ming-Jiang Zhou's facility at Academia Sinica would easily be able to provide us with all necessary watercraft and equipment with which to conduct reconnaissance and sampling.

Drs. Tkalin, Watson and others asked about getting proper clearance and permission from the Chinese government prior to the Workshop. As a point of clarification, Dr. Yang explained the joint agreement which KORDI has with China, relative to conducting research in Qingdao. He pointed out that as one of China's major oceanographic and marine sciences research centers, Qingdao has four different groups of scientists doing work with four separate agencies. These are: (1) First Institute of Oceanography: State Oceanographic Administration, (2) Academia Sinica (Prof. Ming-Jiang Zhou, Director), (3) Yellow Sea Fisheries Research Center, and (4) Ocean University of Qingdao. Each of these is a separate and distinct agency /facility, and Dr. Yang's formal agreement for joint research is with (1).

Dr. Yang, through his working knowledge of the various Qingdao laboratories, commented very favorably on the high quality of work and the level of instrumentation and capabilities at the Academia Sinica (#2 above) in Qingdao. In his opinion, this laboratory is generally well-equipped. Dr. Yang also favored the idea of bringing together 2-4 scientists from each PICES country. He suggested that to best foster the concept of inter-comparison among countries and laboratories, we should do our best to bring everyone together to share techniques on site, with as many techniques being performed together at Qingdao as possible. He is also concerned about QA /QC, as is MEQ as a whole.

Since PICES /MEQ is planning to conduct its workshop via the facilities and courtesy extended to us by Prof. Ming-Jiang Zhou at the Academia Sinica, it is very important that MEQ PICES make sure that the proper diplomatic channels have been contacted within the Chinese government, and that our working agreements are firmly and clearly established at all levels prior to commencing the workshop. This issue is made more urgent in light of the current lack of Chinese representation on the PICES Science Board. Consequently, MEQ/PICES strongly urged that PICES Science Board and Governing Council formally pursue this issue as soon as possible. MEQ also recommended that the PICES Science Board and Governing Council establish an agreement with the Chinese Government relative to obtaining samples, and shipping some of these samples out of China. MEQ also recommended that PICES establish a formal agreement with the Chinese government regarding the release of scientific data to interested global scientific and media parties, publication in the world literature, etc.

Dr. Tkalin reminded all participants that these issues have already been basically agreed upon, at least on an informal basis by all participating MEQ/WG 8 scientists involved. What remains is for MEQ to remind PICES of the critical importance of continued high-level dialogue with our Chinese colleagues via appropriate diplomatic channels, and that the Science Board and Governing Council make sure that any possible diplomatic, regulatory or export barriers are identified and cleared with the Chinese government prior to our actual research.

Dr. Yang stressed the importance of meeting later to discuss results; i.e., at PICES VI and VII.

Prof. Hirano highlighted the need to obtain and study existing data about the Jiaozhou and Laoshan Bay areas, and especially data regarding current and historic human impacts on these two marine ecosystems.

Presentation and Discussion of WG 8 funding request for Jiaozhou Bay Workshop

Dr. Addison then reviewed the projected funding requirements set forth by WG 8, as necessary to carry out the practical workshop. The original total estimated costs set forth by WG 8 were \$62,000 (CDN\$). For the estimated 24 participating scientists from the six PICES countries this was designed to cover travel (\$20,000), accommodation and meals for 15 days (\$36,000), supplies and shipping (\$5,000), and literature review of the Jiaozhou Bay area (\$1,000).

MEQ suggested that because of the need for a reconnaissance survey prior to the sampling, the budget should be increased by \$4,200 to support three scientists for an additional two weeks in Qingdao prior to the Workshop. Also, although WG 8 had factored in no costs for laboratory facilities, MEQ suggested that \$5,000 be allocated for reimbursing Professor Ming-Jiang Zhou and Academia Sinica for their laboratory supplies and other expenditures, in appreciation of their role and services as MEQ's laboratory and scientific coordination facility in Qingdao. These additions resulted in a total estimated Workshop cost of \$71,200 (CDN\$).

Dr. Addison went on to explain that of this total, PICES Governing Council and Science Board will be formally asked by MEQ to provide support at the level of \$30,000. This leaves \$41,200 to be generated by funding sources outside PICES per se, if the practical workshop is to take place in May 1997 as planned. Dr. Addison suggested that some of the more important vending sources for us to contact would include:

1. IOC,
2. WESTPAC (which counts among its members Prof. Jia-Yi Zhou, former Chairman of MEQ /PICES),
3. CETA, and
4. the World Bank.

Dr. Tkalin indicated that the current Chair of WESTPAC is Dr. Taira, at the University of Tokyo. Also, it is his understanding that PICES has already allocated general funds for travel of Russian and Chinese scientists to PICES research venues, and perhaps this can be used in part to support our MEQ Practical Workshop.

Dr. Varanasi suggested that each MEQ member formally approach their respective sponsoring Agencies, and ask that travel funds be set aside for PICES- related research such as Jiaozhou Bay. Perhaps the \$30,000 PICES funding can be used for leverage with these various other PICES-nation agencies.

Prof. Hirano suggested that we keep the workshop open to the possibility of inviting a small number of non-PICES scientists, in case such a need arises. For example, if WESTPAC were to help fund the Practical Workshop, and wished to send a small number of participating scientists, MEQ/PICES should be prepared to accommodate them in our plan.

Recommendations of MEQ Committee to PICES Science Board

After much discussion, the MEQ formulated two recommendations to the Science Board. These were:

1. The MEQ Committee accepts the report of WG 8 and recommends that PICES allocate \$30k as its contribution to support the proposed MEQ Practical Workshop in Jiaozhou Bay scheduled for May/June 1997, at the invitation of the Institute of Oceanology, Academia Sinica, Qingdao, People's Republic of China. Total cost of the Workshop is estimated at \$71.2 K.
2. The MEQ Committee recommends that PICES contact the proper Chinese authorities to arrange all necessary approvals and permits for conducting a cooperative scientific study (a "Practical Workshop") in May/June 1997.

Other Business

Pre-Workshop Timelines

Considerable discussion was generated about the need for the WG 8 Ad Hoc Implementation Group to set up a timeline, and milestones, for the process of gathering technical information and completing other necessary preparatory steps toward carrying out the actual Workshop.

It was agreed upon that a reasonable timeline for obtaining essential preliminary background information about Jiaozhou and Laoshan Bays would be December 1, 1996. This information would consist of two parts: Part A would include the completion of a review of published scientific information in the bay (responsibility; Dr. Levings, with the assistance of a graduate student familiar with Qingdao). Part B would include a summary of pollution sources which impact the bay(s), including mapped information, point sources and quantities discharged, and other locally relevant information about pollution sources (responsibility; Professor Ming-Jiang Zhou).

MEQ topics proposed for PICES VI, Pusan, Korea

Drs. Addison and Stein raised the possibility of MEQ sponsoring a joint symposium with BIO at PICES VI. A suggested topic would be Harmful /Noxious Algal Blooms. It was agreed that MEQ will participate with BIO in this proposed joint symposium, and that the topic will be Harmful Algal Blooms.

Suggestions for PICES VI MEQ-sponsored paper and platform topics included trans-boundary exchange of pollutants (air-sea and land-sea exchange), the impact of human influence on nearshore ecosystems, and impacts of aquaculture.

It was also stressed that in Korea, aquaculture, red tides, and wetlands are extremely critical issues. This is especially the case in highly industrialized areas like Chinhae Bay, which

adjoins the Korea Strait near Pusan. Korea suggested two titles: Jiaozhou Bay, and General Topics. Under the General Topics, Korea also suggested a session topic addressing the ecological functions of coastal wetlands as filters for chemicals, and a session focusing on the habitat value of wetland ecosystems.

Mindful that the charge of MEQ symposium at PICES V was "Processes of Contaminant Cycling", Mr. Harding suggested that MEQ could continue to adhere to this general theme, while focusing on specific sub-areas like boundary exchange, aquaculture, wetland ecosystems, etc.

After some discussion, Dr. Addison then summarized MEQ's proposed topics for PICES VI as follow:

- MEQ will sponsor a joint symposium with BIO. The topic will be "Harmful Algal Blooms".
- MEQ will also sponsor a session focusing on "Processes of Contaminant Cycling".
- At PICES VI, MEQ will also generate and present a draft report of preliminary results from the Jiaozhou Bay Practical Workshop, as mentioned previously.

Presentation by TCODE Chair

MEQ was then given a brief presentation by Mr. Robin Brown, Chairman of the PICES Technical Committee on Data Exchange (TCODE). Mr. Brown explained that the preliminary TCODE Inventory of Long Term Time Series data, which is now available on the World Wide Web Server via the PICES Home Page, represents a significant area of progress for TCODE. Mr.

Brown explained the various functions of TCODE, and its specific physical and chemical oceanographic data sets.

The main value of TCODE is to provide a forum, especially via the World Wide Web, where scientists who are interested in the various PICES-generated data can be in contact with those who actually hold the data.

It was the general consensus of MEQ that at this time, it is too soon to attempt to integrate MEQ data into TCODE. However, the upcoming research proposed by MEQ in the Northwest Pacific (e.g., Jiaozhou Bay Practical Workshop, and the subsequent MEQ research proposed for the mouth of the Changjiang, East China Sea) would no doubt generate much valuable and interesting data regarding marine pollution and biological effects. After peer review and publication, these data would no doubt be very useful and relevant to TCODE, and the PICES Web Site.

Dr. Stein suggested that MEQ explore this issue further via a questionnaire, which will be sent out to MEQ membership by Dr. Addison later in the year. We will then advise TCODE as appropriate, and hopefully be able to eventually share various of our environmental data from the North Pacific, after our MEQ Workshop and subsequent activities have generated their results.

Adjournment

The MEQ Scientific Committee concluded its business meetings for PICES V, and was adjourned by Chairman Dr. Addison at 1730 hours on Thursday, October 17, 1996.

Endnote 1

Participants and Observers

Canada

Richard F. Addison
Lee Harding
Robert C.H. Wilson

Japan

Toshiyuki Hirano**
Makoto Shimizu**

Korea

Dong-Beom Yang
Kwang Woo Lee

Russia

Alexander V. Tkalin**
Evgeny Shumiln**

U.S.A.

Usha Varanasi
C. Michael Watson

Observers

Yuan Gao (U.S.A.)
Jong-Geel Je (Korea)
Hee Sook Kang (Korea)
Makoto Kashiwai (Chairman, Science Board)
Colin D. Levings** (Canada)
John Stein** (Co-Chairman, WG 8)
Bruce B. McCain (U.S.A.)

** Member of Working Group 8

Endnote 2

Report of Working Report 8 Practical Assessment Methodology

The meeting of WG 8 was convened at 0900 on October 11, 1996. Attendees are given at the end. The other Co-Chairman, Prof. Ming-Jiang Zhou, regrettably could not attend due to other commitments.

Dr. Colin Levings agreed to serve as rapporteur with the assistance of Ms. Carla Stehr.

The meeting agenda (Appendix 1) was reviewed and approved. The overall objective of the meeting was to review and refine the draft workplan for convening a Practical Workshop in Jiaozhou Bay, Qingdao, China aimed at harmonizing approaches among PICES countries when assessing ecological impacts of pollution. This workshop represents the first step leading to a much larger scale project (Phase II) in the Changjiang estuary. The Phase II project is proposed to be conducted along a preselected gradient in the East China Sea as a contribution to baseline data for the Three Gorges Project.

Dr. Stein reviewed the Working Group's Terms of Reference and the steps taken in developing the current draft of the workplan.

The Working developed recommendations (Appendix 2) to the MEQ Committee, requesting that the Committee submit a proposal to the PICES Science Board for funding one-half of the expected cost to conduct the Workshop. The remaining funding for the workshop would be solicited by PICES-member

country agencies or other institutions. The recommendations are accompanied by a summary of the process leading to the development of the current draft of the workplan (Appendix 3), a summary of the workplan, products expected from the workshop, and a draft budget (Appendix 4).

Considerable time was dedicated to refining the workplan (purpose and goals, sampling design, analyses to be conducted, and logistical issues), and identifying PICES scientists who would conduct specific analyses. The products (Appendix 5) were: a flowchart for key events; site selection criteria; revised workshop description and tables of target species, samples to be collected, analyses to be performed and the scientists responsible for them; and a timetable for implementing and conducting the workshop. Dr. Stein agreed to have a US colleague serve as the data coordinator for the workshop. Prof. M.J. Zhou has agreed previously to compile existing information on the study area.

The draft meeting report and recommendations to the MEQ Committee were approved by the working group for submission to the MEQ.

There was no other business raised for discussion.

The meeting was adjourned at 1530 h on October 12, 1996.

Appendix 1

WG 8 Working Group Meeting Agenda

October 11 and 12, 1996

1. Welcome and introductions of members and observers.
2. Appoint Rapporteur.
3. Adopt Agenda.
4. Review goal of meeting and anticipated products.
 - a) **Meeting Goals**
 - (1) Revise and refine workplan for the Practical Workshop and establish schedule for implementing the workshop.
 - (2) Develop recommendations to the MEQ requesting support for funding of the workshop by the PICES Science Board.
 - b) **Anticipated Products**
 - (1) Revised workplan and implementation schedule for Practical Workshop.
 - (2) Recommendations to the MEQ, and a summary of the Workplan to be included as an annex to the Recommendations.
5. Review development of current draft of workplan.
6. Workplan review and revision as follows:
 - a) Goals and Objectives
 - b) Sampling Strategy (sites, species, logistics)
 - c) Field Data
 - d) Biological and Chemical Analyses
 - e) Logistics for analysis of samples during practical workshop at host lab
 - f) Analysis of samples following workshop, not at host lab.
 - g) Other items, such as data management, statistical analyses, report preparation etc.
 - h) Budget
7. Develop timeline for implementing the Practical workshop.
8. Determine next steps or actions to be taken.
9. Develop WG8 recommendations to MEQ committee on request for funding to support the practical workshop and the benefits to PICES of granting the request.
10. Consideration and approval of the meeting report.
11. Consideration, review and approval of the recommendations.
12. Other business.
13. Closure of the meeting.

Appendix 2

Recommendation to MEQ

Recognizing the terms of reference from MEQ concerning the need to work toward harmonizing approaches to assessing marine pollution among PICES countries, Working Group 8 recommends that the MEQ forward a request to the Science Board to allocate \$30,000 (Can.) in support of a workshop to contribute to

an environmental assessment of Jiaozhou Bay (Qingdao) China.

The funds requested represent less than half of the funds required to support the workshop. Implementation team members are actively seeking additional support from agencies other than PICES and from their own national

organizations. In order to garner support from other groups, it is essential that we can demonstrate that their funds will be leveraged by funds from PICES supporting this initiative.

This workshop is a necessary step in establishing scientific cooperation for future collaborative efforts in the Changjiang estuary to investigate environmental impacts of the Three Gorges Project, and in the harmonization of approaches by PICES member countries in

assessing the broader scale impacts from human activities on North Pacific marine habitats essential to living marine resources. The workshop will provide an opportunity for participants from PICES member countries to work cooperatively to assess pollution impacts in a coastal bay receiving multiple pollutants, while collecting and analyzing a variety of samples from both contaminated and reference sites.

Appendix 3

Background on Workshop Development

PICES WG 8 (formerly WG 2) has discussed approaches to fulfilling its terms of reference at meetings in Seattle, Nemuro, Qingdao, and Nanaimo (coinciding with the PICES Second, Third, Fourth and Fifth Annual Meetings). Briefly the aim of WG 8 is to promote the collection and exchange of information about approaches for assessing the impact of marine pollution, between the PICES member countries. WG 8 agreed to approach this by organizing a *practical* Workshop at a contaminated site, during which participants could work together on samples of various types from both contaminated and "reference" sites and could gain first-hand knowledge of each others use of methods and tools for assessing the impact of human activities and pollution on quality of marine habitat and the health of indigenous species. The format of the Workshop is being developed to follow that of the successful Intergovernmental Oceanographic Commission/Group of Experts on the Effects of Pollutants (IOC/GEEP) workshops whose results have been published in Marine Ecology Progress Series (vol. 46 (1988) and vol. 91 (1992)) and in the Journal of Experimental Marine Biology and Ecology (vol. 138 (1990)).

Jiaozhou Bay, China, was selected for this workshop, because part of the bay is influenced by run-off from various sources including pesticide factories, oil refineries and electroplating plants, activities associated with

commercial shipping, and contaminant non-point sources, such as sewage outfalls. The site, therefore, presents a range of specific pollutant "stresses" that can be measured, which affect coastal waters of PICES countries. Extensive mariculture is also carried out in the Bay. These mariculture operations could provide appropriate samples for use in the practical workshop. In addition, extensive data sets describing biota and contamination in the Bay are available from both the Institute of Oceanology and the State Oceanic Administration (SOA).

In regard to the logistics for conducting the workshop, Prof. Ming-Jiang Zhou has extended an invitation to use the facilities and research vessels of the Institute of Oceanology, Academia Sinica, for the workshop. In addition, Dr. D.B. Yang from Korea Ocean Research and Development Institute (KORDI) has subsequently confirmed that the KORDI installation in Qingdao may be able to offer back-up facilities. These facilities are critical in carrying out a core set of analyses during the workshop, thus in allowing first-hand observation and exchange in a wide range of sampling and analytical techniques.

An informal Workshop Implementation Team was formed by the MEQ and WG 8 at the PICES Fourth Annual meeting. The team has had ongoing correspondence, and an informal *ad hoc* meeting of some of the North American

members was held in Seattle in June 1996 to develop a work plan. Implementation team members tentatively identified the kinds of sampling and analyses to be carried out and suggested possible participants from all the PICES member countries. This draft list and tables outlining the suite of analyses proposed was sent to the Workshop Implementation Team

members in Russia, Japan, China and Korea that were unable to attend the *ad hoc* meeting. Their review, advice and suggestions were sought and comments incorporated into a revised draft workplan. The revised workplan was further refined and adopted by WG 8 at PICES V, Nanaimo, Canada.

Appendix 4

Workplan for Practical Workshop in Jiaozhou Bay (October, 1996)

Purpose

Work towards harmonizing approaches used in assessing ecological impacts of human activities on the environmental quality of North Pacific marine ecosystems.

Objective

To work cooperatively in assessing contaminant distributions that occur within Jiaozhou Bay and the ecological impacts to the benthic invertebrate and fish communities.

Specific Goals

1. Assess bioaccumulation of chemical contaminants through a food web study.
2. Assess ecological effects of chemical contaminant exposure.

Study Parameters

1. Following data compilation and literature review, the workshop will commence with a reconnaissance survey to assess the feasibility of sampling sediment, fish and invertebrate species to validate the sample design. Duration of this preliminary work will be 1-2 weeks. 3-4 people of variety of background will work with the Chinese. Daily cruise reports might be sent out by email by Prof. Zhou M.J. to workshop participants. A brief period after reconnaissance survey (1 week), refine sampling design based on information collected during reconnaissance survey. Begin cooperative workshop sampling and analysis 1 to 2 weeks after reconnaissance survey.

2. Sample 5-7 sites within Jiaozhou Bay. Sites will be selected according to criteria listed in Table 1. One site will be centre of the bay as a potential integrating site of pollutant inputs. Other sites may include an industrial site, an agricultural runoff site, and an aquaculture site within Jiaozhou Bay. Sample 1-3 reference sites in Laoshan Bay.
3. Replicate sediment samples and samples of tissues from a variety of target species (wild and cultured invertebrates, fish) will be collected for sediment contaminant analyses and bioaccumulation contaminants and responses at the tissue and cellular level. Replicate samples will be collected to allow scientists to analyze the same sample for intercomparison of results. These data will also be used for interpretation of organismal, population, and community responses.
4. Chemical contaminants to be analyzed include polycyclic aromatic hydrocarbon (PAHs), pesticides, chlorinated hydrocarbons, selected metals and tributyl tin (TBT).
5. Biological responses measured will include primary production; benthic community structure; invertebrate mortality/growth (bioassays); demersal fish abundance, feeding and growth rates; and biochemical changes (e.g., CYP1A induction, AChE inhibition).

6. During the cooperative sampling and analysis phase there will be up to 24 participants, approximately 4 from each PICES member country. This effort may be augmented by other scientists at their expense. Under a separate Chinese-Japan project, primary productivity effects may be assessed using mesocosm and in situ measurements.
7. Analyses will be carried out in four steps:
 - i. cooperatively at the Institute of Oceanology in Qingdao;
 - ii. cooperatively at another laboratory/institute in the northwest Pacific;
 - iii. other locations with involvement of participants as feasible;
 - iv. routine analyses (e.g. aging) that do not involve cooperation.
8. The workplan is being developed to primarily encourage "intercomparison" of analyses of all participating institutions/laboratories, and will involve analyses of split-samples (replicates) as part of intercomparison exercises of chemical and appropriate biological variables. However, all work is being designed to be scientifically sound and publishable.
9. The preferable time for the Workshop is May to early June 1997, or possibly between mid September and the end of October 1997. The cooperative workshop sampling and analysis phase will be 2-3 weeks in duration.
10. It is necessary to have wrap up meetings for the workshop. In October 1997 at PICES 6 we would review preliminary results and discuss the format of a descriptive report on the field work possibly to be published in

the PICES Scientific report series. It is proposed to have a more complete discussion of results during the PICES 7 meeting in October 1998. Final publication of results in the scientific literature, as appropriate, to follow soon after.

Figures and Tables in Appendix 5 expand on the information presented above, and include: a flowchart for the Workshop and follow-up activities; sampling-site selection criteria; tables describing samples to be taken, analyses to be conducted, and responsible investigators; and a timeline for implementing and conducting the workshop.

Expected Products of Jiaozhou Bay Practical Workshop

1. An improved understanding of the range and impact of contaminants in Jiaozhou Bay. Although this is site specific, the generic results should be applicable to other industrialized ports and coastal areas in the PICES area of interest.
2. An improved appreciation by PICES participants of the approaches and techniques used by other member countries to assess marine pollution, and improved cultural understanding and technology transfer.
3. Cruise report, archived data accessible by PICES country scientists and depending on the results, a series of papers characterizing the effects of pollution on aspects of the ecology of Jiaozhou Bay. These reports are anticipated to resemble those produced for workshops in Bermuda, Norway and Bremerhaven (IOC/GEEP).

Appendix 4

Estimated Costs for Jiaozhou Bay Practical Workshop (CDN\$)

1. Travel		
8 participants (4 each Canada and U.S.) round trip air fare		
\$1500 each person		<u>total air fare \$12,000</u>
16 participants (4 each from China, Russia, Japan and Korea		
round trip air fare		
\$500 each person		<u>total air fare \$8,000</u>
2. Accommodation and meals		
a. Reconnaissance Survey:		
3 participants for 14 days		
\$100 dollars/day each person		<u>total room and board \$4,200</u>
b. Practical Workshop		
24 participants for 15 days		
\$100 dollars/day each person;		<u>total room and board \$36,000</u>
3. Supplies and shipping		
\$10000		<u>total supplies and shipping \$10,000</u>
4. Contract for literature review on Jiaozhou Bay		
\$1000		<u>total lit. review contract \$1,000</u>

TOTAL ESTIMATED COST: \$71,2000

Publication costs, costs of any subsequent travel, etc. to work up samples in participants labs, or "wrap-up" conferences are not included above. In previous IOC/GEEP workshops, all these items have been considered desirable, although most of the costs have usually been borne by individual investigators or their agency. It is proposed that the "wrap-up" symposium be

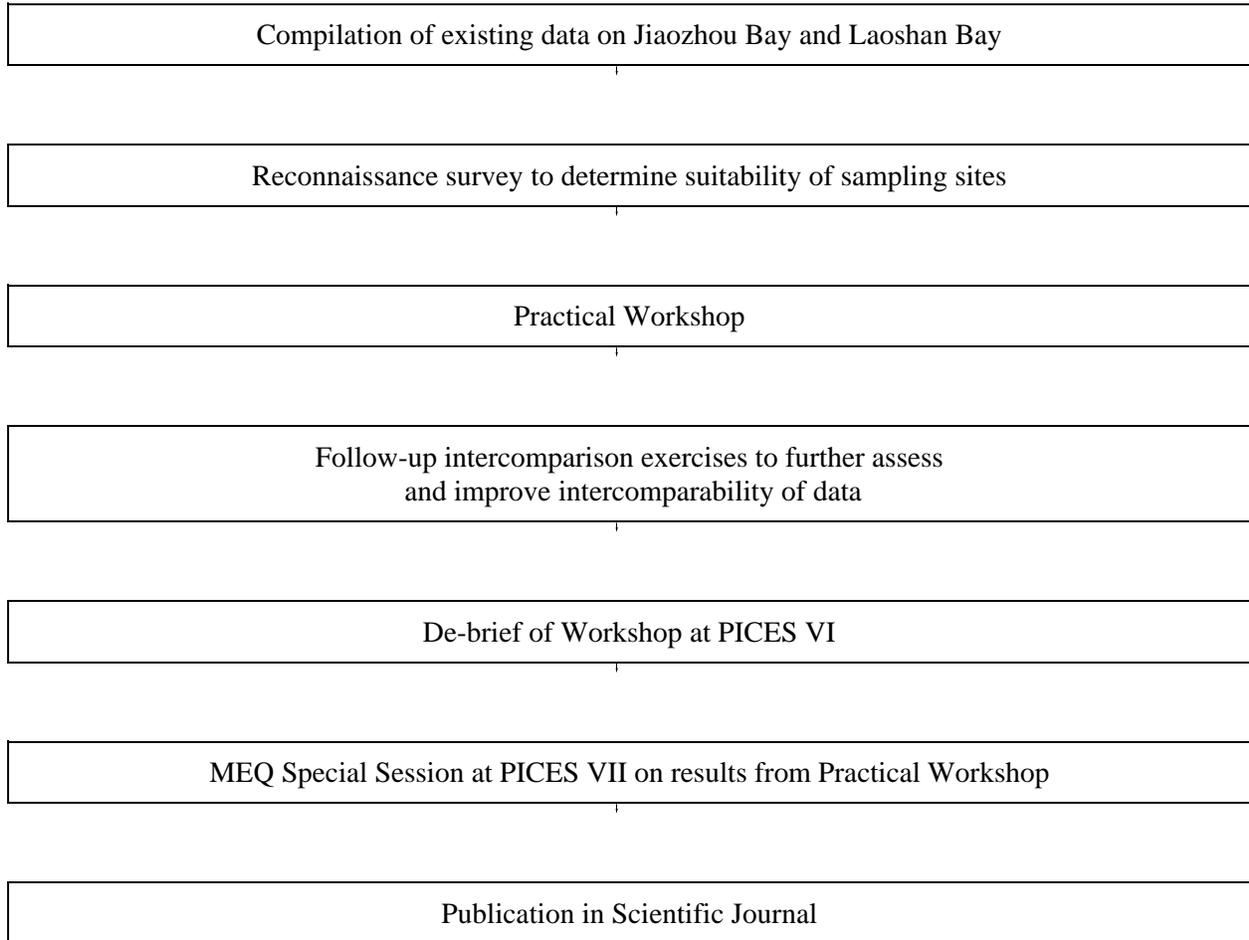
conducted as part of PICES VII. Availability of PICES travel funds will be important to insure that participants can attend PICES VI and VII, so that an initial assessment of the workshop can be conducted and additional planning can take place (PICES VI), and that the "wrap-up" conference (PICES VII) will be well attended.

Appendix 5

Figures and Tables for Workplan for Practical Workshop

Appendix 5.1

Flowchart for Jiaozhou Bay Workshop



Appendix 5.2

Criteria for selection of sites in Jiaozhou Bay and the reference site, Laoshan Bay

- 5 to 7 meter depth (the majority of Jiaozhou Bay)
- "muddy sediment"
- potential different pollution sources
- intertidal invertebrates present (e.g. gastropods)
- avoid dredged areas or shipping lanes
- at least two sites with fish present
- comparable oceanography (estuarine circulation)
- aquaculture bivalve species similar
- similar wild mollusc species (e.g. *Crassostrea gigas*)

Appendix 5.3

**Analyses to be conducted under Specific Goal #1
Bioaccumulation of contaminants: Food Web Study**

<u>Compartment</u>	<u>Sample Type</u>	<u>Analyses</u> (listed in order of priority)	<u>Individuals Responsible</u>
Sediment	grab sample	<ul style="list-style-type: none"> •pesticides, metals •CHs, PCBs, PAHs, metals •TOC, grain size •mineralogy •TBT •PCDD/F 	Russia (Tkalin, Shumilin) Korea (Yang)/US (Loma) China (TBD) if not, Korea (Je) Russia (Shumilin) US (Stein)/Japan(TBD) Canada (Addison)
Biota	mollusc - feral (e.g., gastropod and oyster), aquaculture (scallops)	<ul style="list-style-type: none"> •pesticides, metals •CHs, PAHs, metals •TBT 	Russia (Tkalin) US (Stein) Japan (TBD)
Biota	fish - demersal (maybe rockfish or a species of flatfish, or the intertidal goby)	<ul style="list-style-type: none"> •tissue CHs, PAHs •bile FAC •stomach content CHs, PAHs •stomach taxonomy 	US (Stein)/Korea (Yang) US (Stein) US (Stein) Canada (Levings)/China (Yang J.)
Biota	birds (cormorants, gulls) opportunistic, preliminary work	<ul style="list-style-type: none"> •contaminants in egg yolk sac •opportunistic collection of moribund and dead birds 	Canada (Elliott)/ China (Liu) Korea (Yoo)

Abbreviations:

CHs = chlorinated hydrocarbons

FACs = fluorescent aromatic hydrocarbons in bile

PAHs = polycyclic aromatic hydrocarbons

PCDDs/Fs = polychlorinated dibenzodioxins/furans

TBT = tributyltin

TOC = total organic carbon

TBD= to be determined

Analyses to be conducted under Specific Goal #2
Ecological effects of contaminant exposure

<u>Compartment</u>	<u>Sample Type</u>	<u>Analyse (listed in order of priority)</u>	<u>Individuals Responsible</u>
Water	algal spp. zooplankton	•primary/ secondary productivity	Japan (Harada) [mesocosm] (discuss in November in China/Japan meeting)
Biota	mollusc - feral and aquaculture	<ul style="list-style-type: none"> •chambering (oyster) •imposex (gastropod) •age/size relationships, growth rate •Biomarkers (e.g. comet assay) 	Canada (Levings) Korea (Oh) China (aging lab, TBD) US (Sanders/Steinert)
Biota	flatfish - demersal (perhaps flatfish, or rockfish; determine during preliminary study)	<ul style="list-style-type: none"> •age/size relationships Biomarkers: <ul style="list-style-type: none"> •CYP1A •AChE (brain/muscle) •DNA adducts •histopathology 	China (fish aging lab, TBD) Canada (Addison)/US (Stein) Canada (TBD) US (Stein) US (Stein)
Benthic Community		<ul style="list-style-type: none"> •abundance/diversity •bioassays 	Russia (Tkalin)/China (Zhou)/Korea (Je) Canada (Levings)

Abbreviations:

AChE = Acetylcholinesterase

CYP1A = cytochrome P4501A

TBD = to be determined

Appendix 5.5

Parameters to be measured on site during the Practical Workshop

Biological Parameters	Information needed	Data processing needed	Who will be responsible for collecting data?
<u>Species identification</u>	observation at time of collection (use photographs)	data recorded	Canada (Levings) China (Yang J) Korea (Je; invertebrates)
<u>Length and weight</u>	measurements conducted at time of collection	data recorded	Investigator (TBD)
<u>Sex</u>	observation at time of collection	data recorded	Investigator (TBD)
<u>*Age</u>	collection of otoliths or shells	otoliths or shells processed and read	China (aging lab, TBD)
<u>maturation stage</u>	observation at time of collection	data recorded	Investigator (TBD)
<u>*Stomach fullness, weight of contents</u>	observation at time of collection	data recorded, forage ratio computed	China (stomach lab, TBD)
<u>*Stomach taxonomy</u>	stomach samples preserved	samples processed for taxonomy	Canada (Levings) China (Yang J)
<u>*Condition factor</u>	whole body and gutted body weight at time of necropsy	data recorded and condition factor calculated	Investigator
<u>Other observations:</u> e.g. observable lesions, parasites, deformities, etc.	observations conducted at time of collection (use photographs)	data recorded at time of collection	Investigator (TBD)- using standard protocols
Sediment Characteristics (separate worksheet)	observations on sediment characteristics (use photographs)	data recorded at time of collection	Investigator (TBD)
Physical Water Parameters: Seawater temperature, salinity, Dissolved oxygen, turbidity, CTD profile (separate worksheet)	measurements conducted at time of collection	data recorded at time of collection	China/Korea (TBD)
Identification parameters:** e.g. sample number, date collected, site location, method of collection, DGPS water depth, etc.	observations conducted at time of collection	data recorded at time of collection	Investigator (TBD)

* Two step process involved, collection of samples indicated in data collection spread sheet, followed by laboratory analysis or data calculation later after sample collection completed.

Separate spread sheets will also need to be developed for aquaculture samples.

Data Coordinator will be US (Stein). Data coordinator will be responsible for preparing data collection sheets and incorporating measurements and calculations done in the various laboratories after initial sample collection is completed.

** The numbering scheme will be devised to ensure that all samples are handled “blind” by the researchers conducting analyses (i.e., without the participants knowing the origin of the sample or relation to pollutant sources).

TBD = to be determined

Appendix 5.6

Timeline for Jiaozhou Bay Workshop

October 1996 Contact with Head of China PICES Delegation.	-1-2 weeks; preliminary survey; confirm supplies on site, equipment operational
October 1996 Allocation of PICES money.	-1 week; revised workshop cruise plan; revisions made by steering group and crew of preliminary survey
December 1, 1996 Data compilation, pollution sources, biology, oceanography, translation and distribution (contract established in consultation with M.J. Zhou). Includes both published and unpublished data.	-2-3 week; conduct Workshop -supplies returned; if appropriate
January 1, 1997 On site equipment and supplies confirmed and necessary approvals granted.	Late June, 1997 Draft Cruise report.
March 1, 1997 Final draft workplan to be completed by the workshop steering group (<i>ad hoc</i> Implementation Team).	October 1997 Present at the PICES VI Working Group meeting -preliminary results -data archive and distribution -follow up analyses preliminary results -outline publication format
March 15, 1997 Final budget.	December 1997 Publish final cruise report, perhaps as a PICES publication.
March 31, 1997 Complete draft survey cruise plan; "crew" will be small group of people with field experience.	June 1997 Finalize results and statistical analyses.
April 15, 1997 Supplies for workshop on site.	October 1998 Presentation of Workshop results at PICES 7 meeting in 1998 followed by publication of papers.
May or early June, 1997	

Appendix 6

Participants and Observers

Canada

Richard Addison (Chairman, MEQ, Oct. 12 only)
Colin Levings*

Japan

Shigeki Harada*
Toshiyuki Hirano
Makoto Shimizu

Korea

Jong-Geel Je (representing Dr. D.B. Yang*)

Russia

Evgeny Shumilin (Oct 12 on;y)
Alexander Tkalin*

U.S.A.

John Stein (Co-Chairman)*

Observer

Carla Stehr (U.S.A.)

*Member WG 8 Implementation Group for Practical Workshop

REPORT OF PHYSICAL OCEANOGRAPHY AND CLIMATE COMMITTEE

3

3

The meeting was opened at 14:00 on Oct. 16 by the Chairman, Prof. Paul H. LeBlond (Canada), and was held in two sessions on that day and on the next afternoon.

New members, Drs. Masahiro Endoh (Japan) and Howard J. Freeland (Canada), were welcomed. It was noted also that Dr. Vyacheslav B. Lobanov, who could not attend, had replaced Dr. Alexander Bychkov on the Committee.

Dr. H.J. Freeland (Canada) accepted to act as rapporteur.

Recommendations of WG 7

The report of WG 7, submitted last year, has been published. Its recommendations (WG 7 Report, p. 30) were reviewed and action proposed as follows:

Rec. 1.1. To make higher resolution bathymetric information available for modelers. Dr. Gennady I. Yurasov also mentioned forthcoming 1-km resolution of the Japan/East Sea prepared by Y.I. Melnichenko. Dr. Christopher N.K. Mooers mentioned that there had been talk of de-classifying US Navy data under the "dual-use" policy and suggested PICES write to the US Oceanographer of the Navy.

Action: POC Chair to draft a letter to be sent under the signature of the Chairman of PICES.

Rec. 1.2. Extension of ocean property atlases. POC members felt that others were already pursuing this goal. The need for data archival into world data centres was however strongly emphasized: too much data are unavailable.

Action: POC members to remind institutions in their respective countries of the need for formal archiving of data, including old data. Letter to be drafted by POC Chairman for circulation by Secretariat.

Rec. 1.3. Availability and quality of meteorological fields. Require identification of national efforts. Consult with MODEL Task Team on how best to guide future modeling efforts.

Action: Informal discussion between POC Chairman and MODEL Co-Chairmen.

Rec. 1.4. Strong support for satellite ocean-observing missions. POC members did not suggest specific action but rejoiced at the news that TOPEX altimetry data are likely to be available for many years thanks to the proposed continuation of the TOPEX-POSEIDON mission.

Rec. 2. PICES to express support for development of Ocean Observing System. Dr. Bruce A. Taft, Chairman of WG 9, reported that his WG is addressing that point. Dr. Mooers suggested that a representative of NE Asian Regional GOOS be invited to make a presentation at PICES VI.

Action: Conveners of PICES VI POC Symposium to be requested to include that item in their program.

Rec. 3. Encourage data exchange. This is being pursued by TCODE.

Rec. 4. PICES to encourage workshops on modeling. This is now underway within the CCC Task Teams.

Rec. 5. Encouraging visualization of model results. POC members suggested that the best way to do this was to circulate appropriate software. Mr. Robin Brown (TCODE Chairman) also said that this point was being addressed by TCODE.

Recommendations of Vladivostok Workshop

There continues to be considerable interest and much recent work on the oceanography of the Sea of Okhotsk. POC recommends that a workshop be held in the summer of 1998 to review recent advances. Prof. Nagata outlined plans to hold such a meeting in Nemuro.

Action: To be confirmed at PICES VI.

The preparation of a multilingual (English, Japanese, Russian) nomenclature of place and oceanographic feature names in the Sea of Okhotsk is progressing. Prof. Nagata presented a preliminary draft, and will continue, with the assistance of Dr. V. Lobanov. POC thanked him for his effort and expects a final report by PICES VI.

Action: Nagata and Lobanov.

TCODE Report

Mr. Robin Brown, Chairman of TCODE, briefed POC members on recent progress by TCODE, especially in accessing data sources and other information on the PICES Website.

WG 9 Report

Dr. Bruce A. Taft, Co-Chairman of WG 9, reported on major recommendations. POC expressed support for the ecological moorings, one in the western, one in the eastern gyre. There was some discussion on the exact location of the eastern mooring and it was felt that some overlap with measurements at Station P would be required. POC also supported the idea of monitoring the E. Kamchatka Current using a submarine cable.

WG 10 Report

The Co-Chairmen of WG 10, Drs. Sang-Kyung Byun and Christopher N.K. Mooers, reported on progress of their Working Group on "Ventilation and circulation of the Japan/East Sea". POC expressed satisfaction with progress to date and supported their plans for a meeting in Fukuoka in January 1997. Anticipated completion during the summer of 1997 with report to be presented to POC at PICES VI.

Other interim recommendations put forward by WG 10 included:

- i. A request that PICES should facilitate access of research vessels to the EEZ of other member countries. Supported by POC.
- ii. General support for the work of the CREAMS program:
recognized by POC as an example of good collaboration between member countries.
- iii. A request for translation of a book from Russian to English was held off for re-consideration upon completion of the report.
- iv. Financial assistance for making Web access possible to all WG members was requested.
- v. Establishment of a dynamic, periodically refreshed bibliography on the Japan/East Sea on the PICES Website. TCODE Chairman, Mr. R. Brown, suggested this could easily be achieved.
- vi. A special WG 10 topic session be held at PICES VI.

Review of CCCC Recommendations for 1997

POC supported the recommendation by the MODEL Task Team that a workshop be held to develop vertical profile models for nitrate in the North Pacific and to discuss methods of adapting vertical profile models into three-dimensional models. POC emphasized that recognized modelers should be encouraged to attend.

POC declined to comment on the proposals of the REX Task Team other than to express an offer of general support for regional model development as required.

POC expressed strong support for the one-day symposium recommended by BASS for the 1997 Annual Meeting on the topic "Temporal Variability and Decadal Comparison of the Eastern and Western Gyres".

WOCE Pacific Workshop

Dr. H.J. Freeland and Prof. Y. Nagata reported on the WOCE Pacific Workshop held in August at Newport Beach, California. Dr. Freeland suggested that PICES might be interested in assisting with publication of a WOCE Pacific Atlas. He and Dr. K. Kim will investigate costs and report.

Action: Freeland and Kim.

State of the Ocean

Dr. G.I. Yurasov spoke to a suggestion that PICES produce an annual "State of the Pacific" report, mentioning that Dr. Gennady V. Khen was producing a report for the region of Russian interest. Prof. Nagata outlined plans for the SAGE (Subarctic Gyre Experiment) which will monitor the state of the subarctic gyre. It was also thought that plans for forthcoming research were also of interest. It was resolved that, on a trial basis, contributions would be requested from national members for submission at the next annual meeting.

Action: Chairman of POC to request contributions before PICES VI.

1997 Symposium

Following the request of WG 10 Co-Chairmen, POC proposes for the 1997 PICES Annual Meeting a Symposium on "Ventilation and Circulation in North Pacific Marginal and Semi-Enclosed Seas", to be co-convened by Drs. Moers and Byun. The symposium will include an invited presentation on progress and plans of NEAR-GOOS.

Scientific Program

The following scientific papers were presented from the POC Committee sponsored part of the program. The Best Presentation Award for the POC Scientific Session was awarded to Dr. Susan E. Allen for her paper on "Shelf-break canyons: Flow patterns and deep water advection during an upwelling episode".

Exchanges of water, organisms, and sediment between continental shelf waters and the nearby ocean. Co-convenors: Kenneth L. Denman (Canada) & Kuh Kim (Korea).

S.E. Allen

Shelf-break canyons: Flow patterns and deep water advection during an upwelling episode

E.B. Bennett & E.C. Carmack (given by Carmack)

The thermal curtain hypothesis: Physical basis for stationary mixing structures in the North Pacific Ocean

P.F. Cummins & L.Y. Oey

Simulation of barotropic and baroclinic tides off northern British Columbia

K.L. Denman, M.A. Pena, J.R. Forbes, R.E. Thomson & S.E. Calvert

The annual cycle in shelf-edge to deep ocean gradients in sinking particles and their composition off Vancouver Island, Canada

M. Foreman & R.E. Thomson

Cross-shelf exchanges off Vancouver Island

H.J. Freeland

Near surface changes in the mixed layer at Ocean Station Papa in the N.E. Pacific Ocean

S.V. Gladyshev & S.C. Riser

Some features of water exchange through the Okhotsk Sea, Bussol and Kruzenshtern Straits: Evidence for deep ventilation of the North Pacific

A.J. Hermann & P.J. Stabeno

A preliminary regional circulation model of the eastern Bering Sea

W.W. Hsieh

Forecasting the sea surface temperature anomalies in the Pacific Ocean

- J.M. Huthnance
Physical processes of exchange between continental shelf waters and the nearby ocean
- K. Iseki, K. Okamura & Yoko Kiyomoto
Short and long-term variations of particulate fluxes at the continental margin in the East China Sea
- G.V. Khen, S.A. Shershenkova & V.Y. Efimkin
Dynamics of the hydrological regions on the western part of the Bering Sea shelf in connection with meandering of the Kamchatka Current
- K. Kim & Y.K. Cho
Seasonal variation of the East Korean Warm Current
- D.L. Mackas, D.R. Yelland, K.L. Denman, J.R. Forbes & D.F. Moore
Horizontal exchange of plankton and nutrients between the Vancouver Island continental shelf and the adjoining deep North Pacific.
- C.N.K. Mooers & H.S. Kang
Numerical simulation of the Japan Sea (East Sea) circulation
- C.N.K. Mooers & J. Wang
Numerical simulation of the circulation in Prince William Sound
- A. Nakata, I. Tanaka, H. Yagi, G. Kantakov & A. Samatov
Origin of water in the cold water belt appearing offshore side of the Soya Warm Current near La Perouse Strait (the Soya Strait)
- A.B. Rabinovich, R.E. Thomson & P.H. LeBlond
Lagrangian measurements of diurnal tidal currents near the Kuril Islands
- I. Tanaka, A. Nakata, H. Yagi, A. Samatov & G. Kantakov
Result of direct current measurements in La Perouse Strait (the Soya Strait), 1995-1996
- P. van Meurs & P.J. Stabeno
Evidence of on-shelf flow at the Bering Sea shelf break
- F.A. Whitney & C.S. Wong
Recent changes in surface water properties along Line P in the N.E. Pacific Ocean
- C.S. Wong, Y. Nojiri, T. Kimoto & J. Zeng
Monitoring of nutrients and chlorophyll-*a* in the subarctic North Pacific
- H. Yagi, I. Tanaka, G. Kantakov, A. Samatov, A. Nakata & T. Watanabe
Seasonal changes of the cold water belt in the Soya Straits and adjacent areas and its chemical and biological properties
- S. Yukimoto, M. Endoh & Y. Kitamura (given by Endoh)
Interdecadal variations of the Pacific Ocean as an impact of interdecadal tropical variability in an MRI coupled GCM
- G.I. Yurasov
Tidal currents in the Korea Strait
- O.G. Yurasov (given by Mooers)
On the properties of 3D circulation at oceanic density fronts

Endnote 1

Participants and Observers

Canada

Howard J. Freeland (Rapporteur)
Paul H. LeBlond (Chairman)
C.S. Wong

Japan

Yutaka Nagata
Masahiro Endoh

Korea

Sang-Kyung Byun
Kuh Kim
Jae-Yul Yun

Russia

Gennady I. Yurasov
Gennady V. Khen

U.S.A.

James E. Overland

Observers

Alexander Bychkov (PICES Secretariat)
Edward B. Bennett (Canada)

Robin M. Brown (Canada)
Eddy C. Carmack (Canada)
Sergey V. Gladyshev (Russia)
Kimio Hanawa (Japan)
Christopher N.K. Mooers (U.S.A.)
Bruce A. Taft (U.S.A.)

Endnote 2

**Report of Working Group 10
Circulation and Ventilation in the Japan Sea (East Sea) and its Adjacent Areas**

PICES WG10 Progress Report

Sang-Kyung Byun and Christopher N.K. Mooers, Co-Chairs
18 OCT 96

1. WG 10 was commissioned at the PICES IV Meeting in October 1995. By Spring 1996, members had been appointed: Russia (3), Japan (2), South Korea (4), China (1), U.S.A. (3), and Canada (0). One additional member from both China and Japan have been requested. [Dr. Makoto Terazaki (ORI/Univ. of Tokyo) has agreed to participate with WG10.] Also, (1) a contact list was developed (the latest revision is attached), (2) a tentative outline for the report was established (the latest revision is attached), and (3) a preliminary schedule of activity was developed (the latest revision is attached). In September 96, Prof. Chris Mooers traveled to South Korea, China, Russia, and Japan for discussions with WG 10 members, and to present seminars on his numerical modeling of Japan Sea/East Sea circulation (a trip report is attached).

2. Because WG 10 was asked to try to expedite its study and report for completion by the PICES VI Meeting, our principal activities are planned to be:

- a WG 10 meeting at PICES V
- a WG 10 Workshop immediately following the Second CREAMS International Symposium (Jan 31. To Feb. 2 97; Fukuoka, Japan); travel funds for Russian, Chinese, and American members will be needed

- construction of a dynamic (i.e., updatable) bibliography focused on the modern literature (post-1980) to be placed on the World Wide Web via the PICES homepage; also to be accessible via anonymous FTP over Internet
- WG 10 co-chairs to hold a retreat to finalize the report in summer 1997
- a proposed special session at PICES VI (Oct. 97; Pusan, ROK) to feature salient results from the report and research reports related to the circulation and ventilation of marginal and semi-enclosed seas of the North Pacific
- a review paper derived from the report to be submitted to an international journal.

3. A very important issue has arisen that may impede future cooperative international scientific investigations of the Japan Sea/East Sea. Under the Law of the Sea Convention, various countries bordering the Japan Sea/East Sea have recently declared EEZs (and other restricted access zones) that are in conflict. In the summer of 1996, there was an incident (on a CREAMS cruise) where foreign scientists were not allowed to make CTD casts in the Japanese EEZ. (However, permission was granted after the cruise!) Hence, there is a need for PICES to issue a statement on the importance of access to each nation's EEZ for the mutually beneficial advance of scientific understanding.

4. WG 10 recommends that, as soon as possible, the Yurasov and Yarichin book on Japan Sea/East Sea currents (outline attached) be translated (by a Russian) and edited (by an

American), and that it be published either as a PICES scientific report or a hardcover book. [Through subsequent interactions with the Physical Oceanography and Climate (POC) Committee, it was agreed to table this recommendation for a year while POC and WG 10 consider it further.]

5. WG 10 recommends increased use of (and access to) World Wide Web for scientific communication and collaboration; Russian and PRC colleagues/institutions may need financial assistance to pay Internet fees for the necessary large bandwidth.

6. Dr. Mikhail Danchenkov (FERHRI) has prepared two (of four) parts of a comprehensive, historical bibliography and has requested assistance from PICES in publishing part two (proposal attached). Part one is being published in Korea (either by SNU or KORDI). WG10 will defer recommending on this proposal until its winter 1997 workshop.

7. Importantly, the Coordinating Committee has declared NEAR-GOOS operational. It will be accessible through the IOC homepage. It will include two types of databases: (1) real-time, managed by JMA; and (2) delayed-time, managed by JODC. (Russia and China will also maintain certain associated/national databases.) The implementation of NEAR-GOOS, and its further development, are expected to facilitate extraordinarily research on the circulation and ventilation of Japan Sea/East Sea.

PICES WG 10 Report
Circulation and Ventilation in the Japan Sea (East Sea) and its Adjacent Areas

OUTLINE (DRAFT/REVISED 18 OCT 96)

Executive Summary

I. Introduction

- terms of reference
- membership

- scope of the report
- time horizons of contemporary and near-future studies

Phase I (1981 to 1998)

[era of JECSS/PAMS & CREAMS]

Phase II (1999 to 2005)

[era of CREAMS II, NEAR-GOOS prototype, PICES/GLOBEC (?), research satellite remote sensing missions, model-observations comparisons]

Phase III (2006 to 2025)

[era of operational NEAR-GOOS, “information age“ and operational remote sensing technologies, AUVs, vast supercomputers]

- etc.

II. Summary of the Present Knowledge of the Ocean Circulation and Ventilation in the Japan Sea (East Sea) (Identify Gaps)

- general circulation (upper, intermediate, and lower layers)
- Tsushima, Warm current origin
- water masses
- inflows and outflows through straits
- air-sea transfers
- seasonal cycle
- synoptic scale variability
- mesoscale variability
- interannual variability
- transient wind-driven circulation
- tides
- deep and intermediate water formation
- recent climate state (with hydrochemical variables)
- exchange with adjacent seas
- shelf circulation and water masses
- coastal upwelling zones
- shelfbreak exchange processes
- ice formation
- cold brine formation on shelves
- “fisheries oceanography processes”
- etc.

III. Summary of Ongoing and Planned Scientific Programs (Identify Gaps)

- International Programs
 - PAMS/ JECSS
 - CREAMS
 - PICES/GLOBEC
 - IOC WESTPAC (NEAR-GOOS, etc.)
 - La Perouse Project
 - etc.
- National Programs
 - Whankyungdo (Korean oceanographical atlas project)
 - TINRO's periodic fisheries and oceanography surveys in Russian EEZ
 - others (?)

IV. Summary of Related Chemical, Biological, Geological, Geophysical, and Atmospheric Processes and the Potential for Interactive Multidisciplinary Studies

- chemical processes (dissolved oxygen, trace elements, CO₂ penetration, etc.)
- plankton and fish (marine ecosystems, mechanisms (and zones) of primary production (data acquisition and analysis), fish catch, fishing grounds, etc.)
- sediments (distribution, sedimentation rate, etc.)
- paleoceanography (e.g., pre-historic circulation and transports at different stages of sea level)
- air-sea interaction and ocean-atmosphere coupling
- bio-optical studies
- acoustical oceanography studies
- etc.

V. The Scientific and Logistical Opportunities and Challenges for Research in the Japan Sea (East Sea)

opportunities

- scientific
 - wintertime intermediate and deep water formation
 - biogeochemical tracer distributions (trace elements, nutrients, Chla, CFCs, etc.)
 - etc.
- logistical

- new observational techniques applicable to circulation and ventilation
- availability of ice-strengthened hulls
- etc.

challenges

- scientific
 - exchanges with adjacent seas
 - combined monitoring and modeling system
 - etc.
- logistical
 - data exchange, database management
 - lack of meteorological buoys
 - quality of bottom topography
 - needed monitoring data
 - needed updated oceanic climatology, including deep waters
 - access to newly declared EEZs
 - severe winter conditions (freezing of CTD pumps, etc.)
 - sedimentation of moorings in straits
 - disruption of moorings and drifters by fishermen
 - etc.

VI. Possible Future Process Studies and Their Design

- ventilation
- wintertime deep-convection
- ice formation
- coastal boundary currents
- shelfbreak exchange
- in- and out-flows through the straits
- mesoscale flow interaction with bottom topography
- eddy-mean flow interaction
- Japan Basin cyclone dynamics
- ocean-atmosphere coupling
- coastal atmospheric boundary layers
- response to storms
- climate change detection
- intermediate and deep circulation and turbulent dispersion
- etc.

VII. Status of Numerical Modeling for Japan Sea (East Sea)

- active modeling projects
- needed model-model comparisons
- needs for model validation and verification
- role of models in designing and interpreting observations
- data assimilative models
- water-quality, marine ecosystems, etc. models
- etc.

VIII. Findings and Recommendations

Acknowledgments

Appendix - Alternative geographical names

Bibliography

WG10 Tentative Schedule

(Revised 18 OCT 96)

Spring 1996

- WG10 membership established
- achieved consensus on draft outline and tentative schedule

Summer 1996

- Dr. Chris Mooers visited WG10 members in Japan, Korea, Russia, and China
- continued to assemble bibliography
- scheduled workshop (winter 1997)

Autumn 1996

- informal meeting of those members attending the PICES V Annual Meeting
- plan workshop (make homework assignments)
- prepare homework
- begin to establish post-1980 bibliography on the PICES World Wide Web homepage

Winter 1997

- hold workshop, back-to-back with 2nd CREAMS International Symposium in Fukuoka, Japan)
- members report on their homework
- develop consensus on findings and recommendations

Spring 1997

- members complete writing assignments

Summer 1997

- co-chairs meet to complete and edit draft report
- members review draft
- final draft report submitted for review by POC (late August)

Autumn 1997

- co-chairs present draft findings and recommendations at PICES annual meeting
- receive comments from POC (late October)
- co-chairs revise and submit report for publication

Winter 1998

- submit review paper (co-authored by all WG10 members)

P.S. We consider this a “fast-track” schedule; thus, if we must accept some slippage, we can still complete the report within two years.

PROPOSAL FOR THE PUBLISHING IN PICES

Title: Bibliography of the Japan Sea (oceanography). Part 2.

PI:Dr. Mikhail A. Danchenkov (Far Eastern Regional Hydrometeorological Research Institute(FERHRI)
Dr. Gi-Hoon Hong (Korea Ocean & Research Institute)

Address

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Date of Birth(m/d/y): 02.01.1950

Highest degree: Dr. Field: Oceanography, 1988.

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Abstract

The Japan Sea was called as "World Ocean in miniature" (Ichiye, 1984). This Sea reflects main features and elements of the World Ocean: warm and cold currents, warm and cold eddies, alienation of western boundary current, different water masses including the special one with extremely high dissolved oxygen content, planetary hydrological front and local fronts. The understanding of its waters motion can be useful for the understanding of processes in the World Ocean in common.

The success of investigations of the Japan Sea waters is conditioned by knowledge of results of investigations made in different countries. By some causes the knowledge of Russian papers abroad and, in less degree, the knowledge of Korean and Japanese papers in Russia remains very weak. It is surprising: how few references (and almost the same from paper to paper) there are in Russian and foreign publications on each other. Reason of low citation of foreign papers lays not in language barrier only but in weak knowledge of such papers mainly.

First part of the Bibliography (will be printed in Korea at the beginning of 1997) contains :

- a) Reference list (641 publications and manuscripts),
- b) Author's list (537 names),
- c) Annotations of some interesting papers published in Russian,
- d) Introduction.

This second part of Bibliography will contain:

- a) Brief review of the Japan sea oceanography (including the collection of the published maps of horizontal circulation),
- b) History of investigation,
- c) Addresses of main organizations that were worked ever in regional oceanography,
- d) List of names and addresses of scientists worked on it now (Who is Who),
- e) List of Conferences conducted in 1970-1995 concerning the Japan Sea oceanography,

- f) Last part of Annotations of papers, published in Russian,
- g) Supplement to the Reference list.

A brief review of the Japan sea oceanography contains about 150 figures with schemes of horizontal water circulation, the understanding as main sources of knowledge on regional oceanography. Last part of Annotations of papers, published in Russian helps to avoid difficulties with Russian language. Supplement to the Reference list contains about extra 200 papers.

G.I.Yurasov, V.G.Yarichin
CURRENTS OF THE JAPAN/EAST SEA
(Published in Vladivostok in 1993, 174 p.p.)

Contents:

Introduction

Chap. 1. Short physical-geographical description of the Japan/East Sea

Chap. 2. Investigations of currents of the Japan/East Sea

2. 1. General information on currents of the Japan/East Sea

Chap. 3. Currents' characteristics on instrumental data

3.1. Information on instrumental measurements of currents

3.2. Technique of processing of instrumental data

3.3. Characteristics of residual currents

3.4. Spatial and temporal variability of non-periodical currents

3.4.1. General circulation

3.4.2. Vertical structure of currents

3.4.3. Intra-daily variability of currents

3.5. Formation and characteristics of tidal currents in some areas

3.5.1. General characteristics of tidal currents

3.5.2. Formation of tidal currents in Tatarsky Strait

3.5.3. Tidal currents in Korean Strait

3.5.4. Some features of temporal variations of tidal currents

Chap. 4. Investigations of the Japan/East Sea circulation by diagnostic methods

- 4.1. Diagnostic model for calculations of three-dimensional currents' field
 - 4.2. Formation of input data fields
 - 4.2.1. Grid area
 - 4.2.2. Depth data
 - 4.2.3. Atmospheric pressure field
 - 4.2.4. Boundary conditions
 - 4.2.5. Density field
 - 4.3. Investigations of thermal regimen of the Japan/East Sea
 - 4.4. Technique of data processing of historical oceanographic data
 - 4.5. Results of diagnostic calculations of currents
 - 4.5.1. General circulation
 - 4.5.2. Calculations of horizontal and vertical components of currents
 - 4.5.2.1. Winter season
 - 4.5.2.2. Summer season
 - 4.6. Comparison of results of numerical calculations with instrumental measurements
- Chap. 5. Formation of some features of geophysical fields under the influence of currents
- Conclusions
- References

Brief Summary of Prof. Chris Mooers' PICES WG10/CREAMS
 Trip to South Korea, China, Russia, and Japan
 Sept. 7 to 22, 96

General Comments

The hospitality extended was warm and generous. Members of WG10 are very enthusiastic and cooperative, and genuinely excited about the potential for further international scientific collaboration in the near future for the study of the Japan Sea/East Sea (JS/ES) circulation and ventilation.

China

In China, I met with Prof. Shuzhen Pu (First Institute of Oceanography/State Oceanic Administration) and several of his colleagues.

SOA's interests in JS/ES are primarily the origin and structure of the Tsushima Warm Current and other aspects of exchange between the Yellow Sea (plus East China Sea) with the JS/ES. There is a particular interest in the Tyman River estuary (and its offshore plume) that lies on the border of China, Russia, and North Korea where a tri-national free trade zone is planned. SOA conducted a hydrographic survey of the region five years ago, and a data report and book chapter were published (both in Chinese). Prof. Dunxin Hu (Institute of Oceanology/ Academic Sineca) indicated that IOS has a strong interest in the Tsushima Warm Current, and East China Sea overall, especially shelfbreak exchange processes. Their emphasis is shifting from "blue water" studies to coastal processes, and he will be leading a multi-disciplinary, multi-institutional LOCI study in the Yellow Sea (and the remainder of China's coastal waters).

Korea

In South Korea, I met with Dr. Sang- Kyung Byun (KORDI), Prof. Kuh Kim (Seoul National University), and Prof. Yong Ho Seung (Inha University), plus many others. (Later, I spoke with Dr. Sangbook Hahn (National Fisheries Research and Development Agency (NFRDA)) via telephone.) The Korean scientific interests in the JS/ES circulation are naturally strongest in the flow structure and exchange through the Korean Straits and along the east coast of Korea. (They are also interested in the origins of the inflow due to Tsushima Warm Current from the East China Sea and nearshore flows from the Yellow Sea.) In addition to the general circulation and ventilation of the JS/ES, there is interest in the subpolar front, use of chemical tracers to study the age of Japan Sea Proper Water, use of radioactive waste tracers, air-sea interaction, atmospheric climatology, acoustic tomography, circulation modeling, and paleoceanography (an emerging goal at KORDI), anticyclogenesis in the vicinity of the EKWC separation point (and southern limit of the NKCC), and the salinity minimum layer in such anticyclones. An important development is the governmental reorganization that places

KORDI and NFRDA in the new Ministry for Maritime Affairs and Fisheries; some expansion of activity is anticipated.

Russia

In Russia, I met with Drs. Mikhail Danchenkov (FEHRI), Yuri Zuenko (TINRO), and Vladimir Ponomarev (POI), plus several of their colleagues. Prof. Victor Kuzin flew in from Akademgorodok to join the discussions, and to discuss our collaboration in model comparison; for example, he has implemented his finite element model for the JS/ES and has begun to run barotropic cases on an American computer via Internet. [Dr. Danchenkov and I also met privately with Dr. Yuri Volkov (Director, FEHRI) to discuss American-Russian collaboration for CREAMS II and the possible deployment of an NDBC meteorological buoy off Vladivostok; soon the Russian Navy will provide a chart indicating permissible areas for such a moored buoy. Dr. Volkov stated that they possess about ten quasi-synoptic (ca. one month) maps based on 100 to 200 stations sampled by one-to-three ships.] The Russian scientific interests are focused on the subpolar front, the circulation and water masses of the Primorski shelf, and ice formation, ice cover, and related processes in the Tatarski Strait for fisheries and other reasons. They also have strong interests in surface thermal fronts, current-topography-eddy interaction, deep convection, ventilation over bottom topography, and atmospheric forcing. There is a special interest in the region of Pervenets Rise (off Vladivostock) and its small seamounts. They have a large amount of data (and scientific insights) that have not been reported in the formal scientific literature; thus, they are interested in participating in the synthesis of observations. Fisheries interests are greatest in the subpolar front and the Primorski coastal waters. Dr. Mikhail Danchenkov has been preparing a comprehensive, annotated four-part bibliography with over 600 entries. The first two parts focus on the Russian literature, including internal reports. The first part is awaiting publication in Korea; the second part is

largely complete. However, the 1994 currency of the bibliography makes it already dated, especially considering that about 27 mss have been published per year (by his estimate) over the past decade.

Japan

In Japan, I met with Prof. Masaki Takemateu (Kyushu University) and his colleagues (especially Profs. Yoon and Ostrovskii). (I also spoke with Dr. Mitsuyuki Hirai (and Dr. Steve Riser who is visiting Hokaido University for a few months) by telephone.) The Japanese scientific interests are very broad and encompass fundamental circulation observations and modeling, with special interests in the subpolar front and circulation in their coastal waters. They are working to fulfill the aims of NEAR-GOOS and, thus, have an interest in model comparisons, data assimilation, and satellite IR and color imagery, altimetry, and scatterometry. (Dr. Ostrovskii has a collection of spectacular IR images showing seasonal and interannual variations in mesoscale variability.) There is also an interest in atmospheric pollution over JS/ES.

PostScript. On my final stop, I visited Prof. Sheng-Wen Twu and colleagues at the National Cheng Kung University in Tainan, Taiwan, where I gave my final (of five) seminars on our JS/ES circulation modeling. I had been invited by Prof. Jin Wu (on leave from University of Delaware) who had been the President of National Cheng Kung University the past few years until he was appointed Taiwan's Minister of Education three months ago! I met with Prof. Wu in Taipei and learned of the major reform (revolution) of Taiwan's education system, from top-to-bottom, he is leading. His efforts also have implications for regional interactions that should benefit ocean science. Interestingly, National Taiwan University will host the next PAMS/JECCS symposium in the autumn of 1997, while Korea will host PICES VI. Some effort is being made to schedule them back-to-back to encourage North American participation in both.

REPORT OF THE TECHNICAL COMMITTEE ON DATA EXCHANGE

3

8

The Technical Committee on Data Exchange met on October 11, 12 and 17, 1996, under the Chairmanship of Mr. Robin Brown. A provisional agenda and supporting documents had been circulated prior to the meeting. Dr. William Karp and Mr. William Shaw agreed to act as rapporteurs. (See Endnote 1 for participation).

Mr. Brown opened the meeting and welcomed the participants. The agenda was reviewed and additional items (11, 12, 13 and 14) were added to the agenda.

1. Review of TCODE Work Plans and Science Board recommendations

The Committee reviewed the Science Board recommendations and noted acceptance of the TCODE strategic plan for data management. The committee noted that the preliminary TCODE Inventory of Long Term Time Series data, which is now available on the PICES Web Server represents a significant area of progress for TCODE.

2. Review of meetings attended on behalf of PICES/TCODE

- PICES CCCC meeting - Nemuro, Japan, June 1996 (Brown, Kobayashi)
- Environmental Data for Fisheries Science Pacific Grove, California - July 1996 (Brown, Royer)

The Chairman gave a short summary of these meetings. Detailed reports on these meetings were circulated earlier with the supporting documents for the meeting.

3. The role of the PICES Secretariat in supporting TCODE activities

The Committee discussed and outlined TCODE expectations in support of TCODE activities. The Committee listed the following expectations of the Secretariat:

- maintenance of the WWW server and introductory "pages", including corrections and updates to documents as requested by TCODE.
- the Secretariat shall be responsible for distributing paper copies of WWW documents and database reports from the Inventory of Long Time Series. The responsibility for development and population of this database remains with TCODE for the present.
- The Secretariat will distribute a summary of the long term time series with "broadcast" messages (paper and e-mail).

4. "PICES Perspectives" and Communication Strategy

There was an active discussion of some of the issues raised in Dr. Warren S. Wooster's "PICES Perspectives" and the Communication Strategy paper produced by the Secretariat.

- TCODE members supported the observation that committee members who are appointed by their governments to PICES committees find it difficult to represent all the relevant institutions within their country and often are limited to representing the views of their own home institution. This problem is more severe in some countries than in others, depending on the number and structure of agencies/institutions involved. Some members reported that they felt they did not have the real mandate to represent other institutions (i.e. commit them to action

items) while other members found it difficult to find the time to consult and gain consensus within their country. TCODE members did not provide any additional suggestions to overcome this problem.

- TCODE members supported the observation that Committee members find it difficult to fully participate in their PICES committee activities. The Chairman noted that this TCODE meeting had no representatives from Korea or China. Travel costs were certainly a problem for delegates from China and Russia this year. It is not clear what is limiting participation from Korea, although internal reorganization of government agencies and other (higher) priorities may be a problem. Governments need to reaffirm their commitment to fully participate in PICES activities and provide the necessary support to enable this.
- TCODE has not found that communications technology is the major impediment to progress in achieving its goals. Taking a leading-edge approach in this area will be expensive to implement and maintain and could create additional communications problems (and stratification) within the PICES community. TCODE suggests that it is premature to form such a communications committee.
- TCODE strongly supports the Secretariat's initiative on the questionnaire on internet access and TCODE members would like to review and comment on the results when completed. It will be important to gather responses from PICES participants who are unable to attend this Annual Meeting to complete the survey. We feel that it may be more appropriate to set up some Communications Task Team following the review of the results of the questionnaire.

5. TCODE operations - suggestions for improvements, areas of focus etc.

- As noted in the "PICES Perspectives" discussion above, full participation by all TCODE members continues to be a problem. Most of the work of TCODE is done between meetings by e-mail and fax correspondence, but members felt that the Annual Meetings were very important in improving communications and building commitment to work on these tasks.
- As noted above, TCODE members found it difficult to represent all agencies/institutions in their country on TCODE issues. Some members feel they do not truly have the required mandate or support while others find it difficult to find the time required to consult with and integrate the views of all the parties. Each nation needs to develop a strategy for dealing with these problems.
- We reviewed meeting strategy with a view to increasing participation. After considerable discussion, it was agreed that one meeting per year, immediately before the Annual Meeting was best option (even though it makes for a long meeting). This was considered to be the most cost-effective and efficient option and was most likely to result in maximum participation. Unless the PICES nations reinforce their support for delegates, we anticipate continued problems with participation, especially where trans-Pacific travel is required.
- Communication problems were considered to be a minor irritant, although these are continuing problems with reliable e-mail and fax connections to some member countries. It is our understanding that the barriers to improvements in this area are primarily financial, not technical. We also understand that major improvements in e-mail access to Qingdao and Vladivostok are planned for the coming year.

- TCODE needs to work more closely with other Committees and Working Groups to develop appropriate tasks with achievable goals. There are serious practical limitations to the type, size and complexity of tasks which TCODE can take on. On the other hand, TCODE can develop strategies to support and promote activities that are taking place in various PICES member countries which are focused on the data exchange/management problems recognized by PICES. The Bering Sea fisheries/oceanography meta-database proposal (see agenda item 6) is an example of how this can be achieved.

6. Bering Sea Fisheries Oceanography database on WWW

Dr. Bernard Megrey (NMFS, U.S.A.) described his proposal for a Bering Sea Fisheries Oceanography Meta-database for the World Wide Web. This is a proposal that has been submitted for funding from the ESDIM (Earth Sciences Data and Information Management) Program. During the development of this proposal, Dr. Megrey consulted with TCODE members (and other PICES participants). As a result of these consultations, the scope of the original project (eastern Bering Sea only) was expanded to encompass the entire Bering Sea. Linkage to PICES activities/projects (like the inventory of long term time series and the Bering Sea Working Group) was used in the justification for the utility and importance of the proposed database.

TCODE members strongly supported this initiative. If funded, it will bring significant resources to data inventory problems and challenges previously addressed by TCODE. The Committee agreed to assist Dr. Megrey in soliciting international support for the project and in identifying data sources and key contact persons within their countries.

Dr. Megrey expects that an announcement from the ESDIM Program on funding for this project will be made before the end of 1996.

7. TCODE inventory of long-term time series

Members reviewed the progress to data on the Inventory (now available on the PICES WWW server) and found the format and contents useful. The Chairman agreed to prepare a short article for the next PICES Press newsletter that will describe the Inventory and the methods for gaining access (WWW and printed copies on request from the PICES Secretariat). Dr. Bychkov (PICES Secretariat) confirmed that the Secretariat was prepared to distribute printed copies on request.

There was considerable discussion on apparent "gaps" in the contents. Dr. Tokimasa Kobayashi reported that he has circulated information on how to access the Inventory on the WWW, samples of the existing entries and a request for contributions to various fisheries scientists in Japan and was expecting contributions soon. Dr. Kee Soo Nam (Korea) has written to the Chairman promising contributions from Korea in the coming year. Dr. Thomas Royer (U.S.A.) offered to assemble additional entries for the Meteorology section. Mr. Shaw (Canada) offered to create entries that describe the historical archive of fisheries data in the INPFC/NPAFC documents. In addition, Mr. William Shaw offered to review the contents of the Healey report and create additional entries (as required) from this report. All members agreed to take steps to "promote" the use of the on-line database within their own country. The Committee strongly supported the strategy that TCODE members prepare a short description of the PICES web server and the on-line database (with examples) in the working language of the country for distribution.

Following presentations on the Inventory of Long Time Series, the Chairman agreed to forward copies of the "worksheet" and instructions to the Chairman of WG 11 (Sea Birds and Marine Mammals) and the Marine Environmental Quality Committee for collection of addition entries in the categories of sea birds, marine mammals and contaminants.

TCODE agreed to maintain responsibility for additional entries and corrections for the next year. The Chairman will provide PICES with updated versions of the underlying database and web documents periodically. PICES Secretariat should forward all comments, additions and requests for corrections to the TCODE Chairman. During discussions over maintenance of the database, Dr. Megrey suggested an additional field for the email address of the custodian, so that an automated process could be set up to prompt custodian for comment on updating or correction of the entries. The Chairman agreed to undertake this minor modification.

8. IOC Ocean Pilot Service

A short discussion was held on the IOC (International Oceanographic Commission) Ocean Pilot Program, based on supporting documents circulated before the meeting. This is an attempt to create a master index of important web sites/resources for oceanography throughout the world. The Chairman agreed to contact IOC and obtain further information on how PICES could be linked to this program or make a contribution. Additional information on this will be circulated to the Committee following correspondence with IOC.

9. Report on the PICES Vladivostok meeting - Workshop on the Okhotsk Sea and Adjacent areas

Discussion was held over various recommendations from this Workshop which directly or indirectly make requests of TCODE. The following items were discussed:

- TCODE assistance requested in obtaining high resolution (1-2 decibar) CTD data in the Oyashio and Mixed Water regions.

Chairman to notify WG Chairman to ensure they are familiar with existing data sources (JODC archives, TINRO archives/inventory) and seek clarification on the problem. Dr. Kobayashi reported that high

resolution CTD data from Japan Fisheries Agency cruises may not be submitted to JODC - (perhaps data at standard depths only are transferred). Dr. Tadao Tatsuno (JODC) to comment on possibility of adding high resolution data to JODC archive, if required.

- high resolution (0.25 deg) seasonal ocean climatology - will require an international effort to aggregate and manage physical and chemical oceanographic data.

This is indeed a daunting task! It is not clear that there are sufficient data for a climatology at this scale. The Chairman agreed to forward this request to Dr. Syd Levitus for comments and suggestions.

- Working Group to collate all information on catch, size and age for pollock in the Sea of Okhotsk.

The TINRO catalogue of recent data from this area (and others) is available from the PICES Secretariat or TINRO. All data on fish catch, size etc. will be in the hand of agencies in Russia (no other PICES nations will have any significant data holdings in this area).

- TCODE to consider amassing the data necessary for the special process-oriented studies. Complete data inventories from relevant institutions and individuals needs to be identified. It is recommended that TCODE takes an initiative to solve these problems.

Dr. Zuenko reports that much recent existing data is available in electronic form from TINRO, HydroMet Institute and Academy of Sciences. An inventory of recent data from TINRO is available from TINRO or the PICES Secretariat. Additional historical data are available in paper form in Russia and could be converted to electronic form if funding were available. The Chairman noted that the current contributions from

Russia to the inventory of long time series were restricted to TINRO. TCODE representative from Russia need complete entries for other major labs and institutions. TCODE feels that is its a reasonable request to improve descriptions of data holdings at the key institutions, but actually assembling the data into a standard format or database is beyond our current abilities. These activities could be coordinated with the work of Dr. Syd Levitus at WDC-A.

10. TCODE participation at the Science Board

TCODE members felt that it would be advantageous to have the TCODE Chairman available to discuss recommendations and relate issues. TCODE members also agreed to attempt to attend meetings of other WG's on behalf of TCODE when it is practical to do so and where travel costs will not be a barrier.

11. Ship Schedules

At the 1995 meeting, TCODE agreed to undertake publication and distribution (via WWW) of ship schedule information. The Science Board requested that we review our proposal for a minimal ship schedule database and merge it with a more extensive model suggested by the Secretariat.

There was extensive discussion about utility and practical problems associated with establishing this service. The Chairman also reported on correspondence with the University of Delaware personnel who operate the a similar system for proving ship schedule information worldwide. The University of Delaware people offered to assist in any way (up to and including doing on PICES' behalf). They pointed out that the task was not trivial (which TCODE members had discovered when attempting to assemble this information themselves) and that timeliness was critical if the system was to be useful in identifying opportunities for sharing ship time. This suggests there is no place for a "tiered" system for assembling ship schedule information

(collated in member countries, forwarded to PICES, collated at PICES, forwarded to Univ. of Delaware).

The University of Delaware people suggest they would deal directly with the fleet operators, if PICES/TCODE would help in identification of the contact points for the fleet operators. TCODE members also suggested that it would be important to be aware of the planning cycles in the various countries, so that updates could be requested at the appropriate interval for each country. Members also noted that information on charter vessels was also important and was frequently missing from such databases.

TCODE recommends that PICES take advantage of the offer from the University of Delaware and TCODE assist by identifying the important vessel/fleet operators in each country. Responsibility for reminding/harassing the fleet operators for updated ship schedules is to be clarified with the University of Delaware personnel.

12. Cruise Reports

At the previous meeting, TCODE agreed to attempt to assemble cruise reports for recent cruise by PICES members, and post these on the PICES web site. Some minimal progress was made, but the results were unsatisfactory. There was no indication that this was useful to PICES participants (although no data on "hits" to this page were collected).

JODC archives and distributes cruise reports (via a WWW site) for the IOC-WESTPAC area, which provides an important source of information. TCODE members felt a more rewarding strategy might be to establish links on the PICES WWW site to existing data centers and agencies who are managing data from large programs (such as WOCE, JGOFS, GLOBEC etc.). These project sites often have cruise reports available and submission of reports is often a condition of funding. PICES participants who do not have access to WWW could request that the PICES Secretariat or a TCODE member

undertake a search on their behalf. There are additional benefits to such links, as these same sites often provide inventories of and access to recent data that has not yet migrated to National or International data centers.

13. Structure and Content of PICES WWW site

TCODE members from Canada, Japan and the U.S.A. reported that they had personally used the PICES WWW server. Generally, the Committee is very pleased with the Secretariat's efforts in establishing the site. TCODE members felt that PICES should work to establish itself as the primary "theme page(s)" for North Pacific Marine Science issues, as well as providing a mechanism for internal information exchange. This is a big job, but the competition to fill this niche will be limited. This does provide an inexpensive way of broadening the impact of and participation in PICES affairs.

Some specific issues were discussed:

- Should the full text of PICES reports be available on WWW site?

TCODE members suggest that this is unnecessary at the present time. There should be a document summary and Table of Contents available on line for each publication, as well as information on how to obtain a copy. The PICES Secretariat should pursue fully electronic version of new reports to allow a "print on request" service for documents which are no longer available. This service should be advertised to those who do not have WWW access currently.

If PICES establishes an anonymous ftp (file transfer protocol) facility, complete reports in electronic format (postscript) could be placed in this area. Such files will be large and will not be suitable for downloading on systems with limited bandwidth.

- Additional "lists" of people

TCODE recommends that additional lists of people and e-mail addresses be made available on the web site. For example, all attendees at PICES meetings could be added. Such lists need not be maintained - they can be kept on line for a reasonable period, then deleted after 2 or 3 years. Searches for a specific name might return multiple "hits", as people are found on more than one list, but this is preferable to not finding the name/address at all.

- Automated WWW-based registration for Annual Meeting

TCODE supports such a scheme, if it is simple and robust, but we do not consider it a high priority unless it will provide a significant reduction in the workload for the Secretariat. Acceptance of credit card payment by PICES would also be helpful.

- PICES useful links section

TCODE strongly supports the Secretariat's initiatives in this area. We suggest the following sections in this area:

- International Programs (existing)
- International Organizations (existing)
- "PICES World" (new) - this section would contain links to all home pages of institutes/agencies of PICES participants, organized by nation
- Data Centers (existing)
- Additional subject areas for TCODE (Data and Inventories page)
 - Real Time data for the North Pacific
 - Methodologies, Manuals and Standards for Marine Science
 - Climatologies
 - selected software/tools for marine science
- Usage monitoring and reporting

TCODE recommends that the PICES Secretariat activate usage monitoring for the WWW site. There are standard packages that provide summary reports on which pages are accessed and from where. TCODE members expressed interest in reviewing these summaries with the

goal of improving the utility and use of the WWW site. The PICES WWW site should become the primary site for marine science information for the North Pacific.

14. Data Preservation

Dr. Royer pointed out that many government agencies are downsizing and are at significant risk of losing access to data and samples that are inadequately archived. TCODE recommends that the Science Board make the Governing Council aware of this concern.

15. Additional Items Arising from PICES V Science Committee Meetings

- Coordination of data exchange for intercomparison of results from regional experiments.

The REX group has asked for TCODE's recommendation on facilitating data exchange amongst PICES CCCC participants. TCODE will review various strategies and report to the CCCC-IP in 1997.

- Bathymetric data for numerical models

Discussion at the POC meeting pointed out the need for high resolution gridded bathymetry for regional models. TCODE and POC will work together to produce a list of existing sources for these data.

- Results from presentations on the Inventory of Long Time Series to MEQ, BIO, POC and FIS

TCODE members presented a review of the Inventory for the members of each committee. BIO members suggested categories of Sea Birds and Marine Mammals be added. WG 11 will assist in creating the entries. In addition, the MEQ Committee requested a Contaminants category and offered assistance in creating the entries.

- Concerns about XBT data migration to national/international archives

WG 9 reported a concern that some XBT data may not be retained in national data centres. TCODE agrees to report on the data collection, archival and access situations in each country.

- Procedures for updating inventory entries and metadata

The PICES Secretariat will be the contact point for requests for corrections, modifications and additions to the Inventory of Long Time Series. These changes will be coordinated with the TCODE Chairman. TCODE reaffirms that the primary responsibility for maintaining detailed information about the data) rests with the data holder, not with PICES/TCODE.

Endnote 1

Participants and Observers

Canada

Robin M. Brown (Chairman)
William Shaw

Japan

Tokimasa Kobayashi

Russia

Lev N. Bocharov (17th only)
Yury I. Zuenko (for Yennady I. Yurasov)

U.S.A.

Thomas C. Royer
William A. Karp (11th & 12th only)

Observers

Alexander Bychkov (PICES Secretariat)
Gennady Goussev (Russia)
Bernard Megrey (U.S.A.)

REPORT OF THE FINANCE AND ADMINISTRATION COMMITTEE



The Committee met Oct. 14, 15th and 16th under the Chairmanship of Dr. John C. Davis (See Endnote 1 for list of participants).

The Chairman of PICES, Dr. W.S. Wooster, the Executive Secretary, Dr. W.D. McKone, and the Assistant Executive Secretary, Dr. Alexander Bychkov, also attended. Drs. McKone and Bychkov, together with the Chairman, acted as rapporteurs.

Agenda Item 1. Opening by the Chairman

The Chairman called the meeting to order and welcomed the participants, stressing that the job of the Committee was to review financial and administrative matters in keeping with the rules of the Organization and to provide a report to Governing Council for consideration and adoption.

Agenda Item 2. Adoption of Agenda

The Agenda was adopted with an item on "Perspectives" added under "Other Business". Documents entitled "PICES Perspectives", a synthesis of key ideas in that document, and additional document entitled "Communication Perspective" were identified as background material for review prior to discussion of the "Perspectives" issue.

Agenda Item 3. Scheduling of Annual Meetings

With respect to scheduling of the Sixth Annual Meeting in 1997, the Republic of Korea reaffirmed its invitation to host the meeting with the location to be confirmed prior to December 1996. For the Seventh Annual Meeting in 1998, the U.S.A. is working an invitation through appropriate channels. The Russian Federation is prepared to host the Eighth Annual Meeting in 1999 and will provide the name of a contact

person to the PICES Secretariat with whom to discuss arrangements.

The duration and structure of future meetings was discussed with a view to determining what length of meeting and structure was best. Originally, the concept of having intersessional meetings of Committees and/or Working Groups was explored in order for those bodies to conduct their work prior to the Annual Meeting. A negative aspect of such an approach is the cost associated with international travel to such intersessional meetings. At this Annual Meeting, a structure involving having Committees and Working Groups precede the Annual Meeting was adopted. However, attendance at some meetings was poor and not all members were represented. It was decided to explore the best approach with the scientists and the PICES Members were encouraged to do this with their respective delegations. In addition, the matter of meeting duration and structure were referred to the Science Board which supported continuation for the next year of the 1996 pattern. The Board supported a duration of ten days and a structure consisting of three days of working group meetings, five days for the scientific programs as well as certain meetings of the Governing Council and Finance and Administration Committee, and two days for final actions by the Science Board and Governing Council.

Agenda Item 4. Appointment of Executive Secretary

A draft procedure for proceeding to advertise the position of Executive Secretary and a draft position description were reviewed by the Committee. Some amendments were made to the draft position description to add clarity. With respect to the salary range given in the job description, the decision is deferred pending completion of the Government of Canada's classification review as described under Agenda

Item 10. Revisions to the position description were drafted by a small task group to clarify the document and the revised draft is appended for Council's information. This document will have to be revised by the Finance and Administration Committee at the Sixth Annual Meeting.

The Executive Secretary requested a one year extension to his position term in order to address pension considerations and allow him to complete implementation of training and other tasks in the Secretariat. The Committee considered this request and was unanimous in approving it. Accordingly, the Committee recommends that the appointment of the Executive Secretary, Dr. W.D. McKone, be extended for one year to December 1998. Advertisement for a replacement and selection of a suitable candidate should be arranged in order to provide for some overlap of the incoming and outgoing individuals and details of the position advertisement, job description, and selection process will have to be finalized at the next Annual Meeting (Appendix 1).

Agenda Item 5. Space, Facilities and Equipment

The Executive Secretary briefed the Committee on the status of discussions with respect to space allotted to the Secretariat at the Department of Fisheries and Oceans' Institute of Ocean Sciences in Sidney, B.C. There have been ongoing discussions with Fisheries and Oceans with respect to conversion of additional space for the Secretariat as it grows and there is a need to follow through on provision of that space for the Secretariat. Dr. Davis explained that 1996 had been a very difficult year with respect to budget freezes and cuts and that the Department was prepared to entertain this request in the coming year. The Executive Secretary will pursue discussions with the Department.

With respect to equipment, there was a question of whether PICES could face a budget challenge if large amounts of equipment had to be replaced at short notice. The Executive Secretary explained that desktop computer equipment was

adequate in the short-term and that there was a need to upgrade some laptop computers essential to the operation of the Organization, particularly when meetings are held away from the Secretariat home location. Major budgetary challenges of this sort are not viewed as a problem, provided a gradual replacement and upgrade approach to equipment is followed to keep pace with needs and the capabilities of equipment. It was also suggested that the Executive Secretary investigate whether renting laptop computers was a beneficial approach to allow utilization of the latest technology to meet PICES periodic needs for extra laptops for Annual Meetings while avoiding having to purchase some machines for that purpose.

Agenda Item 6. Rules Change to Allow Past Chairman to Serve as an Ex-officio Participant

The proposal made by the U.S.A. for a rule change which would allow an outgoing Chairman to serve PICES in an ex-officio advisory capacity for the term of the incoming Chairman was discussed. There was general consensus that the idea was a good one and there was debate about how to accomplish this objective (i.e.- by changing the rules or by approving the approach under existing rules through a decision of Council). At issue, was whether PICES should pay the travel expenses for the Past Chairman appointed in this capacity or whether they should be borne by the country of origin of the individual and there was not full consensus on this issue. The Committee decided to recommend that the outgoing Chairman, Dr. Wooster, be appointed in an ex-officio advisory capacity to Governing Council with authorization to attend Annual Meetings with the associated travel budget to be funded from the interest accrued in the Working Capital Fund.

Agenda Item 7. Financial Support for PICES scientist to attend SCOR-WG 105

This item involved a specific issue of approval of a PICES scientist to attend the SCOR-WG 105 meeting at the expense of the Organization as well as the more general issue of whether the Chairman and Executive Secretary would continue to exercise their existing discretion to approve such expenditures in the future. From time to time, it may be desirable to have representatives of the PICES Organization engage in travel at the organization's expense in order to attend important meetings and act on PICES behalf. After discussion, it was agreed that it would be undesirable to restrict the flexibility of the Organization by requiring every specific travel approval to be reviewed by Governing Council. Accordingly, the Committee recommends that the Executive Secretary endeavor to provide the PICES Members with as complete as possible a proposal for travel approvals at the time the budget is prepared and to report fully at the end of a budget cycle on travel that was approved. In addition, it was agreed that Council should ask the Science Board for a projection of any budgetary implications of its recommendations at the time the Science Board report is tabled for consideration by the Governing Council at the Annual Meeting. In this manner, Governing Council can revisit the budget if necessary, prior to cessation of the final session of the Annual Meeting.

Agenda Item 8. Salary Practices of Other Organizations

In keeping with discussions at the previous Annual Meeting, the Chairman reported on his commitment to investigate salary increase practices of other international organizations including whether pay scales were employed. Responses from four organizations were received in writing: the Pacific Salmon Commission, the Great Lakes Fishery Commission, the Inter-American Tropical Tuna Commission, and the Northwest Atlantic Fisheries Organization. In general, these

organizations follow the salary practices of the country in which the Secretariat is located, while in some, there is not strict adherence to that practice. This item is considered an information item for guidance of the PICES Organization.

Agenda Item 9. Audited Accounts for Financial Year 1995

The Auditor's Report was reviewed and after some questions of clarification, adopted by the Committee (Endnote 2). The Executive Secretary, in response to a query from China, explained that further details on any item contained in the Auditor's Report can be provided to any PICES Members requesting such details. The Auditor's Report is recommended to Governing Council for approval. The recommendation of the Executive Secretary to retain the auditor Flader and Greene for another year was approved.

Agenda Item 10. Budget

a) Estimated Accounts for Fiscal Year 1996

This document was reviewed and it was pointed out to the participants that an error had been made in the tables presented to Committee members. The table showing the proposed Contribution from each party and the figures for 1997 should be amended to show a proposed national contribution of \$88,000.00 and a total contribution of \$ 528,000 respectively.

b) Budget for Financial Year 1997

A detailed review of the draft budget proposal was conducted with much discussion amongst the participants. Both Canada and China, particularly, sought explanation of proposed budget expenditures and sought to reduce the size of the proposed budget, particularly with respect to Personnel Services and Travel line items in the budget. China proposed, and it was agreed that travel costs associated with the Annual Meeting not be shown under the line item "Expenses for Annual Meeting" but rather

under "Travel". Furthermore, the Executive Secretary was asked to compile a listing of proposed travel for the budget year that was as detailed as possible to allow the PICES Members to examine travel proposals at the time the budget was reviewed. Each year, this review should include examination of an itemized report summarizing travel paid for by the Organization for the past budget year leading up until the time of the Annual Meeting. There was disagreement amongst the participants as to the merits of a periodic reporting (every three or four months) of in-year travel expenses and it was pointed out that this level of detail was not required in other similar international bodies to which a number of the PICES Members belong. The Secretariat reconfirmed its commitment to provide additional information on any budget item that was of interest to any PICES Member and will respond to specific inquiries as requested.

Canada raised the matter that when the Annual Meeting is on the Western side of the Pacific it has been a practice to have PICES contribute a substantive amount of funding to defray the expenses of the host country while that practice has not been followed for meetings held on the Eastern side of the Pacific. In those cases, the U.S.A. or Canada have covered most of the cost of hosting the Annual Meeting. Canada proposed that for future meetings (after the Sixth Annual Meeting which is currently being planned in accord with this past practice), that PICES contribute no money to offset the costs, or that alternately, some formula be found to keep the cost down. In discussion, Korea proposed there be no change to the process and that the U.S.A. and Canada should apply for assistance to offset Annual Meeting costs in years that they hosted the Annual Meeting.

With respect to Personnel Services, it was agreed that the job descriptions for all positions in the Secretariat be reviewed by a classification specialist from the Government of Canada with the objective of determining if they are suitably classified in accordance with the duties of the positions. This will provide PICES with useful

information with which to judge salary matters and level of remuneration associated with each position. This review should be conducted as soon as possible with the results circulated to the PICES Members. If an upward revision of the salary is justified for any position, the Executive Secretary will be authorized to implement the increase. Pending the outcome of the review only staff entitled to a step increase will receive it. With these adjustments the proposed total budget for personnel services was set at \$274,000.00 for 1997.

Regarding the proposed \$10,000.00 budgeted for the "Trust Fund" line item, this entry was removed from the proposed budget for reasons described below.

After considerable discussion of the line items in the budget, and extensive explanations, largely in response to questions about budget particulars raised by China, there was consensus amongst of the Committee Members that a total budget of \$509,000.00 was appropriate (Endnote 3). This figure could be reached by subtracting savings of \$8,000.00 from Personnel Services, reducing the travel budget to \$64,000.00 (including travel associated with the Annual Meeting) and eliminating the \$10,000.00 proposed for the Trust Fund as indicated above. This revised budget figure is therefore identical to the 1996 budget and will require a contribution from each country of \$84,800. Detailed budget documentation is included at the end of this report and the budget is recommended for adoption.

c) Forecast Budget for Financial Year 1998

This item was examined by the Committee and is recommended for information to Governing Council without need to adopt the forecast budget at this time. It should be noted that although the forecast budget contains an item related to the trust fund, the Finance and Administration Committee has not concluded consideration of the Trust Fund matter and inclusion of this item does not mean there is

agreement on supplementing the Trust Fund from the PICES budget.

d) Working Capital Fund

The Executive Secretary reported on the status of the Working Capital Fund for the information of the Committee Members. The fund contained a total of \$105,013.82 including accrued interest on September 30, 1996.

e) Trust Fund

The Executive Secretary reported that the Trust Fund contained a total of \$64,241.07 as of the 30th of September, 1996. None of this money has been spent to date to support participation of additional scientists at PICES functions. In addition, the U.S.A. indicated that approximately \$43,000.00 that was being held on its behalf could be added to the Trust Fund with the proviso that this money be used to support the participation of Chinese and Russian scientists at future PICES functions.

There was extensive discussion of how the Trust Fund should be used, following on from the decision of Governing Council in 1994 when the fund was established. At that time, Council established the fund "for the purpose of facilitating participation of a broad spectrum of scientists in activities of the Organization". At the current Finance and Administration meeting there was considerable discussion about the merits of including a scheme to replenish the trust fund by making it a line item in the budget, whether contributions to the trust fund should be voluntary and outside the budget process, and whether the funds should be used to support scientists from PICES Members, including those serving on Committees and Working Groups.

On the subject of who was eligible for trust fund support, China felt that the fund should be used to support participation of PICES Members scientists including those serving on committees and working groups. Others felt that such individuals should be supported by the PICES Members sending the individual or the

organization from which the individual came and that these moneys should only be used to allow individuals who would not normally be able to attend to take part in PICES functions. Korea was of the opinion that only scientists from PICES Members should be eligible for trust fund support. Others felt that support from the trust fund should be used to allow scientists outside of PICES Members as well as those from PICES Members to attend. Canada, Japan, Korea, and the U.S.A. stated that there was no financial mechanism within their own financial approval process to allow voluntary contributions to a trust fund if the fund were not specified as an item within the PICES budget.

It was decided that PICES should continue to examine this question, drawing on the documentation available to date, and including:

- whether there should be replenishment of the Fund from the budget,
- developing a process whereby interested scientists apply for funding support from the Trust Fund to attend meetings with the approval to be given no later than 3 months prior to the event;
- a process of review and approval of requests by the Chairman of the Science Board, in consultation with the Chairman and Executive Secretary;
- whether rule and procedural changes are required to facilitate the process.

At the conclusion of this discussion, it was recommended that the Secretariat be asked to develop a draft rule change that would further consider these options and also to develop explanatory guidelines as to how the money would be used and decisions would be made on requests for funding assistance. This information would be circulated to the PICES Members for their consideration.

f) Home Leave Relocation Fund

The Executive Secretary reported on the status of this fund, estimating that to December 31, 1996, the fund would have a total of \$99,642.95.

g) Other Funds Held

A total of \$100,000.00 was held on behalf of PICES Members, including \$50,000 from Japan that would be paid towards contributions in 1997. The remaining \$50,000.00 was held on behalf of the United States, approximately \$7,000.00 of which had been used to cover travel of Russian scientists to PICES meetings. The residual, approx. \$43,000.00 was designated for use in the Trust Fund for support of Chinese and Russian scientists as stated earlier.

Agenda Item 11. F & A Membership and Term of Chairman

The Executive Secretary stressed that the Secretariat has difficulties determining what individuals will attend F & A meetings as PICES Members often do not provide F & A Committee membership. With this lack of information, communication difficulties have been experienced as information sometimes does not reach the individuals who attend F & A meetings and key documents may not be available for analysis by concerned individuals prior to the Annual Meeting. The Committee recommends the Council stress the importance of identification of F & A Committee members and encourage the PICES Members to regularly supply and update this information in writing as changes occur.

The Committee further recommends that rules be amended (Appendix 2) to specify that each PICES Member appoint a member and an alternate for service on the F & A Committee, and that meetings be closed, (in keeping with the existing rules) to all but the members and their alternates, the Committee Chairman and the Vice-Chairman of PICES.

Finally, the Committee proposes that the term of appointment of the Chairman of the Finance and Administration Committee be for a term of two years and that the Chairman shall only be eligible for reappointment only once for a successive term of two years. In keeping with Rule 15, the Chairman of the Finance and Administration Committee would be appointed by the Council from among the Committee members. In that regard, the Chairman, Dr. J.C. Davis, stated that having done the job for five years, he felt the job should be taken over by another individual and stated that he was not prepared to serve as Chairman for an additional term beyond the Fifth Annual Meeting. A rule change is proposed (Appendix 2).

Agenda Item 12. Other Business

a) Perspectives Documentation

The Committee reviewed two documents, one entitled "Perspectives" prepared by the Chairman and the Executive Secretary and a second entitled "Communication Perspective". In addition to the former document, a synopsis of its key findings was reviewed by the Committee.

The item in the "Perspectives" document that was considered to be relevant to the business of F & A was the reference to the trust fund which had been extensively discussed by the Committee as summarized above. Korea noted a preference to have Trust Fund moneys used to support the participation of scientists from PICES members only.

On the matter of the "Communication Perspective" document, the Committee endorsed efforts to improve communications within the Organization. Some members were concerned about the proliferation of committees which increase complexity and expense and were of the opinion that TCODE should be tasked with the initiatives summarized in the document. While there are some concerns about the workload of TCODE, it was noted that TCODE itself is proposing addressing the initiatives in the

document through a TCODE Subcommittee. This seemed an appropriate approach to a

number of Committee members.

Appendix 1 Draft August 28 (revised Oct 15), 1996

NORTH PACIFIC MARINE SCIENCE ORGANIZATION - PICES

Executive Secretary Position

Applications are invited for a five-year appointment to the position of Executive Secretary of the North Pacific Marine Science Organization (PICES).

The purpose of the Organization is to promote and coordinate marine scientific research in order to advance scientific knowledge of the area concerned (i.e. the northern North Pacific and adjacent seas especially northward from 30 degrees North Latitude) and of its living resources, including but not necessarily limited to research with respect to the ocean environment and its interactions with land and atmosphere, its role in and response to global weather and climate change, its flora, fauna and ecosystems, its uses and resources, and impact upon it from human activities; and to promote the collection and exchange of information and data related to marine scientific research in the area concerned.

The Organization's main bodies - the Governing Council and Science Board - meet annually, and more often if necessary. Member States currently are Canada, the People's Republic of China, Japan, the Republic of Korea, the Russian Federation, and the United States of America. English is the working and official language of the Organization.

The Secretariat is located at the Institute of Ocean Sciences, British Columbia and provides services to the Organization in the exercise of its duties and functions.

Description of the Position and Duties

The Executive Secretary is the Organization's chief administrative officer and must be impartial in promoting and coordinating the interests of all Contracting Parties. The Executive Secretary is responsible for the management of the Organization's office, staff and funds, which are presently at the level of CND\$500,000-\$600,000 contributed equally by the Member States; conducts business on behalf of the Organization; arranges annual and other meetings of the Organization and its constituent bodies and committees; prepares annual budget estimates and forecasts; annual financial statements, and other documents as required; invests funds that are surplus to immediate needs; handles correspondence; prepares minutes of Governing Council, Science Board, and Finance and Administration Committee; prepares an annual report of the Organization for distribution to the Member States; and publishes the annual report and other scientific publications as required by the Organization. The successful candidate must be self-motivated and be responsible for administration and staff of the Organization; work with the Chairman of Council, Science Board, Scientific Committees, Working Groups, and other bodies.

The Executive Secretary is assisted by an Assistant Executive Secretary, Administrative Assistant, and a Secretary.

The term of office is a minimum of five years and may be renewed at the discretion of Council.

Qualifications and Essential Experience

Applicants must be a citizen of a Member State of PICES at the time of assuming office. Preference will be given to a Ph.D. or equivalent

experience in one of the marine science disciplines from a recognized university. The applicant must have significant experience in conducting and managing scientific research or significant administrative experience with international cooperative scientific programs and with scientists from a number of countries. This experience relates particularly to marine scientific research and marine scientists.

Applicants should also have experience in or detailed knowledge of the operations of intergovernmental organizations, including demonstrated experience in the selection and supervision of staff, and experience in the preparation of financial budgets and management of funds.

Applicants should have experience in the organization of large and small meetings and the provision of secretarial support, especially to scientific committees and groups, must submit examples of their writing, and be prepared to provide further examples if interviewed.

Applicants must be fluent in both spoken and written English and will be asked to write a paragraph or two if interviewed for the job. Fluency in another language of a member country would be a benefit. A knowledge of marine science activities in the northern North Pacific region is desirable.

Salary and Benefits

The annual salary and benefits of the staff of the Organization are guided by but not limited to the host state (Canada) public service salaries for equivalent responsibilities. The salary is negotiable, in the range of CND\$ (to be determined), commensurate with qualifications and experience. The salary is subject to the equivalent of Canadian income tax.

The Organization participates in:

1. Group Pension Plan with spouse and survivor benefits,
2. Canada Pension Plan,

3. Unemployment Insurance Plan,
4. British Columbia Medical Plan,
5. Group Extended Health Benefits Plan,
6. Group Dental Insurance Plan,
7. Group Long-Term Disability Plan, and
8. Group Term-Life Insurance Plan.

Non-Canadian applicants can be exempt from membership in some of the plans depending on circumstances. Cost to the successful applicant would vary depending on the exemptions.

Payment will be made for moving expenses for the employee and family to the headquarters at the start of employment and return at the end of employment, in accordance with the host state public service guidelines.

Each year annual vacation leave and holidays traditionally celebrated by the host state public service are provided, as well as sick leave. Internationally recruited staff and their dependents are entitled to two paid calendar weeks home leave every two years.

Application Procedure

An application should include a covering letter, and resume written by the applicant. At least three references from persons with a knowledge of the applicant's qualifications and experience are required; it is desirable that at least one reference be from a country other than that of the applicant. Applicants should indicate in their letter a suitable starting date and acceptable salary level. A desirable starting date would be May 1.

Deadline for applications is June 1, 1997

Applicants placed on a short list should expect to be interviewed at the PICES Annual Meeting in October 1997.

The applicant and writers of references should send their submissions marked Personal and Confidential directly to either:
Dr. William G. Doubleday, Chairman
Director General, Fisheries Science Directorate

Department of Fisheries and Ocean
200 Kent Street,
Ottawa, Ont.,
Canada. K1A 0E6
Phone: (613) 990-0271
Fax: (613) 954-0807
Internet:

Dr. W.D. McKone, Executive Secretary

North Pacific Marine Science Organization
c/o Institute of Ocean Sciences
P.O. Box 6000,
Sidney, British Columbia,
Canada. V8L 4B2
Phone: (250) 363-6366
Fax: (250) 363-6827
Internet: pices@ios.bc.ca

Appendix 2

Rule 15

The Finance and Administration Committee shall consist of one member and one alternate from each Contracting Party. The Executive Secretary shall be an ex officio member of this Committee without the right to vote. The Council's Vice-Chairman should attend the meetings of the Committee without the right to vote. The Chairman shall be appointed by the Council from among the Committee's members for a term of two years and shall be eligible for reappointment only once for a successive term. A Chairman of the Committee who is a Delegate shall not function as such during the time of Chairmanship, and the appointing Contracting Party shall have the right to appoint another person to serve as a Delegate. At each ordinary meeting of the Council the Finance Committee shall examine:

Endnote 1

Canada

Dan Goodman
Joyce Quintal-McGrath

China

Qi-Sheng Tang
Lian-Zeng Chen
Yong- Ke Jiao
Qian-Fei Liu
Jian-Hong Meng
Ming Zhang

Rule 18

- (ii) delete "and" at the end.
- (iii) (a) meetings of the Science Board may be attended by persons other than the members only on the invitation of the Chairman of the Council,
(b) meetings of the Finance and Administration Committee may be attended by persons other than the members and alternates only on the invitation of the Chairman of the Council, and;
- (iv) all Delegates, Alternate Delegates, experts, advisors, observers, and any person attending the meeting of the Council may attend meetings of any of the Committees or Groups of the Council, except in cases where participation in meetings of a Committee or Group has been limited by the Council.

Participants and Observers

Yong Li

Japan

Kazumi Hagino
Satsuki Matsumura

Republic of Korea

Jang-Uk Lee
Deok-Bae Park

Russia

Alexander Rodin

Boris N. Kotenev
Gennady Gusev

U.S.A.

John L. McGruder
Dorothy Bergamashi
Mark Wildman
William Sullivan, Jr.

Other

Warren S. Wooster (Chairman, PICES)
John C. Davis (Chairman, F&A Committee)
W. Doug McKone (Executive Secretary)
(Rapporteur)
Alexander Bychkov (Assistant Executive
Secretary) (Rapporteur)

Endnote 2

Auditor's Report to the Organization

Flader and Greene
Chartered Accountants
9768 Third Street,
Sidney, B.C.
V8L 3A4

We have audited the statements of assets and liabilities of the North Pacific Marine Science Organization as at December 31, 1995, and the statement of sources of funds and expenditures for the year then ended. These financial statements are the responsibility of the organization's management. Our responsibility is to express an opinion on these financial statements based on our audit.

We conducted our audit in accordance with generally accepted auditing standards. Those standards require that we plan and perform an audit to obtain reasonable assurance whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation.

In our opinion, these financial statements present fairly, in all material respects, the financial position of the organization as at December 31, 1995, and the results of its operations and the changes in financial position for the year then ended in accordance with generally accepted accounting principles.

Sidney, B.C. Canada
February 29, 1996

Flader and Greene
Chartered Accountants

Statement of Assets and Liabilities
December 31, 1995

	<u>1995</u>	<u>1994</u>
ASSETS		
Current Assets		
Cash and term deposits	\$ 384,330	\$ 287,466
	=====	
LIABILITIES AND FUND BALANCES		
Current Liabilities		
Accounts payable	\$ 10,288	\$23,844
Funds held for contracting parties - Note 5	<u>184,800</u>	<u>30,240</u>
	\$195,028	\$ 54,084
Fund Balances		
Working Capital Fund	\$ 130,418	\$ 221,826
Trust Fund	<u>58,884</u>	<u>11,556</u>
	<u>189,302</u>	<u>233,382</u>
	<u>\$ 384,330</u>	<u>\$ 287,466</u>

**Statement of Sources of Funds and Expenditures
For the Year Ended December 31, 1995**

	General Fund	Working Capital Fund	Trust Fund	1995 Total	1994 Total
Fund Balances , beginning of year	\$ -	\$ 221,826	\$ 11,566	\$ 233,382	\$ 241,996
Sources of Funds					
Transfers from Working Capital Fund	110,000	(240,000)	30,000	(100,000)	-
Contributions from Contracting Parties	330,000	155,833	9,883	495,716	394,060
Interest earned	-	16,553	17,586	34,139	15,160
Fund Balances , before expenditures	440,000	154,212	69,025	663,237	651,216
Expenditures					
Personnel services	240,198	-	-	240,198	212,690
Travel	33,816	-	10,141	43,957	55,038
Communication	24,403	-	-	24,403	14,733
Contractual services	11,081	-	-	11,081	8,290
Printing	22,831	-	-	22,831	21,906
Supplies	3,822	-	-	3,822	1,433
Equipment - Note 2	21,273	-	-	21,273	15,344
Annual General Meeting expenditures	65,864	-	-	65,864	70,725
Vladivostok Workshop	27,598	-	-	27,598	-
Relocation	12,083	-	-	12,083	16,168
Miscellaneous	825	-	-	825	1,507
	463,794	-	10,141	473,935	417,834
Net Funds Available	(23,794)	154,212	58,884	189,302	233,382
Transfers to Working Capital Fund	23,794	(23,794)	-	-	-
Fund Balances , end of year	\$ -	\$ 130,418	\$ 58,844	\$ 189,302	\$ 233,382

**Notes to Financial Statements
December 31, 1995**

1. Accounting Policies

The financial statements are prepared in accordance with the North Pacific Marine Science Organization's Financial Regulations and are prepared in accordance with generally accepted accounting principles. The following is a summary of the significant accounting policies used in the preparation of these financial statements:

a) Fund Accounting

The Working Capital Fund represents the accumulated excess of contributions provided by the Contracting Parties over expenditures in the general fund. The purposes of the General Fund and Working Capital Fund are established by Regulation 6 of the Organization Financial Regulation.

b) Capital Assets

Capital assets acquired by the Organization are expensed in the year of acquisition. (Note 2).

c) Income Tax

The Organization is a non-taxable organization under the Privileges and Immunities (International Organizations) Act (Canada).

d) Foreign Exchange

Transactions originating in foreign currencies are translated at the exchange rate prevailing at the transaction dates. Assets and liabilities denominated in foreign currency are translated to equivalent Canadian amounts at the current rate of exchange at the balance sheet date.

2. Equipment

At December 31, 1995, capital assets on hand and their original purchase price are as follows:

Furniture and fixtures	\$32,423
Computer equipment	<u>60,432</u>
	\$92,855

The assets were expensed in the year of acquisition.

3. Commitments

Office space and services are provided to the Secretariat to the Organization by the Government of Canada through the Department of Fisheries and Ocean. This agreement commenced April 1, 1992 and continues indefinitely with a review every three years. The fixed cost for office space is \$2,000 per year. Services provided are invoiced quarterly.

4. Interest and other income

	Working Capital Fund	Trust Fund
Interest income	\$7,000	\$9,589
Income from contract with APEC		6,733
Income from contract with ISF		1,264
GST/PST rebates	<u>9,531</u>	
	<u>\$16,553</u>	<u>\$17,586</u>
	=====	=====

5. Funds held for Contracting Parties

	1995	1994
United States, Funds Held	\$ 50,000	
Japan, Funds Held	50,000	
Japan, Funds Held for 1996 Fees	20,240	30,240
Japan, Prepaid Fees for 1996	<u>64,560</u>	
	<u>\$ 184,800</u>	<u>\$ 30,240</u>
	=====	=====

6. Comparative Figures

Certain comparative figures have been reclassified to conform to the presentation used in the current year.

Endnote 3

Budget for Fiscal Year 1997

Source	Contributions
<u>Contributions from six Contracting Parties</u>	<u>509,000</u>
Total	509,000
Category	Allotment
Personnel Services	274,000
Travel	64,000
Communication	24,000
Contractual Services	10,000
Printing	37,000
Supplies	6,000
Equipment	10,000
Annual Meeting	45,000
Workshop	37,000
<u>Miscellaneous</u>	<u>2,000</u>
Total	509,000

COMPOSITION OF THE ORGANIZATION

☞

☛

Officers:

Chairman: Dr. W.G. Doubleday
Vice-Chairman: Dr. H.T. Huh

Delegates:

Canada
Dr. J.C. Davis
Ms. K.A. Bruce

Korea
Dr. H.T. Huh
Mr. K.S. Park

China
Mr. C.M. Liu
Prof. Y.K. Xu

Russia
Dr. S.E. Dyagilev
Dr. A.V. Rodin

Japan
Mr. T. Inagawa
Dr. S. Matsumura

U.S.A.
Dr. V. Alexander
Dr. J.W. Balsiger

Finance and Administration Committee:

Canada
Ms. J. Quintal-McGrath
Dr. J.C. Davis

Korea
Mr. C.H. Yoo
Mr. S.H. Song

China
Mr. L.Z. Wei
Mr. L. Yong

Russia
Dr. G.V. Khen
Dr. G.I. Yurasov

Japan
Mr. H. Karube
Dr. S. Matsumura

U.S.A.
Dr. J.L. McGruder (Chairman)
Ms. D. Bergamaschi

Science Board:

Chairman, Science Board

Dr. M. Kashiwai

Chairman, Biological Oceanography Committee
Chairman, Fishery Science Committee
Chairman, Marine Environmental Quality Committee
Chairman, Physical Oceanography and Climate Committee

Prof. P.A. Wheeler
Dr. C.I. Zhang
Dr. R.F. Addison
Prof. P.H. LeBlond

Secretariat:

Executive Secretary:	Dr. W.D. McKone
Assistant Executive Secretary:	Dr. A. Bychkov
Administrative Assistant:	Ms. C. Chiu
Secretary:	Ms. C. McAlister

Scientific Committees:

Biological Oceanography Committee:

Canada

Dr. K.L. Denman
Dr. D.L. Mackas
Prof. T.R. Parsons

China

Prof. Y.Q. Chen
Prof. R. Wang
Dr. M.Y. Zhu

Japan

Prof. T. Sugimoto
Dr. A. Tsuda

Korea

Dr. S.Y. Hong
Dr. J.H. Shim
Dr. S. Yoo

Russia

Dr. B.N. Kotenev
Dr. V.I. Radchenko
Dr. V.V. Sapozhnikov

U.S.A.

Dr. L. Jones
Prof. M.M. Mullin
Prof. P.A. Wheeler (Chairman)

Fishery Science Committee:

Canada

Dr. R.J. Beamish
Dr. J. Rice

China

Prof. Q.S. Tang
Prof. Z. Yan
Prof. M.J. Zhou

Japan

Prof. K. Ohtani
Dr. T. Wada
Dr. K. Wakabayashi

Korea

Dr. S. Kim
Dr. J.U. Lee
Dr. C.I. Zhang (Chairman)

Russia

Dr. L.V. Borets
Dr. V.I. Radchenko
Dr. M. Stepanenko

U.S.A.

Dr. D.M. Eggers
Dr. J.R. Hunter
Dr. L.L. Low

Marine Environmental Quality Committee:

Canada

Dr. R.F. Addison (Chairman)
Mr. L. Harding
Mr. R.C.H. Wilson

China

Prof. S.Z. Feng
Prof. X.P. Jia
Prof. J.Y. Zhou

Japan

Dr. T. Hirano
Prof. M. Shimizu
Dr. M. Watanabe

Korea

Dr. H.G. Kim
Dr. K.W. Lee
Dr. D.B. Yang

Russia

Dr. S.A. Patin
Dr. E.N. Shumilin
Dr. A.V. Tkalin

U.S.A.

Dr. P.K. Park
Dr. U. Varnasi
Dr. C.M. Watson

Physical Oceanography and Climate Committee:

Canada

Dr. H.J. Freeland
Prof. P.H. LeBlond (Chairman)
Dr. C.S. Wong

China

Prof. J.P. Chao
Prof. D.X. Hu
Prof. M.Y. Zhou

Japan

Dr. M. Endoh
Prof. Y. Nagata
Prof. Y. Sugimori

Korea

Dr. S.K. Byun
Dr. K. Kim
Dr. J.Y. Yun

Russia

Dr. S.V. Gladyshev
Dr. G.V. Khen
Dr. V.B. Lobanov

U.S.A.

Prof. D.L. Musgrave
Dr. J.E. Overland
Prof. S.C. Riser

Technical Committee on Data Exchange (TCODE):

Canada

Mr. R.M. Brown (Chairman)
Mr. W. Shaw

China

Mr. S.N. Jiang
Mr. L. Tong

Japan

Dr. T. Kobayashi
Dr. T. Tatsuno

Korea

Dr. S.D. Hahn
Dr. K.S. Nam

Russia

Dr. L.N. Bocharov
Dr. I.D. Rostov
Dr. N.A. Ryakov

U.S.A.

Dr. W.A. Karp
Dr. T.C. Royer

Working Group 5: Bering Sea
(Disbanded as of October 1996)

Canada

Dr. R.J. Beamish
Dr. J. Rice
Dr. C.S. Wong

China

Prof. Q.S. Tang
Prof. R. Wang

Japan

Dr. K. Mito
Prof. K. Ohtani
Dr. T. Takizawa

Korea

Dr. S. Kim
Dr. J.H. Lee
Dr. D.Y. Moon

Russia

Dr. S.V. Gladyshev
Dr. V.I. Radchenko
Dr. V.V. Sapozhnikov

U.S.A.

Dr. R.C. Francis
Ms. P. Livingston
Dr. T.R. Loughlin
Dr. L.L. Low
Prof. A. Tyler (Chairman)
Dr. T.E. Whiteledge

Working Group 8: Practical Assessment Methodology

Canada

Dr. R.F. Addison
Dr. C. Levings

China

Prof. Y.X. Yuan
Prof. M.J Zhou (Co-Chairman)

Japan

Dr. T. Hirano
Prof. M. Shimizu
Dr. M. Watanabe
Dr. H. Yamada

Korea

Dr. G.H. Hong
Dr. S.Y. Hong
Dr. H.D. Jeong
Dr. P.Y. Lee
Dr. T.S. Lee
Dr. D.S. Lee
Dr. J.H. Shim

Russia

Dr. S.A. Patin
Dr. E.N. Shumilin
Dr. A.V. Tkalin

U.S.A.

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LIST OF ACRONYMS

<p>ADCP ALACE APEC ASEAN BASS (TT) BIO CCCC CERN CPR CREAMS CSR CTD EC/IP ECOR FAO FEB RAS FERHRI FIS GLOBEC GOOS GST HAB IACP IASC IATTC IBP ICCAT ICES ICSU IGPB IMB IMG&G IO RAS IOC IODE IP IPHC ITSU IUGG JEBAR JECSS JFA JGOFS JODC</p>	<p>Acoustic Doppler Current Profiler Autonomous Lagrangian Circulation Explorer (float) Asian Pacific Economic Cooperation Association of Southeast Asian Nations Basin Scale Studies Biological Oceanography Committee Climate Change and Carrying Capacity Program Center for European Particle Research Continuous Plankton Recorder Program Circulation Research of the East Asian Marginal Seas Cruise Summary Reports Conductivity, Temperature, Depth profiler Executive Committee / Implementation Panel for CCCC Engineering Committee on Oceanic Resources Food and Agriculture Organization Far Eastern Branch of Russian Academy of Sciences Far Eastern Regional Hydrometeorological Research Institute Fishery Science Committee Global Ocean Ecosystem Dynamics Programme Global Ocean Observing System Goods and Services Tax Harmful Algae Blooms Institute of Automation and Control Process International Arctic Science Committee Inter-American Tropical Tuna Commission Institute of Biology and Pedology International Commission for the Conservation of Atlantic Tuna International Council for the Exploration of the Sea International Council of Scientific Unions International Geosphere Biosphere Programme Institute of Marine Biology Institute of Marine Geology and Geophysics Institute of Oceanology Rasiian Academy of Sciences Intergovernmental Oceanographic Commission International Oceanographic Data Information Exchange (IOC) Implementation Panel for CCCC International Pacific Halibut Commission International Coordination Group for the Tsunami Warning System in the Pacific International Union of Geodesy and Geophysics Joint Effect of the Baroclinicity and Bottom Relief Japan East China Sea Study Japan Fisheries Agency Joint Global Ocean Flux Study (IGPB) Japanese Oceanographic Data Center</p>
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KamchatNIRO	Kamchatka Research Institute of Fisheries and Oceanography
KORDI	Korea Ocean Research and Development Institute
LOICZ	Land Ocean Interaction in the Coastal Zone
MBARI	Monterey Bay Aquarium Research Institute
MEDS	Marine Environmental Data Center
MEQ	Marine Environmental Committee
MODEL (TT)	Conceptual / Theoretical and Modeling Studies
MOU	Memorandum of Understanding
NAFO	Northwest Atlantic Fisheries Organization
NASCO	North Atlantic Salmon Conservation Organization
NOAA	National Oceanographic and Atmospheric Administration (U.S.A.)
NODC	National Oceanographic Data Center
NOP	National Oceanographic Program
NPAFC	North Pacific Anadromous Fish Commission
NSFC	National Science Foundation of China
ODC	Oceanographic Data Center
OECD	Organization for Economic Cooperation and Development
PAMS	Pacific Marginal Seas Studies
PIBOC	Pacific Institute of Bioorganic Chemistry
PICES	North Pacific Marine Science Organization
PIG	Pacific Institute of Geography
PNA	Pacific North America
POC	Physical Oceanography and Climate Committee
POI	Pacific Oceanological Institute
PSC	Pacific Salmon Commission
RAFOS	Listening float (SOFAR spelled backwards)
REX (TT)	Intercomparison of Regional Scale Studies
RHLF	Relocation and Home Leave Fund
ROK	Republic of Korea
SakhNIRO	Sakhalin Research Institute of Fisheries and Oceanography
SCOPE	Scientific Committee on Problems in the Environment
SCOR	Scientific Committee on Ocean Research
SOGI	Sakhalin Oil and Gas Institute
SOI	State Oceanographic Institute
SOPAC	South Pacific Applied Geoscience Commission
SPREP	South Pacific Regional Environment Programme
STA	Science and Technology Agency Japan
TCODE	Technical Committee on Data Exchange
TINRO	Pacific Research Institute of Fisheries and Oceanography
TT	Task Team
UNCED	United Nations Conference on Environment and Development
UNCLOS	United Nations Convention of the Law of the Sea
UNEP	United Nations Environment Program
UNESCO	United Nations Educational, Scientific, and Cultural Organization
UNOLS	University National Oceanographic Laboratory System
VNIRO	Russian Federal Research Institute of Fisheries and Oceanography
WCF	Working Capital Fund
WCRP	World Climate Research Program
WDC-A	World Data Center - A

WESTPAC	Sub-Committee for the Western Pacific Intergovernmental Oceanographic Commission
WG	Working Group
WMO	World Meteorological Organization
WOCE	World Ocean Circulation Experiment
WWWP	World Wide Web Page