REPORT OF WORKING GROUP 18 ON MARICULTURE

The Working Group on *Mariculture in the 21st century – The intersection between ecology, socio-economics and production* (WG 18) met on October 1, 2005, under the chairmanship of Dr. Ik-Kyo Chung (*WG 18 Endnote 1)*. Only 6 scientists from 4 PICES member countries were in attendance (representatives from Canada and the United States were absent), and only 4 of the 14 Working Group members were present. The agenda was reviewed and adopted as presented (*WG 18 Endnote 2).*

National reports and publication (Agenda Items 3-5)

In 2004-2005, activities of WG 18 focused on the preparation of national reports on the status and projected trends in marine aquaculture. At PICES XIII, the Working Group received reports from all countries, except Russia. Summaries of these reports as well as comments and questions from the participants are appended as *WG 18 Endnote 4* in the 2004 PICES Annual Report.

Highlights of national reports prepared for PICES XIII were reviewed. These were followed by a report on the status of invertebrate mariculture in the Russian Far East (with a short summary of aquaculture development in Russia in general) presented by Dr. Galina Gavrilova (*WG 18 Endnote 3*). Prior to her talk, Dr. Gavrilova pointed out that due to economic reforms in Russia, reliable aquaculture statistics is not available, and information on genetics, diseases and feed supply is currently lacking and not included in the report.

WG 18 intends to prepare a publication in the PICES Scientific Report Series based on the national reports on the current status and trends in aquaculture in PICES member countries. In order to accomplish this, references have to be added to the submitted reports. The WG 18 Co-Chairmen have to take the lead on this issue, but contributors from each member country should be identified and involved in the project.

Topic Session at PICES XIV (Agenda Item 6)

Dr. Chung provided a brief overview of a ½-day MEQ/FIS Topic Session on "*Current and emerging issues of marine and estuarine aquaculture in the Pacific Region: Carrying capacity, ecosystem function and socioeconomics*" scheduled for October 5. The summary of the session is included elsewhere in this Annual Report.

Recommendations to Science Board (Agenda Item 7)

Topic Session at PICES XV

The Working Group recommends a 1-day MEQ/FIS Topic Session at PICES XV on "*Aquaculture for sustainable management of marine environment and ecosystem*", co-convened by Drs. Ik Kyo Chung (Korea), Toyomitsu Horii (Japan) and Michael B. Rust (U.S.A.) (*WG 18 Endnote 4*). Travel support was requested for 1 invited speaker for this session. [Later, the session title was changed to "*Aquaculture for sustainable management of the marine ecosystem*", and Dr. Chung was replaced by Dr. Jie Kong (China) as one of the convenors, as he cannot attend PICES XV because of other commitments.]

Inter-sessional WG 18 Workshop

WG 18 discussed the feasibility of sponsoring a 2-day workshop on "*Conducting environmental risk assessment applied to marine aquaculture*". The idea is to apply the approach used by the EU/US and ICES to develop a systematic and common approach to environmental risk assessment for aquaculture using the WHO method (following ICES and FAO) focused on aquaculture in the Pacific Rim. The Working

Group decided to continue exploring this issue and to consider whether to adopt this project by the end of this year or at PICES XV. The Working Group recommends that Dr. Michael Rust take the lead on this topic.

Symposium on "*Stock enhancement and sea ranching*"

The 3rd International Symposium on "*Stock enhancement and sea ranching*" will be held in September 2006, in Seattle, U.S.A. It would be desirable to send one person to attend this symposium and report back to the group at PICES XV. The Working Group recommends Dr. Carolyn Friedman, WG 18 Co-Chairman, as the representative at the Symposium, and requests PICES to support her registration costs.

Others

- Difference of aquaculture business in PICES *vs*. ICES regions: Benchmarking of future works in PICES countries including environmental risk assessment;
- A survey of US national aquaculture sector: Reconsider Dr. Colin Nash's survey and respond promptly.

WG 18 Endnote 1

Participation list

Members

Ik Kyo Chung (Korea, Co-Chairman)
Toyomitsu Horii (Japan)
Hisashi Yokoyama (Japan)
Galina S. Gavrilova (Russia)

Observers

Igor Soukhin (Russia)
Xuelei Zhang (China)

WG 18 Endnote 2

WG 18 meeting agenda

1. Welcome and introductions
2. Adoption of agenda
3. Summary of national reports on "*Current status and trends in aquaculture*" presented at PICES XIII
4. Russian national report on "*Current status of research and problems of invertebrate mariculture in the Russian Far East*"
5. Finalizing and editing report for publication
6. Topic Session at PICES XIV
7. Adoption of report and recommendations to Science Board

WG 18 Endnote 3

Russian national report on "Current status of research and problems of invertebrate mariculture in the Russian Far East"

Production

In the 1970-80, the total (marine and freshwater) aquaculture production in the USSR accounted for 1% of the world production. Marine aquaculture was only 5-6,000 t, mainly from kelp culture in the Russian Far East (Dushkina, 1998). At the end of the 1990, practically all mariculture enterprises were closed due to economic reforms in the country, and reliable aquaculture statistics is not available now. Some estimations indicate that Russia occupies the 14th place in algae cultivation (3 thousand tons) and the 28th place in fish and invertebrate cultivation (68 thousand tons). There are 45 salmon hatcheries in Russia, which produced about 700 millions newly-hatched fishes in 2003 (Mamontov, 2003).

The main centres of mariculture research are, in the southern regions, in the Azov and Black Seas, in the northern region in the Barents and White seas, and in the Far-East, in the Sea of Okhotsk and the Japan/East Sea.

There are about 30 sea farms in Primorye that vary in size from 10 to 3,500 hectares. The total area under cultivation is about 8,000 hectares. The major cultivated species are Japanese scallop, Pacific mussel and kelp *Laminaria japonica*. The most important of these is the Japanese scallop, which accounts for 500-600 t annually. Biotechnologies for cultivating of sea urchins, sea cucumber and king crab are under development. In recent years, special attention was on a sea cucumber commercial cultivation scheme (because of low natural reproduction of these species). Technology of sea cucumber breeding was introduced and the first Russian breeding factory was built in Primorye in 2003.

Environmental and ecosystem function

Carrying capacity

One of the major objectives of research in bivalve cultivation is the estimation of carrying capacity. In Russia, methods of estimating carrying capacity were developed by different researchers in the White Sea, Black Sea and Prymorye near-shore regions. They are based on different theoretical approaches. Burkinsky and co-authors (1985) offered an economical-ecological method. It is based on the idea that the main anthropogenic load on an ecosystem during aquaculture development is the value of organic matter extracted from near-shore waters. A second method to determine the capacity and size of mussel farms was based on region-specific trophic capacity, estimated by Holodov and co-authors in 1991. This method is currently used in the Black Sea. In this case, the potential production of mussels was calculated by assuming complete utilization of all organic matter entering water per unit of time.

A preliminary calculation of mussel farm capacity in the near-shore areas of the White Sea was made with regard to food availability data, parameters of water activity and others (Kulakovsky *et al*., 2003). The amount of biosediments produced by mollusks during cultivation was also estimated. Oyster cultivation increases the sedimentation rate by 3.7 times on average. One hectare of oyster plantation produces up to 8 t of wet biosediment per month. A plantation with 1 million scallops or mussels produces more than 1.5 t of wet biosediments per month.

Habitat

The Primorye near-shore (including its southern part) is less favorable for aquaculture than the best mariculture regions of Japan, China, Norway and others. Shallow bays of southern Primorye can be ice-bound for more than four months a year. The hydrological peculiarities of Peter the Great Bay, including summer water stratification, provide characteristic biological features of this region. To calculate the maximal load onto some parts of Posiet Bay during oyster, mussel and Japanese scallop cultivation, an original model was developed (Bregman and Kucheryavenko, 1987). In the opinion of the model's authors, the most complete idea about potential loading relies on the consideration of a variety of characteristics which are: size of plantation, water activity in the bay, concentration of suspended matter (seston) at different sites, quantity of mollusks, and rate of filtration.

Native and exotic species

As a rule, major mariculture objects are native species of fishes, invertebrates, and algae. Mussel, kelp, herring and salmon are cultivated in the White Sea region (a joint Russian-Norwegian enterprise is planning to cultivate up to 5,000 t of salmon in the near-shore regions of the White Sea within 2-3 years). Great progress is achieved in cultivation of mussel and oyster, and fish-pond cultivation of salmon, sturgeon and mullet in the Black Sea. Sturgeon cultivation was of great importance in the Black, Azov and Caspian Seas. Biotechnologies of fish-pond and ranching cultivation of sturgeon were developed in the Caspian Sea.

There are well-known examples of some species' acclimatization in new regions: pink salmon (*Oncorhynchus gorbuscha*) in the White and Barents seas; harder (*Mugil soiuy*) in the Azov and Black Seas; Pacific oyster (C*rassostrea gigas*) in the Black Sea, and king crab (*Paralithodes camtshaticus*) in the Barents Sea.

Sustainability of production: Due to economic reforms in Russia, reliable aquaculture statistics is not available.

Genetics, diseases and feed supply: Information on these issues is currently lacking and not included in the report.

Socioeconomics: Experiments prove that the changing of hydrobionts enzymatic activity may be a diagnostic sign of changes in ecological conditions. For instance, when scallops are cultivated in ponds with high concentrations of these species, a revealed increase of enzymatic activity is an animal response to environmental conditions worsening (Kucheryavenko, 2002). In sea urchin cultivation researches (including hatchery of larvae and juveniles), juveniles bred in natural conditions and meliorative actions for sea urchins' marketable quality improve local economics.

Restoration of stocks: No information available.

Public aware awareness: Aquaculture in Russia is at an initial stage of development. The absence of legal framework for the aquaculture activity is also a constraining factor.

References

Biological basis of mariculture (Ed. L. Dushkina), Moscow, VNIRO, 1998, 320 p.

Bregman Ju. E., Kucheryavenko A.V. Methods of potential load on water areas estimation. In book: Cultivation of Pacific invertebrates and algae, Moscow, Agropromizdat, 1987, pp. 63-66.

Burkinsky B.V., Glushakov V.E., Belyi V.G. Economico-ecological approach in choosing methods for estimatiom of maximum values of near-shore mariculture. In book: Biological basis of aquaculture in the seas of the European part of the USSR, Moscow, Nauka, 1985, pp. 79-80.

Kulakovsky E.E., Jitniy B.G., Gazdieva S.V. Mussel cultivation near Karelian shore of the White Sea, Petrozavodsk, 2003 – 160 p.

Kucheryavenko A.V. Organic matter in shallow bays of Posjet Bay, Vladivostok, TINRO-Center, 2002, 86 p.

Mamontov Ju.P. Aquaculture in Russia, Rybnoye Khoziaystvo, 2003, No. 3, 46-49.

WG18 Endnote 4

Proposal for a 1-day MEQ/FIS Topic Session at PICES XV on
"Aquaculture for sustainable management of marine environment and ecosystem"
[later renamed "*Aquaculture for sustainable management of the marine ecosystem*"]

Activities associated with aquaculture can result in both positive and negative impacts on the marine ecosystem. The environmental, ecological and genetic capacities of the marine environment need to be considered to maintain sustainable aquaculture development and a healthy wild ecosystem. At various levels of aquaculture production, environmental hazards can be assessed and management measures developed to minimize those hazards to the marine ecosystem and/or their probability (risk) of occurrence. PICES WG 18 has begun to consider environmental and ecological impacts associated with aquaculture. These include ecological hazards associated with nutrient release, escaped or released cultured organisms (predation, competition), and the potential for disease transfer. In addition, the escape of genetically-selected species used for aquaculture may have harmful effects on the genetics of the wild populations of native species. Genetic risks should be evaluated based on potential impacts to biodiversity and ecosystem conservation using proper evaluation techniques. These techniques should be consistent among researchers where possible. Moreover, it is necessary to consider the influence on the ecosystem and genetic diversity when

artificially-produced seedlings are released for stock enhancement or rebuilding. To promote responsible aquaculture in a healthy marine ecosystem, it is critical to continuously evaluate and manage the aquaculture activity. Clearly defining the potential hazards to the ecosystem, assessing the probability that hazards will occur and implementing mitigation strategies to reduce or eliminate hazards can facilitate this oversight. The goal of this session is to identify and establish evaluation techniques and models for potential hazards which aquaculture exerts on genetic diversity, ecosystem function and/or the marine environment. The potential for standardization of methods and models that deal with interactions between aquaculture and wild organisms will also be explored.

Recommended conveners: Ik Kyo Chung (Korea), Toyomitsu Horii (Japan) and Michael B. Rust (U.S.A.).