Third Meeting of the Project Science Team for the PICES/MAFF Project on "*Marine Ecosystem Health and Human Well-Being*"

The third meeting of the Project Science Team (PST) Project Science Team for the PICES/MAFF project on "*Marine ecosystem health and well-being*" was held on October 10, 2013, in Nanaimo, British Columbia, Canada. The meeting was co-chaired by Drs. Mitsutaku Makino (Japan) and Ian Perry (Canada).

PST members and meeting participants are identified in *Appendix 1*, and the meeting agenda is presented in *Appendix 2*.

Meeting Objective

The objective for this meeting was to review progress since the second PST meeting (http://www.pices.int/publications/other/2013-Second-PICES-MAFF-Project-Science-Team-Meeting-Report.pdf) in Honolulu in June 2013, in particular, regarding:

- planning for the Indonesia and Guatemala case studies,
- advances in the Well-being Cube analyses,
- development of a workplan for 2014.

1. Adoption of the agenda

The provisional agenda circulated prior to the meeting was adopted without changes,

2. Introduction of the project

Progress is being made internationally on an ecosystem approach to the management of marine systems. Very recently, the concept of human well-being within marine social-ecological systems has become recognized as an important step forward. Well-being shifts the perspective from objective measures of sustainable livelihoods (comprised of the physical, social, human, natural, and financial resources available to a community or country) to include the subjective or perceived well-being of individuals and communities. This represents a shift from people as exploiters of the ocean to people as integral components of resource sustainability and ecosystem health (Coulthard *et al*. 2011, *Global Environmental Change*, 21: 453–463; Charles 2012, *Current Opinion in Environmental Sustainability*, 4: 351–357). The Japanese concept of "*Sato-Umi* (village sea)" is an example (*e.g*., see United Nations University Institute of Advanced Studies Operating Unit Ishikawa/Kanazawa (2011); Biological and Cultural Diversity in Coastal Communities, Exploring the Potential of Satoumi for Implementing the Ecosystem Approach in the Japanese Archipelago. Secretariat of the Convention on Biological Diversity, Montreal, Technical Series no. 61). Therefore, this project is funded by the Ministry of Agriculture, Forestry and Fisheries (MAFF) of Japan. The project lifespan is expected to be 5 years (until March 31, 2017).

The goal of this project is to identify the relationships between sustainable human communities and productive marine ecosystems in the North Pacific, under the concept of fishery social-ecological systems. In particular, and considering the global changes in climate and human social and economic conditions, the project is expected to determine: (a) how marine ecosystems support human well-being and (b) how human communities support sustainable and productive marine ecosystems.

The project is expected to integrate with PICES activities, for example:

- FUTURE Research Theme 3 on "*How do human activities affect coastal ecosystems and how are societies affected by changes in these ecosystems?*";
- Section on *Human Dimensions of Marine Systems* (S-HD);
- Section on *Ecology of Harmful algal Blooms in the North Pacific* (S-HAB);

- WG 28 on *Development of Ecosystem Indicators to Characterize Ecosystem Responses to Multiple Stressors*;
- WG 21 on *Non-indigenous Aquatic Species*.

Major activities since October 2012 include:
- First PST Meeting, October 11, 2012, Hiroshima, Japan, in conjunction with PICES-2012,
- Scoping meeting (January 23–23, 2013) and first MarWeb workshop (March 13–14, 2013) in Jakarta, Indonesia,
- Second PST Meeting, June 10–12, 2013, Honolulu, USA,
- Progress and financial reports for *Year 1* (April 1, 2012 – March 31, 2013) submitted to MAFF,
- Two articles in PICES Press newsletter (2013, Vol. 21(1–2)).

3. Progress reports

Annual Reports for Science Board and MAFF

The progress and financial reports for *Year 1* (April 1, 2012 – March 31, 2013) are available at the project web site (http://www.pices.int/projects/MarWeb.aspx).

Results of the 2nd MarWeb PST meeting in Hawaii

The report from the 2nd MarWeB PST meeting, held June 10–12, 2013 in Honolulu, Hawaii, is available at the project web site (http://www.pices.int/projects/MarWeb.aspx).

Pond experiments and research support plan in Karawang, Indonesia

Plans are progressing for the pond experiments in Indonesia. Three potential focal species were presented and discussed (with their anticipated project costs):
- fish-seaweed-bivalves, $27K,
- shrimp-seaweed-bivalves, $30K,
- milk fish-crabs-bivalves, $17K.

Overall, it was felt the total costs were too high, and beyond the scope of our (shrinking) budget. Dr. Mark Wells suggested that the extent of work needed to be trimmed to better match the budget available for this work in *Year 2* (about $43K).

Plans for social science research in Indonesia related to the project

1. Dr. Masahito Hirota reported how multiple use of the products from marine activities (multi-utility: processing of multiple species by the same people) provide welfare and benefits for people's livelihoods in the fishing areas (*e.g.*, Fig. 1).
2. In Karawang, Indonesia, shrimp aquaculture expanded from 2002–2009, but subsequently collapsed due to degradation of the ecosystem. Local consumption should be encouraged rather than relying on exports, but the question remains how local consumption can be 'regulated'.
3. A social survey scoping meeting took place on October 2–4, 2013, involving (a) mapping of commodity chains (see Fig. 2), (b) confirmation of a checklist and guideline for field work (see discussion on checklist from the 2nd MarWeB PST meeting (http://www.pices.int/publications/other/2013-Second-PICES-MAFF-Project-Science-Team-Meeting-Report.pdf); (c) what can be done to assist the Well-being Cube analysis, and (d) confirmation of data items. This involved meeting with fishers, traders, wholesalers and processors.
4. Shrimp have traditionally been used for the export market only, whereas in multi-trophic aquaculture and livelihood contexts, other products (seaweed and bivalves) could be used locally. Traditionally, the export-oriented shrimp monoculture activities do not contribute seafood protein to the local community, but multi-trophic aquaculture might.
5. A milk fish experiment and shrimp experiment would provide a nice contrast of local (milk fish) *vs* export (shrimp) market commodities.

6. Which bivalves should be included in the pond experiments? At present, there is no market for bivalves because of general fears of *Vibrio* and other infections/diseases. Therefore, there is some uncertainty about the acceptability of bivalves to the local market. *Gracillaria* (algae) is used primarily for agar. There is a benefit to using the system that directly benefits the food (diet) of the local people.

Indonesia would like a more formal agreement with PICES, similar to that used for Guatemala and PICES for a previous MAFF-funded project on the "*Development of the prevention systems for harmful organisms' expansion in the Pacific Rim*". This needs to be discussed with the PICES Secretariat.

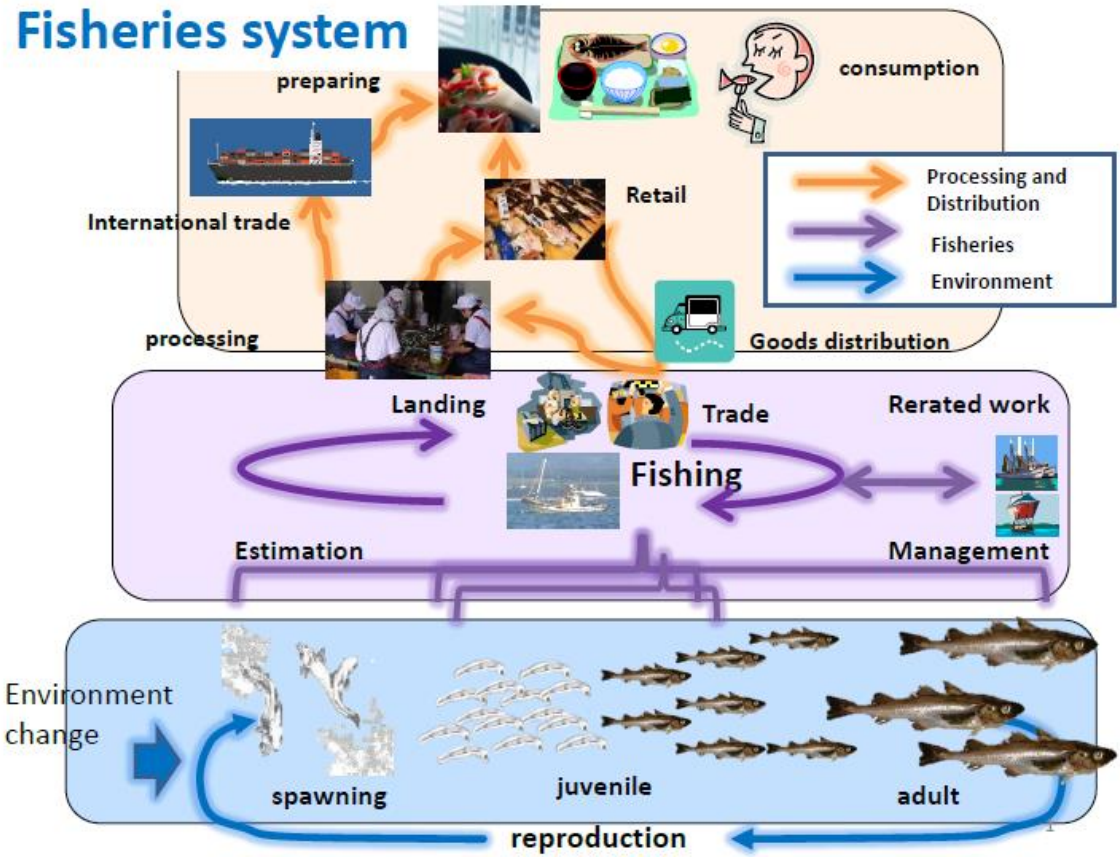

Fig. 1 An example of an integrated social-ecological fishery system. This example is for walleye pollock in Japan (Makino and Sakurai, 2014, Fisheries Science 80:227–236). It is representative of a similar system in Indonesia, illustrating the integration of fish biology, fishing, processing, and marketing activities.

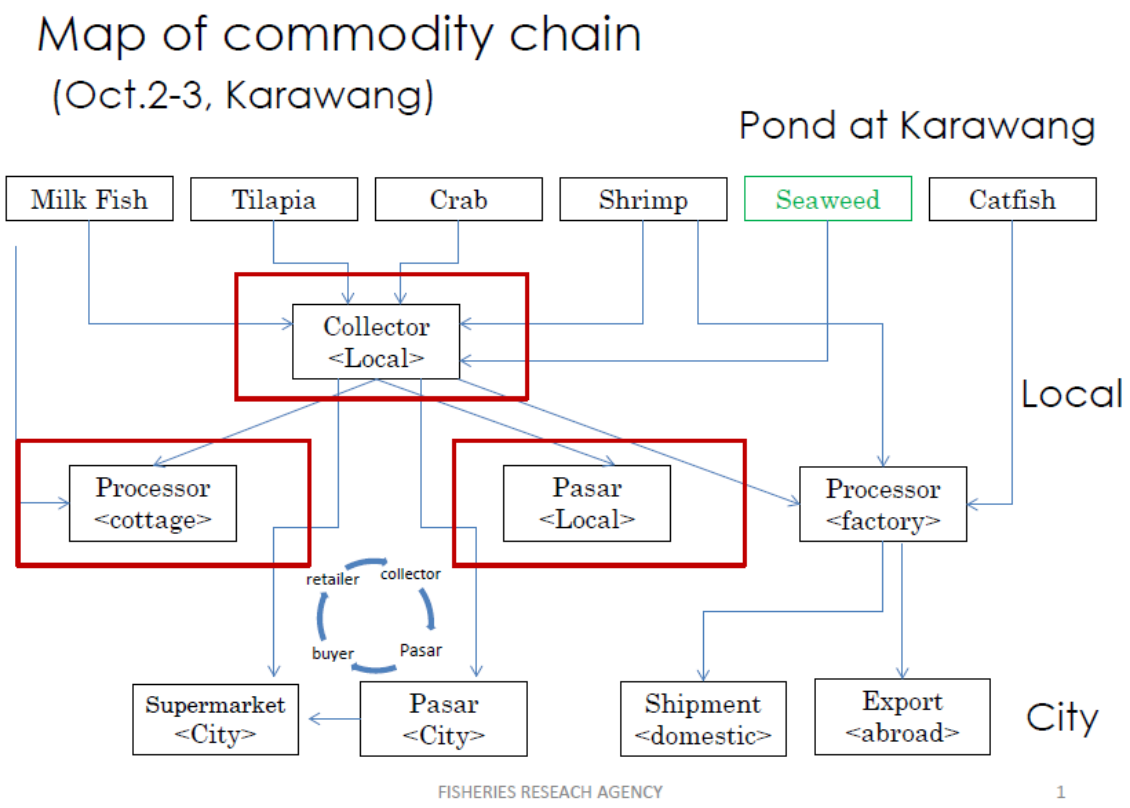

Fig. 2 Definition of the commodity chain for the pond culture in Karawang, Indonesia (new research by M. Hirota, October 2013).

Plans for research activities and workshops in Guatemala

1. Dr. Vera Trainer reported on conversations with Guatemalan colleagues (Leonel Carrillo and Carolina Marroquin) at the University of San Carlos, Guatemala City.
2. Fisheries exports are among the top 25 exported goods in Guatemala, increasing by about 6% from 2010 to 2011 (which is small relative to other exported products).
3. Fish, shellfish and seafood generally are too expensive for locals, except for the very wealthy. The majority of these products are exported. However, shrimp are sold fresh in markets and frozen in supermarkets. Products sold domestically are bought by intermediates who then resell in terminal markets. Distributors sell to final consumers or door to door. Some small-scale fish mariculture projects have been tried, but have not progressed.
4. Shrimp aquaculture: Previously, large shrimp were cultured, but in last 6 years small-scale shrimp producers have generated about 2.5 million pounds ($8M/yr) which has increased by 25% in last 3–5 years. Typically, culture activities start in February–March, grow during the warm period, reach a certain size, and then are harvested for domestic consumption.
5. Locals would prefer marine finfish and bivalves. They do not eat seaweeds. There likely needs to be an economic benefit to growing seaweeds because the population is generally very poor. It was noted that Dr. Thierry Chopin (seaweed expert from Canada's East Coast) is working on using seaweeds to capture excess nutrients in aquaculture operations. However, this is technologically difficult. The initial goal is to use seaweeds for bioremediation in these culture operations. In multi-trophic aquaculture bivalves must be cultured immediately adjacent to finfish; it has been observed that bivalves may grow faster in Integrated Multi-Trophic Aquaculture (IMTA) settings.

6. Shrimp culture in Indonesia is done in brackish ponds, with nutrient-laden water pumped into coastal waters. There is interest in making shrimp farms environmentally sustainable, enhancing coordination among farms, and in exports.
7. Two possible projects were presented and discussed:

   Project #1 – *Ecosystem approach to shrimp aquaculture*
   - Nutrient-laden water being pumped into coastline (tourist areas),
   - Interest in making shrimp farms environmentally sustainable,
   - Enhancing coordination among farms,
   - Interest in exporting.

   Project #2 possibility – *Marine finfish aquaculture*
   - Efforts have failed to date because of no attempts have been made to grow from fingerlings
   - Fishers need to become involved in aquaculture – using a common wholesaler gets a better price.
   - Prices have not been good for fish species considered not 'attractive', literally for Gar (an "ugly fish"), and for tilapia.
   - Fish aquaculture would be the best option to improve food security and give coastal residents a way to improve their income, whereas shrimp aquaculture would be the best option to promote aquaculture, create jobs and promote small- to mid-sized companies.
8. A social scientist from Guatemala, who has experience in how tilapia production might influence development, suggested that, at a cost of $50/day, social science questionnaires could be given by students in coastal communities. To obtain 1000 surveys, many small communities would need to be visited. Note that the coastal area is very narrow – approximately 10 km from the sea is considered the maximum distance for marine influences. Participants could request supplies for their town, such as children's books for the library, trash cans for the beach, supplies for school, etc. instead of payment. However, an outreach activity would need to be conducted first to explain the benefits of this project to the community.
9. Dr. Trainer's impressions of starting a project:
   - The University of San Carlos is very interested in a multi-trophic project;
   - The focus should be on small shrimp farms (~3) as model systems;
   - Visit those farms during the scouting mission;
   - Work with small shrimp farms to develop bivalve or tilapia culture. These would be primarily for domestic consumption;
   - Bivalve culture will have to consider pollutants and bacteria (wastewater is contaminated);
   - Consider using seaweed for fertilizer or oil;
   - Shellfish culture is mostly on sand substrate, with little seed. The Japanese have supplied oyster seed in El Salvador, which has worked well. Can we find these Japanese contacts for Guatemala?
   - It is difficult to keeping people interested in the long term, so we need to see progress;
   - Smaller shrimp farms stock 3–4 times per year. Shrimp reach 12–13 g in 15 weeks for local markets. Growing seasons are March–June/July, then August–September. It rains in between these times and salinity goes down. The multi-trophic aquaculture product needs to be salinity, temperature, and solids tolerant.
10. A clear, unified vision for the project, and what kind of support or benefits partners can expect (economic, training, supplies) needs to be determined;
11. Decisions needed for the Guatemala project:
    - The Guatemalan partners need a clear idea of what the project hopes to achieve.
    - What kind of support or benefits can partners expect to receive (economic, training, supplies, other)?
    - What benefits will the University of San Carlos gain?
    - How will we measure the project benefits?
    - Who is our specialist in multi-trophic aquaculture? Will this person participate in the scouting mission?
    - Who is going on the scouting mission? When?
    - Should the social scientist at the University of San Carlos be included? Should we meet with her during the scouting meeting?
    - How and when will social science surveys be conducted?

- Suggested scouting meeting dates: January 27–31 or April 7–11 (or both?). Farmers and the University have down time in January. The first stocking of shrimp ponds is in the second week of February (white spot disease occurs when T < 26°C). Open in mid-March.
- Is an MOU needed?

12. A scoping budget was presented which included:
    - 5-day scouting Trip, including a visit to shrimp or fish farms on the coast,
    - Flight (from USA) $700,
    - Flight (from Japan) $1800,
    - Hotel $800 (Guatemala City + coast); note: a hotel on the coast is much cheaper, but we paid gas costs for trip),
    - Meals $200 (actuals),
    - Miscellaneous (internet, tourism tax, taxis, *etc*.) $300,
    - U.S. scientist $2000,
    - Canadian scientist $2100,
    - Japanese scientist $3100 (2),
    - Guatemalan scientist travel $400,
    - Scouting trip in 2014: Cost for 4 visiting scientists = ~$11,000.

Discussion on this presentation included the following points:
The Guatemala project needs a clear idea of what is hoped to be achieved. We need a vision of the social science survey. How many responses are needed? Should the focus be on immediate coastal recipients? What should be the focal community for the survey?

Dr. Hirota gave a brief preview of his questions prepared for Indonesia—focus on coastal communities with indices discussed at the second PST meeting in Honolulu, based on World Ocean Assessment. Team members agreed that collaborating with social scientists in Guatemala is critical. Shrimp aquaculture (option 1) is becoming more sustainable, so seems to have a higher probability of success. Basic social surveys should consider the needs/uses of seaweed, and the effects on markets of increased production of small shrimp. Others questioned why it was necessary to do this. Was it a model for increasing income, employment, or healthier diet—at what cost to the environment quality? What other species could be co-produced with shrimp aquaculture—what do you eat; what would you eat? It was imperative to start with social surveys and clearly identify the goal. There needs to be a reduction in eutrophication—water quality needs to be improved to favor tourism, *etc*. We need to specify the advantages of the proposed changes—Is tourism a benefit, or is there a local bias against tourism, because they are multinational corporations?

What are the outputs and outcomes anticipated from the project? The outputs of MarWeb are a database and manuals. One project outcome might be to mitigate waste disposal processing (waste processing is an ecological service that is underappreciated) in Guatemala; there is a need to treat the waste.

Goals should be: (1) mitigate nutrient loading (environmental stewardship), (2) provide employment (3) provide food security (protein), and (4) improve human well-being. Social science surveys should be conducted first. Research initiatives may need to include possible training and education to implement Integrated Multi-Trophic Aquaculture

Another suggestion was to do a "walk through", to get a flavor of the types of producers and commodity pathways. A workshop could be held to identify the importance/relevance to marine environment—this would help to set up the direction you want to go; it could be community-participatory based to get personal investment in the project and would give PST members the opportunity to meet with government officials and small shrimp farm operators. Members should contact Dr. Trainer if they are interested in participating.

Well-being Cube (WB-Cube) analysis progress

Well-being Cube analysis is a methodology for understanding the detailed contents and structure of Human Well-being. Based on psychological science, the WB-Cube measures the detailed characteristics of choices

and actions people want to make. Therefore, using WB-Cube analysis we can determine people's needs to generate the scientific information which PICES can provide for better Human Well-being. Surveys have been done for Korea, Japan and USA. Initial results were presented, and look very encouraging.

1. Background - Ecosystems → services → well-being (security, materials for a food life, health, good social relations)
2. WB-Cube analysis can be confusing—the questions are subject to interpretation and experience of the survey participant/conductor.

Discussion included questions about how the analysis was done and how the data were normalized within country or across country.

MarWeB Project web page

A MarWeB web page was established on the PICES web site (http://www.pices.int/projects/MarWeb.aspx) and is being populated.

4. Proposals for research topics/sessions

A MarWeB Topic Session on "*Ecological and human social analyses and issues relating to Integrated Multi Trophic Aquaculture*" was proposed and ultimately accepted for PICES-2014 (Yeosu, Korea; see *Appendix 3*).

5. Project management

Possible Project Science Team membership changes were discussed. Dr. Skip McKinnell resigned from the PST, and was thanked for his service. Potential additional expertise (Integrated Multi-trophic Aquaculture (IMTA) expertise; aquaculture, developing countries expertise) was discussed for the PST. Suggestions for members included Mark Flaherty (University of Victoria, Canada), Charles Trick (University of Western Ontario, Canada), Thierry Chopin (University of New Brunswick, Canada).

6. Budget for *Year 3*

Suggestions for the *Year 3* budget (April 1, 2014 – March 31, 2015) included:

- a possible PST meeting in April 2014 or early June 2014;
- moving $14K currently held in equipment into other activities (perhaps Indonesia related);
- a publication of Well-being Cube results in a peer-reviewed journal;
- the need for a translator for the Guatemala scoping trip.

To date, the budget and workplan for *Year 3*:

- Rough budget shows (FUTURE Open Science Meeting, $14K; Indonesia case study, $19K; Guatemala case study, $35K; Well-being Cube analysis, $9K; PICES Secretariat, $10K; PICES overhead, $13K)
- The need to develop a multi-year budget plan was recognized, in particular for field projects such as those in Indonesia and Guatemala.

7. Other matters

The presentation to Science Board on October 19, 2013 (at the 2013 PICES Annual Meeting) highlighted the following three major initiatives:

- Social-ecological interactions related to IMTA in Indonesia;
- Social-ecological interactions related to small-scale shrimp aquaculture in Guatemala;
- Development of the "Well-being Cube" approach to assessing national well-being related to marine systems.

Other issues: Replacement of PST membership

Challenges: Declining MAFF funding

Appendix 1

Project Science Team membership

Harold (Hal) P. Batchelder	(Oregon State University, USA)
Keith R. Criddle	(University of Alaska, Fairbanks, USA)
Masahito Hirota	(Fisheries Research Agency, Japan)
Juri Hori	(Rikkyo University, Japan)
Dohoon Kim	(NFRDI, Korea)
Suam Kim	Pukyong National University, Korea
Mitsutaku Makino (Co-Chairman)	Fisheries Research Agency, Japan
Grant Murray	(Institute for Coastal Research, Canada)
Jongoh Nam	(Maritime Institute (KMI), Korea)
Ian Perry (Co-Chairman)	(DFO, Pacific Biological Station, Canada)
Thomas W. Therriault	(DFO, Pacific Biological Station, Canada)
Vera L. Trainer	(NWFSC, NMFS, NOAA, USA)
Mark L. Wells	University of Maine, USA

Participants of the third Project Science Team meeting for the PICES/MAFF project on "*Marine ecosystem health and well-being*". Left to right: Vera Trainer (USA), Sinjae Yoo (Korea), Masahito Hirota (Japan), Juri Hori (Japan), Hiroyuki Shimada (Japan), Grant Murray (Canada), Thomas Therriault (Canada), Harold (Hal) Batchelder (USA), Keith Criddle (USA), Alexander Bychkov (PICES), Charles Trick (Canada), Suam Kim (Korea). Kneeling: Co-Chairmen, Mitsutaku Makino (Japan) and R. Ian Perry (Canada).

Appendix 2

Project Science Team meeting agenda

1. Adoption of the agenda
2. Introduction of the project and this meeting (PIs)
3. Progress reports
   - Annual Reports for Science Board and MAFF (PIs)
   - Results of the 2nd MarWeb meeting in Hawaii (PIs)
   - Pond experiments and research support plan in Karawang, Indonesia (Wells)
   - Plans for social research in Indonesia related to the project (Hirota)
   - Plans for the research activities and workshops in Guatemala (Trainer, Trick)
   - Progress of the Well-being Cube analysis (Hori)
   - Construction of MarWeB Webpage (PIs)
   - Other reports
4. Proposal of research topics/sessions
   - Topic Session proposals for PICES-2014 (Hirota)
   - Potential intersects/synergies with WG-28, S-HD, and other groups within PICES and FUTURE Program
   - Other proposals
5. Project management
   - Discussion on possible revision of Project Team membership
6. Discussions on the 3rd year (2014) plan and budget
7. Other matters
8. Concluding remarks

Appendix 3

Proposal for a MarWeB Topicc Session at PICES-2014 (Yeosu, Korea)

MarWeb Topic Session S1 (½-day)
Ecological and human social analyses and issues relating to Integrated Multi Trophic Aquaculture

Co-Convenors:
Masahito Hirota (Japan)
Jianguang Fang (China)
Mitsutaku Makino (Japan)
Grant Murray (Canada)
Naesun Park (Korea)
Mark Wells (USA)

Invited Speakers:
Thierry Chopin (University of New Brunswick, Canada)
Mark Flaherty (University of Victoria, Canada)
Susanna Nurdjaman (Bandung Institute of Technology, Indonesia)
Suhendal Sachoemar (Indonesian Agency for the Assessment and Application of Technology, Indonesia)

Several recent studies and reports suggest that increased aquaculture production is essential if we are to meet the growing world demands for marine protein. However, the rapid current development of intensive fed aquaculture (*e.g.*, finfish and shrimp), in both developed and developing countries, has generated concerns about the environmental impacts of these often monospecific practices. To help address such issues, Integrated Multi-Trophic Aquaculture (IMTA) has been attracting global attention as a means to conduct aquaculture activities, while at the same time improving/rehabilitating coastal environmental conditions and improving the well-being of the people living in coastal areas. By integrating fed aquaculture with inorganic and organic extractive aquaculture (seaweed and shellfish), the wastes of one resource become a resource (fertilizer or

food) for the others. This “ecosystem-like” approach provides nutrient bioremediation capabilities, mutual benefits to the co-cultured organisms, economic diversification by production of other value-added marine products, and increased profitability and food security for the local community. This session seeks contributions and case studies of how to implement and conduct IMTA activities, in particular that reduce negative impacts to the quality of the local environment and improve the well-being of the local human communities. Examples of activities in tropical and semi-tropical locations are particularly welcome, as well as examples of general methods and approaches that can be applied in many different environments. This session is a contribution of, and towards, the work of the PICES Project on Marine Ecosystem Health and Human Well-Being (MarWeB).