

PICES/MAFF PROJECT ON “MARINE ECOSYSTEM HEALTH AND HUMAN WELL-BEING”

FIFTH MEETING OF THE PROJECT SCIENCE TEAM

October 16, 2014

Yeosu, Korea

The fifth meeting of the Project Science Team (PST) for the PICES/MAFF project on “*Marine Ecosystem Health and Human Well-Being*” (MarWeB), funded by the Ministry of Agriculture, Forestry and Fisheries (MAFF) of Japan, through the Fisheries Agency of Japan (JFA), was held October 16, 2014, in conjunction with the 2014 PICES Annual Meeting in Yeosu, Korea.

The meeting objective was to review progress from the fourth PST meeting in April 2014 and plans for FY 2015, in particular: a) development of the Guatemala case study and b) further development of the Indonesia case study.

The meeting was co-chaired by Drs. Mitsutaku Makino (Japan) and Ian Perry (Canada). All PST members (*Appendix 1*) and the Project Coordinator, Dr. Alexander Bychkov, attended the meeting.

1. ADOPTION OF THE AGENDA

The agenda was adopted as proposed (*Appendix 2*). The PST welcomed its new members, Dr. Jongoh Nam (Maritime Institute, Korea) and Dr. Charles Trick (University of Western Ontario, Canada).

2. INTRODUCTION OF THE PROJECT

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. Considering that global changes are affecting both 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.

Dr. Makino briefly reviewed the background and context for the project and summarised the major activities to date, including:

- First PST meeting in conjunction with PICES-2012 (October 11, 2012, Hiroshima, Japan);
- First Indonesia workshop (March 13–14, 2013, Jakarta and Karawang, Indonesia);
- Second PST meeting (June 10–12, 2013, Honolulu, USA);
- First Indonesia social survey (October 2–3, 2013, Karawang, Indonesia);
- Third PST meeting in conjunction with PICES-2013 (October 10, 2013, Nanaimo, Canada);
- Guatemala scouting visit (January 27–31, 2014, Guatemala City, Guatemala);
- Second Indonesia workshop and second social survey (March 24–27, 2014, Karawang, Indonesia);
- Fourth PST meeting in conjunction with the FUTURE Open Science Meeting (April 13, 2014, Kona, Hawaii, USA);
- Progress and financial reports for Year 1 (April 1, 2012 – March 31, 2013) and Year 2 (April 1, 2013 – March 31, 2014) submitted to MAFF;
- Two articles published in PICES Press: Vol.21, No. 1 (winter 2013) and Vol. 21, No. 2 (summer 2013);
- Fifth PST meeting in conjunction with PICES-2014 (October 16, 2014, Yeosu, Korea; this meeting);
- MarWeB Topic Session on “*Ecological and human social analyses and issues relating to Integrated Multi Trophic Aquaculture*” to be convened at PICES-2014.

Reports from previous PST meetings, annual progress and financial reports, and other project-related materials are available on the project website at <http://meetings.pices.int/projects/marweb>.

3. PROGRESS REPORTS

The MarWeB project has focussed on three major initiatives:

1. Social-ecological interactions related to integrated multi-trophic aquaculture (IMTA) in Indonesia;
2. Social-ecological interactions related to small-scale shrimp aquaculture in Guatemala;
3. Development of the “well-being cube” approach to assessing national well-being related to marine systems.

3.1 Annual Reports for Science Board and MAFF/JFA

The progress and financial reports for Year 2 (FY 2013: April 1, 2013 – March 31, 2014), accepted by MAFF/JFA, were presented for information and are available at the project website. The progress report includes a glossary for Japanese readers. Drafts of progress and financial reports for Year 3 (FY 2014: April 1, 2014 to March 31, 2015) are due in June 2015 for submission to MAFF/JFA in July 2015.

3.2 Report of the fourth PST meeting

Dr. Perry briefly reviewed the report from the fourth PST meeting held April 13, 2014, in conjunction with the PICES FUTURE Open Science Meeting at the Hapuna Beach Prince Hotel, Kohala Coast, Hawaii, USA. The report was approved with no changes and is now available at the project website.

3.3 Development of the research activities in Guatemala

Based on an evaluation of existing shrimp-focused aquaculture in Guatemala, and considering the interests and goals of the MarWeb project (and comparability with the project activities in Indonesia), a focus on multi-trophic aquaculture for science pillar is recommended. The goal would be to collaborate with Guatemalan experts to expand economic potential (shellfish aquaculture), thereby bringing greater well-being to coastal communities. This would be a self-sustaining enterprise managed by a cooperative.

It was proposed to support an oyster study led by Lic. Leonel Carrillo and Lic. Carolina Marroquin (University of San Carlos, Guatemala City). The objective would be to test the feasibility of growing, processing and marketing *Crassostrea gigas* (mangrove oyster) with the Integral Fisheries Cooperative on the Pacific coast of Guatemala. The potential outcomes include income for coastal people, and improved health and well-being.

Specific objectives are to:

- Assess the performance of the long-line shellfish culture system in La Barrona estuarine lagoons;
- Determine yield potential of the culture system, including growth rates and time for mollusks to reach market size;
- Evaluate shellfish survival rates during different phases of their growth and assess mitigation methods against predation;
- Adapt or develop culture practices appropriate for the management of the system;
- Produce oysters that conform to the microbiologic standards of food safety;
- Assist in finding suitable markets for the sale of the final product.

The anticipated results include:

- Start the commercial production of *C. gigas* in the southern region of Guatemala, using a cooperative model;
- Within a year, it is anticipated that this community will earn income from oyster sales to allow reinvestment in their own businesses and to improve their financial situation;
- Partially meet the domestic demand of consumption of oysters, which is currently met by imports paid in dollars;
- Validate a system of commercial production of bivalve mollusks, which could be replicated in other regions with similar environmental characteristics.

In discussion, it was noted that *C. gigas* is a common invasive species world-wide, and Drs. Trainer and Trick were asked to check if there is any concern about introducing it to this region or it is already present. Also, questions were raised as to whether the local communities have the legal rights to this aquaculture, *i.e.*, who 'owns' the water and who would benefit from this activity?

Dr. Trick presented the concept of a 'participatory needs assessment'. In this approach, success is considered to result from a step-wise process: (1) to develop a questionnaire to understand two things within a community, specifically what they want, and what are they missing? and (2) to develop a way to measure "success" if changes were to occur. For example, in the case of Guatemala the problem is to establish how shrimp aquaculture can enhance the community's sense of well-being and purpose. The level of literacy was noted, and the use of disposed cameras was suggested. It was recommended Dr. Trick to begin a community needs assessment for the social aspects of this project.

Actions:

- Drs. Trainer and Trick to check on whether *C. gigas* is already present in Guatemala, and if there are any legal issues around ownership of rights to coastal waters;
- Dr. Trick to begin a community needs assessment for the social aspects of this project.

3.4 Development of the research activities in Indonesia

Intensive shrimp aquaculture was developed in the Karawang area (3 hours from Jakarta) in the 1990s, and led to de-forestation, then marine pollution, shrimp mass-diseases and, ultimately, to pond abandonment. The main issue is serious environmental degradation and land erosion as a result of removal of mangroves and building of coastal shrimp ponds. This has resulted in a current ecological system with intensive shrimp monoculture.

A preferred approach would be IMTA, possibly including seaweed, bivalves, shrimp and fish, which would have low emissions of deleterious materials into the natural environment and would help stabilize the coastline (forestation). In the social system, present practice is to export shrimp to Japan, Canada, USA, and the EU. It would be desirable to produce shrimp for export and to use other products for local consumption, local job creation, and improved food self-sufficiency.

MarWeB activities include the following:

Ecological systems

- Workshop to disseminate the concept of “Sato-umi” in Indonesia (March 2013, September 2014);
- Material circulation box-model construction (2013–);
- Training workshop for nutrient analysis and phytoplankton identification (March 2014);
- Pond experiment for IMTA (August 2014–);

Social systems

- Collection of basic social information (statistics) (January 2013–);
- Commodity chain analysis for IMTA products (October 2013–);
- Preliminary study using an “analytic hierarchy process” (AHP) approach to support local decision-making (AHP is a structured technique for organizing and analyzing complex decisions);
- Psychological analysis for well-being (“well-being cube” analysis) (January 2013–).

The first pond experiment at the National Center for Brackishwater Aquaculture in Karawang started in August 2014. The main purpose of this experiment is to investigate the effect of IMTA on: (1) the economic return of pond operations, and (2) the water quality of the ponds, defined in terms of the (macro-)nutrient concentrations of nitrate/nitrite, ammonia, and phosphate, in addition to other parameters (*e.g.*, oxygen, phytoplankton, bacteria, *etc.*). The underlining hypothesis is that the addition of bivalves (*Anadara*) and seaweed (*Gracilaria*) into the aquaculture ponds of fish (*Tilapia* species) or shrimp will allow successful growth of all species, and decrease of macronutrient concentrations.

The optimal pond conditions for shrimp and fish are a high phytoplankton biomass (including diatoms and green algae), with low light penetration. The phytoplankton provide additional food which enhances the flavor of the shrimp and fish. Low light penetration creates less stress for the shrimp (and fish?) and prevents the growth of grasses in the pond. For these reasons, nutrients (nitrate, phosphate) are added to high concentrations at the very start, quickly ramping up and maintaining high biomass over the pond experiment.

The experiment was designed using four 4000 m² ponds: Pond 1 – Shrimp only, Pond 2 – Shrimp + *Gracilaria* + *Anadara*, Pond 3 – Fish (*Tilapia*) only, and Pond 4 – *Tilapia* + *Gracilaria* + *Anadara*. All ponds were prepared for a mid-August start (delayed to allow them to dry out sufficiently before adding the brackish water). Water to the ponds was drawn from a tidal canal, mixed with river water to establish a low salinity (~17–25 mg/kg).

Early results suggest the following:

1. There appears to be no negative effect on the shrimp or *Tilapia* weight gain in the ponds with the *Gracilaria* and *Anadara*. This was the main concern.
2. The replenishment of water in the *Tilapia* ponds from the reservoir is a potential source of nutrient variability, but concentrations in all ponds seem to track each other reasonably well (particularly NO₃/NO₂). The implication is that despite the considerable mixing (from paddle mixers), vertical gradients may be

forming within the 1 m deep ponds. There also may be variation from site to site within the pond as the water circulates. Collecting vertically integrated samples was suggested.

3. The biggest problem was the high level of nutrient added to the ponds to generate enough plankton to prevent light from reaching the bottom of the pond.

The social science studies in Indonesia have been very active. A revised commodity chain model was presented (Fig. 1). Dr. Hirota recommended moving towards a ‘system dynamics’ model approach to explore the effects of changing parameters (*e.g.*, in the commodity chain), and examining the impacts of changes to various social parameters (Fig. 2). An AHP approach was suggested to evaluate the choice of scenarios, *e.g.*, the effects on outcomes of intensive culture, polyculture and IMTA approaches.

Actions:

- Dr. Makino to discuss with Prof. Suhendar the possibility to develop the ‘natural’ process manual (major project outcome), based on the pond results;
- Dr. Hirota to produce a description and application of the social aspects for the MarWeB report and the project website;
- Dr. Wells to continue overseeing the pond experiments and interpreting the results.

3.5 Topic Session on IMTA at PICES-2014

The IMTA Topics Session was briefly reviewed by the co-convenors. The schedule of speakers is provided in *Appendix 3*. In addition, a small field trip to visit Korean aquaculture sites was arranged by Dr. Nam.

3.6 Other reports

A brief presentation on progress with the “well-being cube” analysis was given by Ms. Juri Hori. She pointed out that all the countries surveyed to date (Japan, Indonesia, Korea, USA) have similar processes of well-being with respect to the ocean. However, the well-being of the ocean’s bounty has different meanings depending on the country. Therefore, the concept of what is a “desirable ocean” differs from country to country. Also the conservation strategy may change from person to person, even within each country. The analyses are progressing towards a paper in a peer-reviewed journal.

4. PROJECT MANAGEMENT

4.1 Possible revision of PST membership

Dr. Makino recommended that Dr. Osamu Tamaru (Japan) be invited to join the PST to help with the social dynamical analyses.

4.2 Discussion on the FY 2014 budget

The budget breakdown for Year 3 of the project (FY 2014: April 1, 2014 to March 31, 2015), as proposed at the fourth PST meeting in April 2014, is presented in Table 1.

5. DISCUSSIONS ON THE FY 2015 WORKPLAN AND BUDGET

The estimated budget for Year 4 of the project (FY 2015: April 1, 2015 – March 31, 2016) is \$85,000. There may be a small carry-over of unspent funds from FY 2014, and this will be confirmed once the accounting for Year 3 has been completed.

The PST decided there were too many uncertainties and projects in action as of October 2014 to create a reasonable draft budget for FY 2015 (for example, the Indonesian pond experiments are on-going, and the field trips and a Community Needs Assessment survey in Guatemala is planned for early in 2015). There was also discussion of whether an inter-sessional PST meeting would be needed. It was noted that there were inter-sessional meetings in 2013 and 2014, and these felt to be extremely useful for concentrated planning and budgeting. The option of having an inter-sessional meeting in 2015 was left open, depending on progress by

the Indonesia and Guatemala case studies. A starter budget for MarWeB activities in 2015–2016, to be completed by correspondence or at an inter-session meeting, is presented in Table 2.

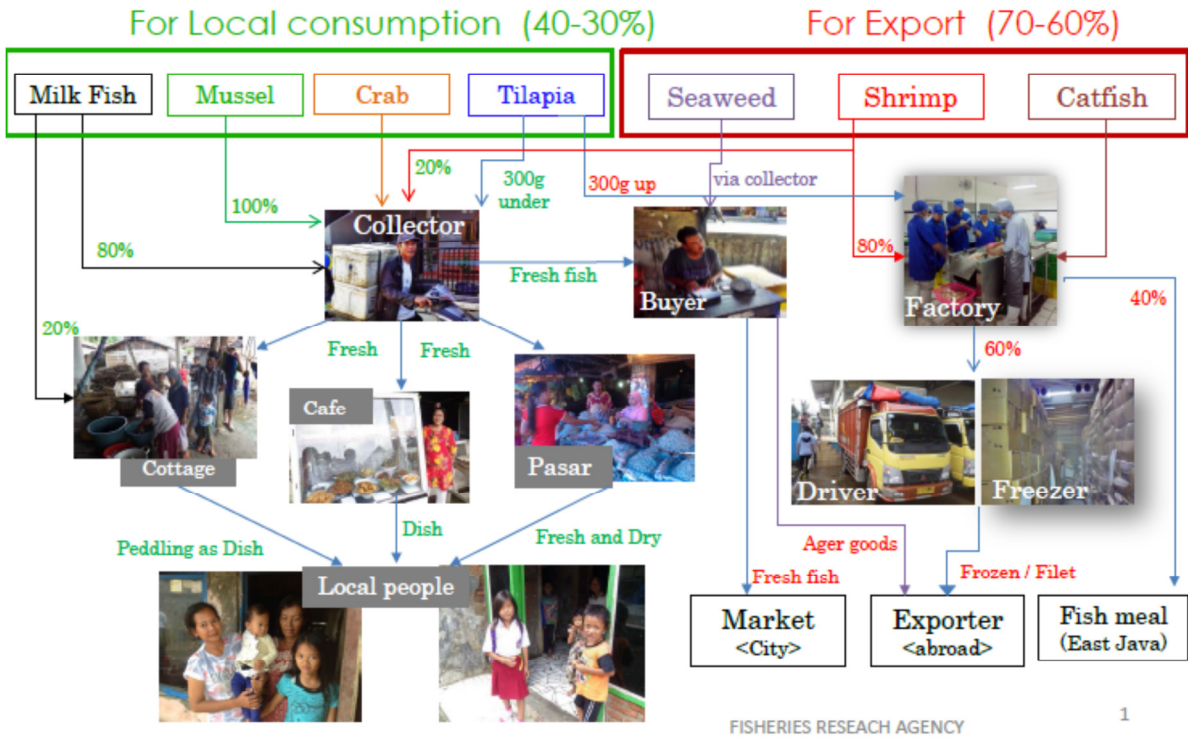


Fig. 1 Revised commodity chain map for marine aquaculture products in Karawang, Indonesia (from presentation by M. Hirota at the fifth PST meeting, October 16, 2014).

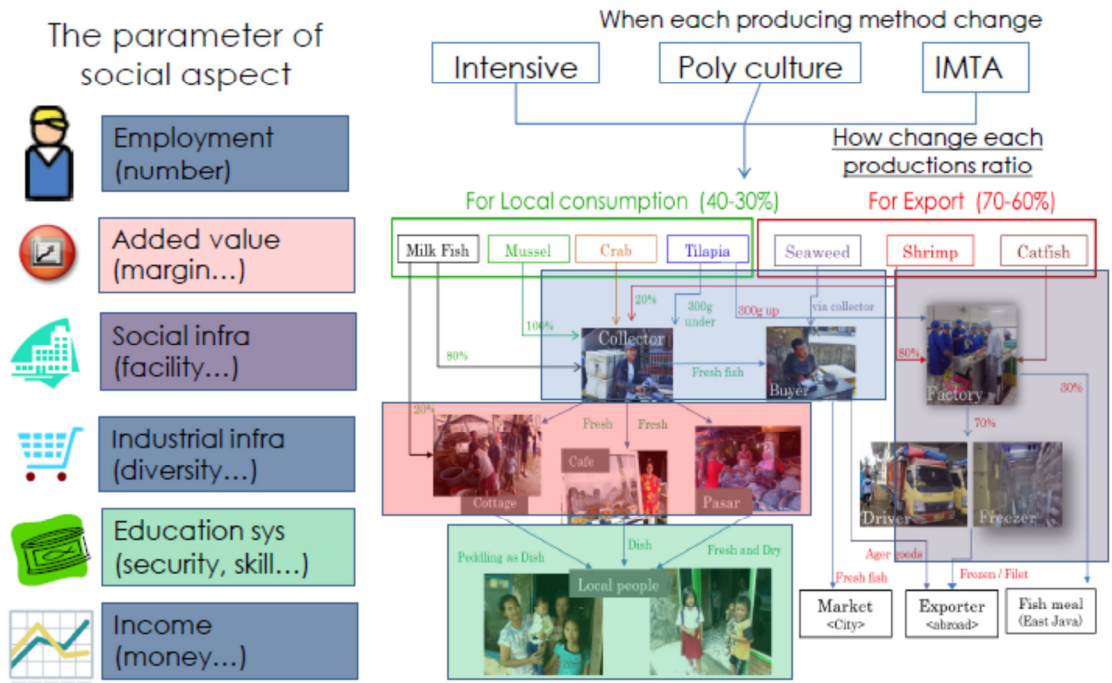


Fig. 2 Example of social parameters that could be varied in a dynamic systems model approach, to understand potential impacts on outcomes (from presentation by M. Hirota at the fifth PST meeting, October 16, 2014).

Table 1 Proposed MarWeB budget breakdown for Project Year 3 (FY 2014)

Indonesia		
Follow-up visit by Dr. Wells in June 2014 (Pond experiment and model instruction)	2,000	30,000
3 rd Social survey by Dr. Hirota and Ms. Hori	5,000	
3 rd Workshop for manual development in Pekalongan (incl. travel costs for Drs. Makino and Hirota)	23,000	
Guatemala		
2 nd Guatemala Workshop (Dr. Trainer lead)	50,000	50,000
Meetings		
Travel support for Hawaii FUTURE OSM meeting	8,000	25,000
Travel support for PICES 2014 Annual Meeting (Yeosu, Korea; incl. invited speakers):	16,000	
IMTA field trip in Yeosu	1,000	
TOTAL		105,000

Table 2 Proposed MarWeB budget breakdown for Project Year 4 (FY 2015)

	Activity/Event	Expense Type	Amount	Section total
PICES Overhead		Overhead	10,000	10,000
Cube analyses	500 questionnaires for “well-being cube” survey in Russia (telephone survey conducted by a Japanese company)	Contract	8,000	8,000
Indonesia	Workshop for manual development (led by Dr. Suhendar Sachoemar)	Contract	9,000	13,000
	Follow-up visit(s) to Karawang for instruction /advice for pond experiment	Travel	4,000	
Guatemala	Workshop for manual development	Travel	15,000	35,000
	Workshop for manual development	Contract	20,000	
Equipment		Equipment	1,000	1,000
PST Meetings	Travel support for a possible inter-sessional meeting (location TBD)	Travel/Meetings	??	16,000
	Travel support for PICES 2015 Annual Meeting (Qingdao, China)	Travel/Meetings	16,000	
	TOTAL			83,000

6. OTHER BUSINESS

There was brief discussion of opportunities for MarWeb topic sessions at the upcoming 2016 PICES Annual Meeting and the ICES/PICES Symposium on “*Understanding marine socio-ecological systems: Including the human dimension in Integrated Ecosystem Assessments*” (May 30–June 3, 2016, Brest, France), and the possible PICES Human Dimension Conference. No decisions were made.

7. CONCLUDING REMARKS

Dr. Makino thanked the participants for their ongoing efforts in support of the MarWeB project. The meeting was adjourned at 1800.

Appendix 1

Project Science Team membership

Harold (Hal) P. Batchelder
Keith R. Criddle
Masahito Hirota
Juri Hori
Suam Kim
Mitsutaku Makino (Co-Chairman)
Grant Murray
Jonghoh Nam
Ian Perry (Co-Chairman)
Thomas Therriault
Vera Trainer
Charles Trick
Mark Wells

PICES Secretariat
University of Alaska, Fairbanks, USA
Fisheries Research Agency, Japan
Rikkyo University, Japan
Pukyong National University, Korea
Fisheries Research Agency, Japan
Institute for Coastal Research, Canada
Maritime Institute, Korea
Pacific Biological Station, Department of Fisheries and Oceans, Canada
Pacific Biological Station, Department of Fisheries and Oceans, Canada
Northwest Fisheries Science Center, NOAA Fisheries, USA
University of Western Ontario, Canada
University of Maine, USA



Participants of the fifth Project Science Team meeting for the PICES/MAFF project on “Marine ecosystem health and well-being” (left to right): Vera Trainer (USA), Harold Batchelder (PICES), Charles Trick (Canada), Thomas Therriault (Canada), Mitsutaku Makino (Japan; Co-Chairman), Grant Murray (Canada), Ian Perry (Canada; Co-Chairman), Mark Wells (USA), Jonghoh Nam (Korea), Keith Criddle (USA), Juri Hori (Japan), Masahito Hirota (Japan). Not shown: Alexander Bychkov (PICES) and Suam Kim (Korea).

Appendix 2

Fifth Project Science Team meeting agenda

1. Introductions and adoption of the agenda
2. Introduction of the project and this meeting (Co-Chairs)
3. Progress reports
 - 3.1 Annual Reports for Science Board and MAFF (Co-Chairs)
 - 3.2 Report of the fourth PST meeting (Co-Chairs)
 - 3.3 Development of research activities in Guatemala (Vera Trainer, Charles Trick)
 - 3.4 Development of the research activities in Indonesia (Mark Wells, Masahito Hirota)
 - 3.5 Topic Session on IMTA at PICES-2014 (Masahito Hirota, Mark Wells, Grant Murray)
 - 3.6 Other reports (“well-being cube” analysis, PICES Press, *etc.*)
4. Project management
 - 4.1 Revision of PST membership
 - 4.2 Discussion on the FY 2014 budget
5. Discussions on the FY 2015 workplan and budget
6. Other business
7. Concluding remarks

Appendix 3

MarWeB Topic Session (S11) at PICES 2014 Annual Meeting (Yeosu, Korea)

“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) and 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).

Wednesday, October 22 (09:00-12:30)

09:00 *Introduction by Session Convenors*

09:05 *Integrated Multi-Trophic Aquaculture (IMTA): An environmentally, economically and societally responsible aquanomic approach to farming the sea with many variations (Invited)*

Thierry Chopin

- 09:35 *Obtaining a social license for IMTA: Challenges and opportunities in British Columbia, Canada (Invited)*
Mark Flaherty
- 10:05 *The effect of multi-trophic aquaculture on nutrient loading in fish and shrimp ponds, Karawang Indonesia*
Mark L. Wells, Mitsutaku Makino, Suhendar I. Sachoemar and Masahito Hirota
- 10:45 *Dissemination of Sato-umi for sustainable aquaculture development in Indonesia (Invited)*
Suhendar I. Sachoemar, Tetsuo Yanagi, Mitsutaku Makino, Mark L. Wells, Masahito Hirota and Ratu Siti Aliah
- 11:15 *Implementation of Sato-umi concept at pond aquaculture in Karawang, Indonesia (Invited)*
Susanna Nurdjaman, Tetsuo Yanagi and Suhendar I. Sachoemar
- 11:45 *Social-ecological studies towards the integrated management of local fisheries in North-Eastern Hokkaido, Japan*
Emmanuel A. Sweke, Rotaro Okazaki, Yumi Kobayashi, Mitsutaku Makino and Yasunori Sakurai
- 12:05 *Discussion*

Posters S11

- S11-P1 *Parasites of marine fishes and climate change: Implications for Korean aquaculture*
B.A. Venmathi Maran and Jung-Goo Myoung
- S11-P2 *Accumulation of lactate in the coelomic fluid of sea urchins under stress suggests the switching-on of anaerobic glycolysis*
Konstantin A. Drozdov, Anatoliy L. Drozdov and Lidia T. Kovekovdova