

Fifth U.S.-China Living Marine Resources Joint Coordination Panel Meeting

Minutes

In accordance with the Protocol on Marine and Fishery Science and Technology Cooperation between the United States of America and the People's Republic of China, the U.S.-China Joint Coordination Panel for Living Marine Resources (LMR) held its fifth meeting in Sanya, Hainan Province, People's Republic of China, from April 19-21, 2002. The meeting was co-chaired by Mr. ZHANG Xianliang, Vice President of the Chinese Academy of Fishery Sciences (CAFS) of the Ministry of Agriculture of the People's Republic of China, and Dr. James McVey, Aquaculture Program Director for the National Sea Grant College Program of the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce.

On behalf of the Chinese delegation, Mr. ZHANG Xianliang opened the meeting by extending a warm welcome to the U.S. delegation. Dr. James McVey expressed his pleasure to lead the U.S. delegation and appreciated the Chinese host's preparations for holding this meeting. The co-chairs introduced their respective delegation members (see list of delegates in Appendix I).

Mr. Zhang and Dr. McVey gave overviews of the LMR priorities during their respective opening remarks. The co-chairs reaffirmed that the U.S.-China LMR Program has established an effective vehicle for cultivating win-win partnerships and collaborative relations between the two countries. The U.S. scientific and commercial sectors have benefited from access to large scale fisheries and aquaculture production technologies practiced in China, and the Chinese scientific community has gained access to U.S. research labs to assist its scientists in addressing disease, genetic and biotechnology issues, and environmentally-friendly fish farming techniques.

The co-chairs shared the common understanding that the U.S. and China will: continue collaborative efforts to optimize integrated aquaculture and fisheries technologies by promoting new concepts of integrated aquaculture (marine polyculture) systems including algae, filter-feeders, mollusks, shrimp, and finfish; adopt environmentally-friendly aquaculture practices to help sustain and increase seafood supply; advance our understanding of biosecure systems, bioremediation techniques, and biotechnology applications mutually beneficial for both countries. The delegations agreed to the agenda for the 5th LMR panel meeting (see Appendix II).

Both Chinese and the U.S. Executive Secretaries, Mr. LI Yingren and Dr. Dosoo Jang, reported on the status of cooperative activities of 2000-2001, which were endorsed at the fourth LMR meeting. Both delegations reviewed and discussed the interim activities and expressed their satisfaction with the program (see Appendix III for more details).

Both parties discussed and agreed on the new collaborative research projects for the next interim 2002-2003 (see Appendix IV). Due to budget limitations, both sides shared the same

understanding that the LMR program would require efforts to select the highest priority projects mutually beneficial to both countries. In this context, both sides agreed that the panel should use a working team on a provisional basis to develop a vision and more efficient and effective implementation plan for the LMR projects. This team will identify long-term goals and develop a five-year action plan for the LMR program (see Appendix IV for more details).

The LMR Joint Coordination Panel confirmed the need to continue the ongoing framework to facilitate collaborative activities under the auspices of the U.S.-China Marine and Fishery Science and Technology Protocol. These minutes will be submitted to the 16th U.S.-China Joint Working Group Meeting of the Protocol for review and endorsement.

The U.S. delegation agreed to host the sixth LMR meeting in the United States in 2004. The co-chairs will decide the schedule and location for the next meeting through correspondence. The minutes were signed on April 20, 2002 in Sanya, Hainan Province, People's Republic of China, in English and Chinese, both texts being equally authentic.

James P. McVey
U.S. Chairperson
Aquaculture Program Director
National Sea Grant College Program
National Oceanic and Atmospheric
Administration
United States of America

ZHANG Xianliang
Acting Chinese Chairperson
Vice-President
Chinese Academy of Fishery
Sciences
Ministry of Agriculture
People's Republic of China

Appendix I

LIST OF PARTICIPANTS

U.S. Delegates

Dr. James P. McVey, Co-Chair
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Resource Ecology and Fisheries
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Aquaculture School
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P.R.C. Delegates

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Chinese Academy of Fishery Sciences
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Professor ZHU Mingyuan

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Mr. LI Yingren

Chinese Executive Secretary
Director
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Meeting Agenda
5th China-U.S. Living Marine Resources
Joint Coordination Panel Meeting

April 18-22, 2002
Sanya, Hainan Province
People's Republic of China

Thursday, April 18, 2002

00:05 U.S. delegation arrives in Sanya via Korean Air #877
Hotel: South China Hotel

09:30 Meeting of Co-Chairs and Executive Secretaries

Friday, April 19, 2002

Part I. Opening Session: (Meeting Hall, South China Hotel)

09:00-09:10 Welcome & Introduction of the Delegations
ZHANG Xianliang Acting Chinese Chairman (Lead)
James McVey, U.S. Chairman

09:10-09:40 Opening Remarks
& Overview of Chinese National LMR Priorities
ZHANG Xianliang

09:40-10:10 Remarks
& Overview of U.S. National LMR Priorities
James McVey

10:10-10:20 Adoption of the Agenda (China Lead)

10:20-10:30 Coffee Break

Part II. Review of Cooperative Activities Since the 4th LMR (2000-2001)

10:30-11:30 Review of 2000-2001 Activities
LI Yingren, Chinese Executive Secretary
Dosoo Jang, U.S. Executive Secretary

11:30-12:00 Supplementary Reports from the panel members
Charles Yarish, Mac Rawson, and John Curtis

12:00-13:30 Lunch

Part III. Discussion and Adoption of New Collaborative Activities Proposals

13:30-14:00 Shrimp Culture
WANG Qingyin, Yellow Sea Fishery Research Institute, CAFS
LIU Ruiyu, Institute of Oceanology, CAS

14:00-14:30	James McVey, U.S. Co-Chair Shellfish Culture Standish Allen, Virginia Institute of Marine Sciences (VIMS) Lowell Bahner, NOAA Chesapeake Bay Office LIU Ruiyu, Institute of Oceanology, CAS QU Dequan, Zhanjiang Ocean University WANG Aimin, Hainan University
14:30-14:40	Finfish LI Jiaer, South China Sea Fishery Research Institute, CAFS James McVey, U.S. Co-Chair
14:40-15:10	Algae Charles Yarish, University of Connecticut LIU Ruiyu, Institute of Oceanology, CAS
15:10-15:30	Coffee Break
15:30-16:00	Harmful Algal Blooms ZHU Mingyuan, First Institute of Oceanography, SOA Charles Yarish, University of Connecticut
16:00-16:30	Coastal Modeling and Carrying Capacity Mac Rawson, University of Georgia ZHU Mingyuan, First of Institute of Oceanography, SOA
16:30-17:00	Educational Exchange on Aquaculture ZHOU Yingqi, Shanghai Fisheries University John Curtis, Bridgeport Regional Vocational Aquaculture School
17:00-17:10	Data and Information Loh-Lee Low, Alaska Fisheries Science Center of NOAA LI Yingren, Chinese Academy of Fishery Sciences
17:10-17:30	Aquaculture Policy and Management Michael Rust, Northwest Fisheries Science Center of NOAA LI Yingren, Chinese Academy of Fishery Sciences
17:30	Adjourn
18:30	Banquet in honor of the Chinese Delegation

Saturday, April 20, 2002

Part IV. Closing Ceremony:

08:30-10:00	Meeting of executive secretaries in preparation for minutes of discussion
10:00-11:00	Adoption of minutes of discussion (<i>Plenary Meeting resumes</i>)
11:00-11:20	Coffee Break
11:20-12:00	Closing remarks James McVey, U.S. Chairman ZHANG Xianliang, Acting Chinese Chairman Signing of minutes of discussion The 5 th LMR Panel concludes and adjourns
12:00-13:30	Lunch
13:30-17:00	Coastal site visits
19:00	Dinner in honor of U.S. delegation

Sunday, April 21, 2002

09:00-17:00

18:30

Aquaculture site visits

Dinner

Monday, April 22, 2002

08:50

U.S. delegation returns to the U.S. via China Southern Air #3103

Appendix III

Summary of Activities 2000-2001

Shrimp

A. Endocrinology of reproduction, maturation, and spawning

Dr. Li Fuhua of the Institute of Oceanology, Chinese Academy of Sciences (IOCAS), has spent a total of 18 months in Dr. Hans Laufer's laboratory learning isolation, purification, and quantification measurement procedures for the hormone, methyl farnesoate (MF) in several species of crustacea including *Fenneropenaeus chinensis* and *Litopenaeus vannamei*, during gonad maturation and during morphogenesis. The researchers from the two countries had obtained progress in this sub-project. In 2000, Dr. Li collected blood and ovary samples from Chinese shrimp *Fenneropenaeus chinensis* at different ovary developmental and ovarian maturation stages for further research. At the same time, she took samples from normal shrimp and eyestalk ablated shrimp and preserved them for further analysis. Dr. Hans Laufer originally planned to visit China for one week in June 2000, but the visit had been cancelled due to a family emergency.

Dr. LI Fuhua planned to visit USA for 6 months in 2000, but her visit was also postponed to 2002-2003. IOCAS is planning to invite Dr. Hans Laufer to visit China again in 2002 for 1-2 weeks for cooperative research. Both scientists worked to publish an article entitled "The Present and Future of Methyl Farnesoate in Morphogenesis and Reproduction of Crustacea" by H. Laufer and F. Li (1999), in: *Recent Developments in Comparative Endocrinology and Neurobiology*, Roubos, Bonga, Vaudry and De Loof, Editors. European Society for Comparative Endocrinology, Publishers, Nijmegen, The Netherlands. Scientists from both sides hoped to continue their cooperation on the function of hormone methyl farnesoate (MF) in *Fenneropenaeus chinensis* during the stages of growth, maturation, and reproduction.

U.S. contact: Dr. Hans Laufer, University of Connecticut

Chinese contact: Dr. LI Fuhua, Institute of Oceanology, CAS

B. Shrimp virology and development of specific pathogen-free (SPF) shrimp

(a) Shrimp virology

The work was not conducted during 2001 due to the funding constraint for a Chinese scholar to visit Tucson.

(b) Development of SPF shrimp *Fenneropenaeus chinensis*

In April 2001, under the U.S.-China LMR, Dr. Carlos Pantoja (Department of Veterinary Science and Microbiology, University of Arizona) and Dr Hui Gong (Arizona Mariculture Associates Shrimp Farm) were assigned to the Yellow Sea Fishery Research Institute (YSFRI) in Qingdao to select the larvae of *F. chinensis* for SPF shrimp research. PCR was

used for the screening of wild gravid female shrimp for WSSV and HPV. For detecting WSSV, DNA extracted from hemolymph of the shrimp was used as a template for PCR amplification. WSSV was detected in seven shrimps out of the 36 shrimps. For detecting HPV, DNA extracted from feces collected from the bottom of the tank for PCR amplification. HPV was detected in two out of the 36 shrimp.

Healthy, highly active nauplii were selected from the spawners of seven females where no WSSV or HPV was detected. Fertilized eggs, in advanced stage of development, were selected from one additional female. A total of approximately 25,000 to 30,000 nauplii and 60,000 to 80,000 eggs were transferred into 6L of clean seawater and packed with double-walled plastic bags(water temperature was about 15°C and salinity was 32‰). Two bags with nauplii were packed into one transportation box with two ice packs placed beside each bag.

Dr. Carlos Pantoja left for Arizona on April 26, 2001, with candidate SPF nauplii or fertilized eggs from 8 different single-spawned wild female *F. chinensis*. Candidate SPF nauplii (F-1 generation) from 8 different single-spawned wild female *Fenneropenaeus chinensis* were acquired with the cooperation of YSFRI. Seven of the eight stocks of nauplii arrived in good condition at the University of Arizona's primary quarantine facility in Tucson where the stocks were reared to PL, and tested repeatedly for specific pathogens and general health status. No pathogens on the Oceanic Institute or U.S. Marine Shrimp Farming Consortium lists were detected in the stocks. Following completion of primary quarantine at the University of Arizona, seven stocks of small juvenile *F. chinensis* were identified as SPF. Sub-populations of these stocks were provided to their collaborations in the project for rearing, maturation, production of an F-2 generation, and for subsequent evaluation by the University of Arizona as SPF stocks. The facilities with secondary quarantine capabilities that received the SPF stocks of *F. chinensis* were the Oceanic Institute in Hawaii, Arizona Mariculture Associates in Arizona, Seafood Systems, Inc. in Michigan, and the Laboratory of Invertebrate Reproduction of the University of Connecticut in Connecticut, United States.

U.S. contact: Dr. Donald Lightner, University of Arizona

Chinese contact: Professor HUANG Jie, Yellow Sea Fishery Research Institute

C. Molecular genetics of shrimp

Dr. Acacia Alcivar-Warren of the Department of Environmental and Population Health, Tufts University, was invited to visit China from April 3 to 16, 1999. She gave lectures on molecular genetic markers, and discussed with Professor XIANG Jianhai about the implementation of the joint research item on shrimp molecular genetic markers in Qingdao. Professor ZHOU Linghua from Institute of Oceanology, Chinese Academy of Sciences, went to Tufts University to do cooperative research with Dr. Alcivar-Warren for 3 months started from July 18, 2000. She prepared several hundreds of slides with chromosome metaphase of *Litopenaeus vannamei* for doing genome mapping in shrimp and did some preliminary work in USA.

From Aug. 2000 to Feb. 2001, Dr. Linsheng Song went to School of Veterinary, Tufts

University working with Dr. Alcivar-Warren on the identification and isolation of the genes related to disease resistance in shrimp and made good progress. He had conducted BLAST analysis of ESTs, and assorted them into different groups based on their potential, and screened the microsatellite DNA sequences in the ESTs. He constructed a cDNA library of shrimp larvae and subtracted cDNA library for WSSV challenged and normal individuals of *L. vannamei* in order to identify the genes related to disease and got preliminary results.

In September, 2001, Dr. Alcivar-Warren and Dr. Zhenkang Xu from Tufts University visited China to continue their cooperation research with Professor Xiang Jianhai on sample collection along the northern and eastern China coast.

U.S. contact: Dr. Acacia Alcivar-Warren, Tufts University School of Veterinary
Medicine

Chinese contact: Professor XIANG Jianhai, Institute of Oceanology, CAS

D. Study of shrimp cell line
(no activity)

U.S. contacts: Dr. Charles Helsley, University of Hawaii, Sea Grant
Dr. Cheng-Sheng Lee, Oceanic Institute

Chinese contact: Professor JIANG Shigui, South China Sea Fishery Research
Institute, CAFS

Shellfish

A. Scallop mortality in China

Since the mid 1990s, the Chinese native zhikong scallop (*Chlamys farreri*) has experienced repeated and heavy mortalities during the summer, which have seriously diminished commercial production. The mortalities were first observed in 1994 and have continued since then. Investigations to date have failed to identify a cause.

In response to the problem, a joint project was established between Drs. Susan Ford and Ximing Guo and Professor Zhang Fusui. The project was designed to methodically examine the three principal hypotheses for the mortalities: overcrowding, a pathogen, and inbreeding. In the summer of 2000, scallops were deployed at three densities in commercial lantern nets at three culture parks in Shandong Province. Growth and mortality were monitored over a 3-month period. Samples were collected for histopathological and genetic analysis before, during, and after the mortality. A Master's student, Ms Jie Xiao, coordinated the sampling in China and spent 6 months at the Haskin Shellfish Laboratory in 2001 to receive training in methods to study diseases of commercial molluscs and to process the samples. This is perhaps the first systematic, multifactor investigation of the scallop mortality.

During this study, mortality occurred at all sites. Most deaths occurred over a three-week period during July and August, when the temperature was highest, and exceeded 80% by the end of the study. Final mortality was not associated with the stocking density, but scallops in the high density groups began dying earlier and faster than those in the low density groups, suggesting that high density accelerated mortality.

U.S. contacts: Dr. Susan Ford, Haskin Shellfish Research Lab, Rutgers University
Dr. Ximing Guo, Haskin Shellfish Research Lab, Rutgers University
Chinese contact: Professor ZHANG Fusui, Institute of Oceanology CAS

B. Chromosome manipulation in shellfish

The implementation of joint research was postponed, as the funds supporting the joint research was not available from U.S. side.

[A proposal for cooperation in 2002-03 is being put forward: The cellular mechanism of tetraploid induction in shellfish]

Chinese contact: Dr. QUE Huayong, Institute of Oceanology, CAS
U.S. contact: Dr. Standish Allen, Virginia Institute of Marine Sciences

C. Shellfish Disease

A joint study on scallop diseases between the Institute of Oceanology of CAS and the Virginia Institute of Marine Sciences has not been implemented, and suggested to be postponed to 2002-2003.

Chinese contact: Professor XIANG Jianhai, Institute of Oceanology, CAS
U.S. contact: Dr. Fulin Chu and Dr. Eugene Burreson, Virginia Institute of Marine Sciences

D. Molecular genetic marker technique, genetics and breeding of bivalve Mollusks
(no activity)

Chinese contact: Professor XIANG Jianhai, Institute of Oceanology, CAS
U.S. contact: Dr. Dennis Hedgecock, Bodega Marine Laboratory, University of California at Davis

E. Study on Perkinsus disease of cultured scallops (Chlamys farreri)
(no activity)

Chinese contact: Mr. LIANG Yubo, Institute of Marine Environment Protection, SOA
U.S. contact: Dr. Eric N. Powell, Institute of Marine and Coastal Sciences, Rutgers University

F. Study of a spherical virus from abalone
(no activity)

Chinese contact: Professor JIANG Shigui, South China Sea Fishery Research Institute, CAFS
U.S. contact: To be determined

Finfish

A. Finfish culture, training, and exchange program

In the research of mullet, the South China Fishery Research Institute (SCSFRI) and Dr. Cheng-Sheng Lee from the Oceanic Institute in Hawaii established cooperation and exchanged their view on the propagation of mullet, Dr. Lee gave the researchers of SCSFRI some helpful advice. The research on the propagation of mullet has been finished on schedule smoothly. China discovered that the related institutes of China have made much progress in the research of American redbfish. Therefore, it is not necessary to do the same research repeatedly.

In addition, from 19-21, 2000, a workshop, organized and hosted by the Aquaculture Interchange Program (AIP), and funded by the National Oceanic and Atmospheric Administration (NOAA), took place at the Oceanic Institute, Waimanalo, Hawaii, USA. Dr. Cheng-Sheng Lee led in organizing the workshop focused on the status of aquaculture in China and eight leading scholars from a variety of institutions in that nation were invited to speak. They covered a wide range of topics, providing an overview of the history and current focus of aquaculture in China; recent research, economic, and environmental advances; problems; and future needs for the further growth of this important industry. This workshop was a major step in forming solid relationships with researchers in China. The papers that were presented will be published, and future collaborations between scholars from China and the United States are expected.

Chinese contact: Professor JIANG Shigui, South China Sea Fishery Research Institute, CAFS

U.S. contacts: Dr. Cheng-Sheng Lee, The Oceanic Institute
Dr. Robert R. Stickney, Sea Grant College Program, Texas A&M University

*B. Culture and reproductive biology study of Atlantic Croaker (*Micropogonias undulatus*)*

Both sides have exchanged some experience in culture and reproductive biology of finfish called Atlantic croaker.

Chinese contact: Professors ZHANG Chaohui and MAO Xinghua, First Institute of Oceanography, SOA

U.S. contact: Dr. Robert Vega, Texas Parks and Wildlife

C. Influence of sex pheromones on the reproductive physiology and behavior of fish (no activity)

Chinese contact: Professors LEI Jiling and LIU Xinfu, Yellow Sea Fishery Research Institute, CAFS.

U.S. contacts: Dr. Peter W. Sorensen, University of Minnesota

Virus Research

Study of marine virus ecology

(no activity)

Chinese contact: Professor HUANG Jie, Yellow Sea Fishery Research Institute, CAFS

U.S. contact: Dr. William Liang, RTC Romberg Tiburon Center, San Francisco State University

Algae

A. Seaweed cultivation, biology and biotechnology

The item has not been implemented because Professor Xiugeng Fei has committed to other urgent domestic tasks so that he could not make his trip to the U.S.. The cooperative study was postponed to the next interim of 2002-2003.

U.S. contact: Dr. Charles Yarish, University of Connecticut

Chinese contacts: Professor FEI Xiugeng, Institute of Oceanology, CAS
Dr. TANG Xiaorong, Ocean University of Qingdao

B. Development of a cooperative research program on Porphyra

Research on the *Porphyra* species: (1) Chinese researchers have carried out the research on *Porphyra katadai* var. *hemiphylla* and *P. haitanensis*. As the results, it seems that there are many life history stages without sexual fertilization in *Porphyra*. Tang has completed the life cycles without normal fertilization from unisexual *Porphyra* tissues from either species. (2) The developments of conchocelis from unisexual tissues and wild carpospores were studied and an ultrastructural study was carried out. (3) Currently, cytological, ecophysiological and biochemical studies are underway. (4) In order to compare differences between PRC native species (Pacific species) and US native species (Atlantic species), Dr. Tang Xiaorong is visiting Dr. Charles Yarish's laboratory for further ecophysiological research on *Porphyra*. Professor Yarish has provided funding for a 6-month visit for Professor Tang.

U.S. contact: Dr. Charles Yarish, University of Connecticut

Chinese contact: Dr. TANG Xiaorong, Ocean University of Qingdao

Harmful Algal Blooms

This project has been conducted for three years. Dr. Sherwood Hall from FDA and Dr. Donald Anderson from Woods Hole Oceanography Institution participated in the final Task Team and Steering Committee meeting of APEC Project on Management of Red Tide and Harmful Algal Blooms, which was held in Haikou, China during April 15~19, 2000. Professor ZHU Mingyuan was the local host. Both sides make significant contribution to the success of this project. Dr. Donald Anderson attended a symposium for preparation of China GEOHAB project in Haikou, China during April 20~21, 2000, and serves as an international consultant of China GEOHAB.

Dr. Sherwood Hall visited Beijing, Qingdao, Shanghai, Guangzhou and Wuhan, China from late November to mid-December 2000. He met many Chinese scientists and management officers working on detection methods of HAB toxin, routine monitoring, early warning and management of HAB and seafood safety. It was a fruitful visit and both sides discussed the

possibility to hold the second HAMM meeting in Qingdao, China. It was decided that this Conference will be held in Qingdao during November 12~16, 2001, and Qingdao in spring 2000 to present recent work in HAB research at the FDA and to discuss future topics for collaboration. Detection and management of HAB toxins will also be explored during this visit.

Dr. Sherwood Hall and Professor ZHU Mingyuan organized the Second International Conference on Harmful Algae Management and Mitigation in Qingdao, China in November 12-17, 2001. Over 200 participants from 25 economies attended the Conference.

One junior scientist will visit the Marine Biotoxins Program, the Center for Coastal Environmental Health and Biomolecular Research, the National Ocean Service, NOAA, to learn the receptor assay for the detection of PSP toxin in May 2002. This visit is supported by IAEA.

U.S. contact: Dr. Donald Anderson, Woods Hole Oceanographic Institution
Dr. Sherwood Hall, U.S. Food and Drug Administration
Chinese contacts: Professor ZHU Mingyuan, First Institute of Oceanography, SOA
Professor CHEN Yaqu, East China Sea Fishery Research Institute, CAFS
Professor JIA Xiaoping, South China Sea Fishery Research Institute, CAFS

Ecosystem modeling

A. Ecosystem modeling of semi-enclosed Bay

Dr. Mac Rawson visited Qingdao in late November, 2000. He developed a proposal for the further cooperation in this field. Chinese side supported his proposal. A young scientist Mr. Shang Chen went to University of Georgia for 6 months. He will use computer models to determine the impact and carrying capacity for aquaculture in Jiaozhou Bay, China.

U.S. contact: Dr. Mac Rawson, University of Georgia
Dr. Charles Yarish, University of Connecticut
Chinese contact: Professor Xinhua Mao, First Institute of Oceanography
Dr. WANG Lu, Hainan Marine Development, Planning, and Design Institute

B. Microbial diversity as an indicator of environmental health (no activity)

U.S. contact: Dr. Mac Rawson, University of Georgia
Chinese contacts: Dr. WU Suqi, First Institute of Oceanography
Ms. FENG Juan, South China Sea Fishery Research Institute, CAFS

C. Yellow Sea Large Marine Ecosystem (YSLME)

NOAA's National Marine Fisheries Service worked with SOA to develop the Yellow Sea Large Marine Ecosystem study in the past several years. The YSLME Project, internationally

coordinated to develop environmentally sustainable use and ecosystem-based management program, has been approved by the Global Environmental Facility (GEF) Council and Secretariat for five years at a level of \$25 million. NOAA will continue to provide scientific and technical expertise and support to assist in program implementation. Representatives from China, Korea and UNDP met in UNDP Beijing office. It was decided that the Project Coordination Office will be in Korea. The project will have 5 working groups. China will chair three and Korea two.

U.S. contact: Dr. Loh-Lee Low, Alaska Fisheries Science Center, NMFS

Dr. Kenneth Sherman, Narragansett Lab, NMFS

Chinese contact: Professor ZHU Mingyuan, First Institute of Oceanography, SOA

Coastal Upwelling

Georges Bank in the Gulf of Maine and Zhejiang Coastal Upwelling Zone in East China Sea

(no activity)

U.S. contact: Dr. Fei Chai, University of Maine

Chinese contact: Professor NING Xiuren, Second Institute of Oceanography, SOA

Aquaculture education exchange

Curriculum for Bridgeport Regional Vocational Aquaculture School

In March 1-April 30, 2000, Professor Pan Honggeng, Mr. CAI Shengli, and Ms. WANG Yiwen went to Bridgeport Regional Vocational Aquaculture School to give lectures on Aquaculture, Mathematics and Chinese Culture.

From April 26-May 7, 2000, 5 teachers and students from Bridgeport Regional Vocational Aquaculture School visited Shanghai Fisheries University.

In return, in May of 2001, a reciprocal number of staff and students traveled to the U.S. and the BRVAS. Instruction and cultural learning were the focus of the exchange.

From Nov. 1-7, 2000, Dr. Sonia Diaz Salcedo, Dr. John Curtis from Bridgeport Regional Vocational Aquaculture School, Dr. Charles Yarish and Dr. Shili Liu from University of Connecticut visited Shanghai Fisheries University and signed an agreement between the 3 institutions.

In May 2001, 2 teachers from Shanghai Fisheries University, Mr. JIANG Min and Mr. HE Peimin, went to the University of Connecticut to do research and then went to Bridgeport Regional Vocational Aquaculture School to give lectures.

From 2000 to 2001, Professors at Shanghai Fisheries University gave 4 lectures to students at Bridgeport Regional Vocational Aquaculture School by distant communication.

U.S. contact: Mr. John Curtis, Bridgeport Aquaculture School

Chinese contact: Mr. WEI Hua, Shanghai Fisheries University

Data and information*China-U.S. fishery statistics analysis and exchange*

In 2000, Prof. Yang Ningsheng from the Information Center, Chinese Academy of Fishery Sciences work at NOAA's Central Library for 1 month. He updated the home page (www.lib.noaa.gov/china/chinafp.htm) on NOAA's computer network. This home page was developed by Prof. Yang in 1997 that presents fishery information about China.

U.S. contact: Mrs. Janice Beattie, NOAA Central Library

Chinese contact: Mr. YANG Ningsheng, Information Center, CAFS

Appendix IV

Work Plan 2002-2003

Shrimp

A. Endocrinology of reproduction, maturation, and spawning of Fenneropenaeus chinensis

To help us understand the reproductive endocrinology of the Chinese shrimp, both principal investigators from the Institute of Oceanology of the Chinese Academy of Sciences (CAS) and the University of Connecticut will investigate ways to improve maturation and spawning. The hormone methyl farnesoate (MF) seems to play major roles in shrimp maturation and in morphogenesis, but little work has been done on the basic reproductive endocrinology and metamorphosis of this shrimp. The advantage of this organism is its greater tolerance for colder climates, so that it should be able to grow with a broader distribution than most of the tropical shrimp under common cultivation in much of the world.

Dr. Fuhua Li has spent a total of 18 months in Dr. Laufer's laboratory learning isolation, purification, and quantification measurement procedures for the hormone, methyl farnesoate, in several species of crustacea (Laufer and Li, 1999) including *Fenneropenaeus chinensis*, during gonad maturation and during morphogenesis. Dr. Li is well qualified to continue the proposed research.

In 2002-2003, one scientist from the Institute of Oceanology will be sent to the U.S. for up to 6 months and one scientist from the U.S. will be invited to visit China for 1-2 weeks to do the following collaborative research. The proposed project is to build on the information available.

1. MF is to be measured in normal *Fenneropenaeus chinensis* during stages of growth, maturation and reproduction. (Samples from Qingdao)
2. MF is to be measured following eyestalk ablation, including stages of ovarian maturation. (Samples from Qingdao)
3. Diets are to be formulated with several concentrations of gonad maturation factors (MF, as well as other compounds are to be tried) on various stages of growth and ovary maturation, with one half of the females destalked unilaterally. (These trials should be undertaken in a facility in the U.S.)

U.S. contact: Dr. Hans Laufer, University of Connecticut

Chinese contacts: Dr. LI Fuhua, Institute of Oceanology, CAS

Professor XIANG Jianhai, Institute of Oceanology, CAS

B. Shrimp virology and development of specific pathogen-free (SPF) shrimp seed

In 2001-2002, the University of Arizona will acquire and test samples of the F-1 *P. chinensis* from secondary quarantine for general health status and for specific pathogens at each collaborating facility. Maturation and production of F-2 generations are expected to begin in 2002 at which time the University of Arizona personnel will again acquire and test representative samples from each breeding family line for specific pathogens. The University of Arizona and the Gulf Coast Research Laboratory Consortium will continue ongoing collaboration with the Yellow Sea Fisheries Research Institute of CAFS on the development of SPF shrimp stocks and introduction of the relevant technology.

Research topics are:

1. Breeding for SPF/SPR stocks
2. Introduction of quarantine technology for SFP/SFR shrimp
3. Introduction of technology to hold the NBC (nucleus breeding center)
4. Foundation of the high health shrimp strains (HHSS) in China

U.S. contacts: Dr. Donald Lightner, University of Arizona

Dr. Steve Arce, The Oceanic Institute

Chinese contacts: Professor HUANG Jie, Yellow Sea Fisheries Research Institute, CAFS

Professor WANG Qingyin, Yellow Sea Fisheries Research Institute, CAFS

C. Molecular genetic markers in penaeid shrimp

This joint study has been implemented as scheduled, and made fruitful progress. Both sides expressed intention to continue cooperation between the two countries in the following areas:

1. Development of genetic marker techniques of shrimp
2. Screening of disease resistance genes or genetic makers in *Fenneropenaeus chinensis*
3. Genome map construction techniques of *Fenneropenaeus chinensis*

The purpose of this joint study is to develop molecular genetic maker techniques for study of population genetics, MAS, location, isolation, and clone of gene in shrimp. The ultimate goal is to breed disease resistant Chinese shrimp *Fenneropenaeus chinensis*. As part of this program, two scientists from Tufts University plan to visit China for two weeks and in return two scientists from the Institute of Oceanology, CAS, plan to visit Dr. Acacia Alcivar-Warren's lab for 6 months.

Chinese contact: Professor XIANG Jianhai, Institute of Oceanology, CAS

U.S. contact: Dr. Acacia Alcivar-Warren, Tufts University

Shellfish

A. Scallop mortality in China

Heavy mass mortality of the zhikong scallop (*Chlamys farreri* Jones & Preston) has severe impacts on the sustainable development of mariculture industry of this species. In response to the problem a joint project was established between Drs. Susan Ford and Ximing Guo and Professor ZHANG Fusui.

Ms. Xiao Jie from the Institute of Oceanology of CAS has visited Rutgers University and

completed the historical examination of representative scallops from all sites and densities. However, this work failed to reveal any organisms that could be a cause of the problem. The following items will be studied:

1. Effects of sudden change of environmental factors on scallop mortality rate
2. Identification of possible pathogens causing the mass mortality
3. Relationship between the genetic degeneration and mass mortality

Chinese scientists will visit U.S. to participate in research work in Haskin Shellfish Research Laboratory of Rutgers University.

U.S. contacts: Dr. Susan Ford, Haskin Shellfish Research Lab, Rutgers University
Dr. Ximing Guo, Haskin Shellfish Research Lab, Rutgers University
Chinese contact: Professor ZHANG Fusui, Institute of Oceanology, CAS

B. Genetic breeding and genetic markers screening in bay scallop

Professor ZHANG Guofan from the Institute of Oceanology of CAS and Dr. Ximing Guo from Rutgers University have agreed to establish cooperative study on the selective breeding and genetic marker in bay scallop, *Argopecten irradians*. The objectives of the project are as follows:

1. The genetic structure of U.S. stock of bay scallop
2. The genetic differentiation in different generation of culture population after transplantation to China from the U.S. and the relationship between the genetic variation and traits
3. Selective breeding based on the size and relative body weight and establishment of self-fertilization and crossing between different populations
4. Screening of OTLO genetic markers

Dr. Ximing Guo will work for 1-2 weeks in China, and one scientist from China will visit Dr. Guo's lab for 6 months.

U.S. contact: Dr. Ximing Guo, Rutgers University
Chinese contact: Professor ZHANG Guofan, Institute of Oceanology, CAS

C. Shellfish disease

Dr. Fulin Chu will be invited to visit China for 1-2 weeks to participate in scallop disease research. During his visit, Dr. Chu will discuss one Chinese scientist exchange to the U.S. to participate in a joint study on shellfish disease with her and Dr. Eugene Burreson of the Virginia Institute of Marine Sciences.

Chinese contact: Professor XIANG Jianhai, Institute of Oceanology, CAS
U.S. contact: Dr. Fulin Chu and Dr. Eugene Burreson, Virginia Institute of Marine Sciences

D. Culture potential of Crassostrea ariakensis in the mid-Atlantic region of the U.S.

The Aquaculture Genetics and Breeding Technology Center (ABC) of the Virginia Institute of Marine Sciences was established in 1997 with Dr. Stan Allen as Director. ABC is one of only a few facilities in the world which concentrates primarily on shellfish breeding approaches. ABC is taking a number of tacts to shellfish breeding including breeding for disease resistance in oysters, developing molecular genetic markers for mapping studies, evaluating strains of hard clam (*Mercenaria mercenaria*), and continuing studies with chromosome set manipulations especially with non-native species.

One of the most important projects for ABC, and perhaps for the whole mid-Atlantic region, is looking at the culture potential of the Jinjiang oyster, *Crassostrea ariakensis* (formerly *rivularis*). This species is widely cultured in China and SE Asia and has shown promise as a culture species in the Chesapeake Bay where native oysters have been decimated by disease. Opportunities for collaborative work abound with this species. For example, the U.S. has little knowledge of the native ecology and biology of this species, but even so, it will have to be more or less redefined in the environment of the Chesapeake Bay. For these studies, triploids are used, and where triploids are useful, tetraploid technology is needed. ABC seeks to establish a program with our Chinese colleagues in studying the ecology of this species, in relation to triploids planted in Chesapeake Bay, that ABC envisions to be a multiyear, multi-institutional investigation utilizing the molecular, cytogenetic, population genetic, aquaculture, and breeding tools available at ABC.

U.S. contacts: Dr. Standish K. Allen, Jr., Virginia Institute of Marine Science
Mr. Lowell Bahner, National Marine Fisheries Service/NOAA
Chinese contacts: Professor QIU Dequan, Zhanjiang Ocean University
Professor WANG Aimin, Hainan University

Finfish

A. Introduction of Pacific threadfish (Polydactylis sexfilis)

From the previous exchange of mullet breeding, South China Sea Fishery Research Institute has obtained rich experience of marine fish reproduction. The Oceanic Institute in Hawaii has successfully reproduced Pacific threadfish for several years. Therefore, South China Sea Fishery Research Institute intends to learn about the breeding and growing technologies for this species and receive its fertilized eggs from the Oceanic Institute in Hawaii.

U.S. contact: Dr. Cheng-Sheng Lee, The Oceanic Institute
Chinese contact: Professor LI Jiaer, South China Sea Fishery Research Institute, CAFS

Algae

The **objectives** of these on-going collaborative research projects are: (1) to do comparative physiological and developmental research on select US and Chinese species and determine which species of *Porphyra* have the greatest nutrient removal abilities (from finfish and inorganic sources) under various conditions of irradiance, temperature, and water flow; (2) Continued cooperation on *Porphyra* seeding technology for the development of free conchocelis culture of US and Chinese for biomass production to support land-based integrated finfish/seaweed culture; (3) Continue to work on developing a small, pilot-scale, Chinese-US style nori farm in US coastal waters using New England *Porphyra* species in conjunction with the Bridgeport Regional Vocational Aquacultural High School and the University of Connecticut; and (4) and develop a working group to share information on the establishment of a land based model for an integrated fish/seaweed recirculating aquaculture system.

The **benefits** of the proposed field and culture study are: to increase our understanding of the growth potential of American *Porphyra* species that are closely related to economically important sister species in Asia and develop a pilot-scale nori farm at Bridgeport Regional Vocational Aquaculture School. This work will also supplement current Chinese and US supported research in developing land-based integrated polytrophic culture systems that will reduce the discharge of inorganic nutrients into coastal waters. Our studies are of particular importance for each country because the coasts already suffer eutrophication to a greater or lesser extent and the ability of sequestering and removing nutrients by aquaculture techniques has the potential to reduce noxious blooms of harmful algae and reduce "green tides." By developing land-based systems to capture N and P during the production of salable nori and biochemicals, operators of finfish and shellfish companies will be able to generate a product that more than compensates for their expenses.

Prof X.G. FEI of the Institute of Oceanology, CAS, will come to the US at least two times for a period of up to 6 months total to assist with *Porphyra* seeding technology. Prof. FEI has agreed to bring advanced Chinese patented technologies to the University of Connecticut. Prof. C. Yarish or a member of his staff (including a graduate student) will go to Ocean University and Yellow Sea Fishery Research Institute for a period of up to 3 months. A faculty member of Shanghai Fisheries University will be nominated to come to Bridgeport Regional Aquaculture High School and the University of Connecticut to support the development a Chinese small-scale demonstration nori farm for a period of up to 1 year depending upon funding availability.

U.S. contacts: Professor Charles Yarish, University of Connecticut
Dr. Shili Liu, University of Connecticut
Mr. John Curtis, BRVAS

Chinese contacts: Professor FEI Xiugeng, Institute of Oceanology, CAS
Professor HE Peimin, Shanghai Fisheries University
Professor TANG Xiaorong, Ocean University of Qingdao
Professor WANG Qingyin, Yellow Sea Fishery Research Institute,
CAFS

Harmful Algal Bloom (HAB)

A. Collaborative research on technology to address the HAB issue

Harmful algal blooms (the so-called red tides) have become a global problem in coastal zones

and have caused considerable damage to the economy and public health worldwide. It is no exception in China, which has a long coastline. Along with the rapid development of economy in China, eutrophication from aquaculture has steadily worsened, and the frequency of red tide incidents has increased several-fold during the last decade. In the 1990s, more than 200 red tide outbreaks were recorded. Between 1997 and 1999 alone, relatively large scale red tide outbreaks occurred as many as 45 times, spread out from Bohai and the Yellow Sea in the north down to the East China Sea and South China Sea, with economic losses totaling over 2 billion Chinese yuan (approximately US\$250 million).

The direct economic loss has mainly resulted from the mortality of fish and shellfish. It is urgent to make efforts on: 1) understanding of the ecological and oceanographic mechanism of HAB occurrence; 2) detection of HAB toxin; 3) prevention and control of HAB; and 4) prediction of HAB.

A monitoring network that allows detection of red tide events in their early development and pre-event warning based on water quality and phytoplankton biomass is critical for taking response measures and making coastal management decisions. The catastrophic economic loss associated with HABs is often attributable to the lack of knowledge about the development of HABs. The collaborative research interests are:

- Select one seriously impacted site (heavy aquacultural area) as a model system.
- Develop species-specific probes that will allow accurate identification and quantification of the potentially responsible species. Gene probes and antibodies can be produced within a 1-2 year period. Experimental methods and monitoring procedures developed in Lin's laboratory at University of Connecticut and other laboratories can be applied. In the meantime, nitrate/ammonium, phosphate, silicate, and organic matter will be measured.
- At the selected site, start the monitoring program, surveying both the potentially HAB species and major nutrient concentrations in the water column.
- Develop multi-species seaweed farming systems in the selected site, monitoring effects of such operation on dynamics of microalgae and nutrients.
- Expand the monitoring and remediation network to other impacted areas nationwide.

U.S. contacts: Dr. Senjie Lin, University of Connecticut

Dr. Charles Yarish, University of Connecticut

Chinese contacts: Professor ZHOU Mingjiang, Institute of Oceanology, CAS

Professor ZHU Mingyuan, First Institute of Oceanography, SOA

Professor WANG Qingyin, Yellow Sea Fisheries Research Institute,
CAFS

Dr. HE Peimin, Shanghai Fisheries University

Ecosystem Modeling

Management of Extractive and Fed Aquaculture Using Ecosystem Models

Integrated aquaculture that mixes fed and extractive species offers a balanced approach to aquaculture. The human tendency to adopt a successful technology and to expand the use of the technology until it exceeds the carrying capacity of an area severely complicates resource

management. Resource managers are caught between increasing economic goals and maintaining water quality. Integrated aquaculture and ecosystem modeling technology offer tools that can help aquaculturists and coastal resource managers address the difficult environmental questions (Rawson *et al.*, in press). However, the models must be adapted to each body of water. Our approach is to create scientifically valid ecosystem models for key aquaculture types, test the models and train local and regional managers to use the models in a variety of situations.

Integration of the fed and extractive components is an approach to aquaculture that seeks balance protection of the environment and increase total production. The positive environmental potential of integrated aquaculture has not been explored sufficiently nor have the scientific models to fully evaluate the consequences of management decisions been available until recently. This project will provide an ecosystem approach to integrating multiple aquaculture types into a coherent embayment-wide management strategy using three-dimensional hydrodynamic and water quality models. The key in integrating aquaculture is to determine the capacity of a body of water to sustain human activities. This assimilative capacity is the interaction of physical, chemical and biological factors.

The first step is determining the inputs and extraction of the organic matter and inorganic nutrients into a body of water. The interactions of the complex physical, chemical and biological processes are not completely understood, but substantial progress has been made. The techniques for simulating these interactions in ecosystem models also are improving rapidly (Chen *et al.*, 1999). In step two, the three-dimensional ecosystem modeling of coastal estuaries and embayments offers an excellent tool for integrating natural processes and simulating both negative and positive aspects of aquaculture. Step three is to suggest how three-dimensional models can be used to develop a management strategy and integrate that strategy into coastal management.

Ecosystem modeling and subsequent ecosystem management offers a strong over-arching approach to coastal and ocean management. This activity will be to create an ecosystem modeling and management as appropriate funding sources are identified.

The following objectives would be accomplished:

- Utilize ecosystem modeling to simulate the impacts of aquaculture and to simulate potential improvements through integrated aquaculture.
- Compare similar aquaculture approaches in key regions in participating countries.
- Develop management strategies that will allow resource managers to optimize aquaculture systems and conduct international symposium to discuss the management strategies.
- Create user-friendly model packages for resource managers for decision making
- Conduct educational aquaculture management workshops in the participating countries

U.S. contacts: Dr. Mac V. Rawson, University of Georgia

Dr. Changsheng Chen, University of Massachusetts-Dartmouth

Dr. Charles Yarish, University of Connecticut

Chinese contacts: Professor ZHU Mingyuan, First Institute of Oceanography, SOA

Dr. WANG Yan, Shanghai Fisheries University
Dr. WANG Daoru, Hainan Marine and Fisheries Research
Institute

Aquaculture educational exchange

Remote education

Making use of the existing equipment, initiative lecture series on ornamental aquaculture for the students of Bridgeport Regional Vocational Aquaculture School (BRVAS). The lecture will be in four sections. Shanghai Fisheries University (SFU) will provide course materials.

Time: The lecture will be once in 2002 and 2003, respectively.

In order to practice the remote education technology, SFU will open an online English course such as "Ichthyology" and "The Introduction of Fisheries". The directors from USA will instruct the students (The students can be not in BRVAS). The students will obtain certificates if they pass the course.

The field trip of students of BRVAS

BRVAS will organize the students to have a field trip to Shanghai. It will include the SFU Whale Museum, SFU Aquatic Biology Museum, and the related farming facility.

Academic exchange

2002 is the 90th anniversary of the founding of SFU. SFU will invite U.S. experts of ocean and fisheries to take part in the academic activities.

Education and Research cooperation

In 2002, SFU will designate scholars to take part in some related Sino-US scientific project. The highlight of cooperation is on marine pharmaceuticals and aquatic process. The U.S. can find the list and SFU will select suitable scholars. SFU will discuss the cooperating graduate education and exchange graduate education with related universities.

U.S. contact: Mr. John Curtis, BRVAS

Chinese contact: Professor ZHOU Yingqi, Shanghai Fisheries University

Data and Information

A. Data retrieval of historical pollock catches in the Central Bering Sea

At the Fifth Annual Convention of the Parties to the Conservation of Pollock Resources in the Central Bering Sea in Shanghai in 2002, the Parties to the Convention recommended that a common data base of historical pollock catches in the central Bering Sea be compiled. The central Bering Sea pollock fisheries developed quickly in the early 1980s and depleted the pollock stocks within fifteen years. During this period, the fisheries were not regulated since it took place in the international waters of the central Bering Sea. As such, the fisheries data were not properly compiled. As the pollock stocks came under intensive exploitation, an international Convention was signed to manage the fisheries. The AFSC has acted as a central point to retrieve and archive the data. The AFSC has researched previously reported data by China and would like to work cooperatively with China to review the data, verify them, and find missing data from the Chinese side.

The AFSC has made some funds available to work cooperatively with China to complete the central Bering Sea pollock fisheries data project. About US\$10,000 would be made available in 2002 for Chinese scientists to review the data compiled by the Alaska Fisheries Science Center and have Chinese experts find missing data from the Chinese Bureau of Fisheries and fishing companies that were involved with the historical pollock fisheries. The five companies that conducted the fisheries were from Shanghai, Dalian, Zhongshan, Qingdao, and Yantai. When completed, a data base of pollock catches by monthly periods, by statistical blocks (of 1 degree longitude by half degree latitude or smaller blocks), by vessel types and their fishing efforts will be computerized. The data will be structured for plotting by the SURFER 7 plotting program (www.goldensoftware.com).

The Chinese side expressed their support for the proposed project and would look into the data logs of Chinese fishing vessels which conducted the Pollock fisheries in the central Bering Sea during the 1980s and the early 90s. Professor Zhou Yingqi of Shanghai Fisheries University indicated that his university had conducted survey with some of the relevant fishing companies for reference of their logbooks. Professor Zhou also expressed his support for this Pollock fisheries data retrieval project by having his university's students decode and retrieve the possible data from additional relevant fishing companies. Both sides agreed to cooperate on the Pollock fisheries data retrieval project.

U.S. contact: Dr. Loh-Lee Low, AFSC/NMFS/NOAA

Chinese contact: Professor ZHOU Yingqi, Shanghai Fisheries University

B. Introduction of Chinese fishery websites

In China, there are over 400 fishery websites built by government, research institutes, universities and enterprises. Among them there are 20 key comprehensive websites and over 100 key commercial websites. The information in these websites includes statutes, developments, scientific research, resource, environment and a lot of commercial information on Chinese fisheries. Both parties agreed to cooperate to update the U.S-China LMR website. One Chinese website and data expert will work in the NOAA Library in Silver Spring, Maryland, USA, for approximately six (6) weeks. The date and time for the visit will be decided through correspondence.

Chinese contact: Professor YANG Ningsheng, Information Center, CAFS
U.S. contact: Ms. Eileen McVey, The NOAA Library

NMFS Aquaculture Research and Management

Research in both countries seeks to provide the scientific bases for further enhancement and commercial activities with species not currently being cultured as well as support for existing industries. Specifically this research addresses these issues:

1. Development of culture systems (including engineering, feeds, and hatchery) for marine organisms;
2. Biology and physiology of culture species especially dealing with development, growth and reproduction;
3. Affects of released organisms on ecology and genetics of receiving ecosystems and populations; and
4. Environmental impacts and standards for marine aquaculture.

Research from both countries is needed to provide information to develop environmentally-sound science-based policy and management approaches. Both countries can benefit from exchange of knowledge and approaches and developing sustainable and environmentally-sound aquaculture industries.

Both parties agreed to pursue collaborative efforts with scientists and policy makers from both countries mutually agreeable. This could include scientist or technician visits, exchanges and/or integrated research projects.

U.S. contact: Dr. Michael Rust, Northwest Fisheries Science Center/NMFS/NOAA
Chinese contact: Mr. LI Yingren, Chinese Academy of Fishery Sciences

Strategic Planning Team for Living Marine Resources Panel

During the course of the 5th LMR meeting, both sides agreed that the LMR Panel needed to develop a vision and efficient and effective implementation plan for the future. It is recommended that each side identify 4-6 top scientists and administrators to develop a vision and a five-year action plan for the future activities of the LMR Panel. This document should be completed by June 2003. The plan should cover where aquaculture and fisheries sectors will likely be moving over the next decade and what aquaculture and fisheries project priorities both countries will mutually concentrate on.

U.S. contact: Dr. James McVey, U.S. Chairperson
Chinese contact: Mr. ZHANG Xianliang, Chinese Chairperson