

# REPORT OF FISHERY SCIENCE COMMITTEE



## Approval of agenda

The meeting was opened by the Chairman, Prof. Chang-Ik Zhang. The meeting agenda was reviewed and approved by all members. The Chairman appointed Dr. Anne B. Hollowed as rapporteur.

The FIS Committee welcomed four new members: Dr. Jang-Uk Lee (Korea), Dr. Michael A. Henderson (Canada), Dr. Douglas E. Hay (Canada) and Dr. Akihiko Hara (Japan).

The Committee briefly discussed the results of the IP and the REX Task Team Workshop on Climate Change and the Carrying Capacity.

## Review of WG 12 Report

Dr. Robert Otto summarized the activities of WG 12. He submitted an interim report of the Inter-sessional workshop on Crab and Shrimp held in Nemuro, Japan, September 9-18, 1997. Dr. Otto discussed several recommendations and concerns from WG 12:

1. WG 12 requests that PICES co-sponsors the ICES-NAFO joint Special Session: Pandalid Shrimp Symposium in 1999.
2. WG 12 requests funds for a second 4-day interim workshop in 1998.
3. WG 12 noted their concern regarding non-commercial species for which there is limited information. Several of these stocks could potentially be commercially exploited.
4. WG 12 noted that their working group would benefit from the participation of scientists from all PICES regions including China and North Korea. Dr. Qi-Sheng Tang noted that the Chinese member of WG 12 has been working in New Zealand and will remain there for 2 years. He will assist WG 12 in identifying a replacement for the Chinese representative on the WG. Dr. W. Doug McKone noted that PICES made several attempts to improve participation by N. Korea in PICES. So far these attempts have been unsuccessful.

The major accomplishments of WG 12 were summarized. WG 12 prepared a comprehensive review of the major crustacean stocks in the North Pacific. The group identified the major zoogeographic provinces where crustacean species are found. Several members of the WG participated in the REX Workshop and assisted in identifying the major areas for retrospective studies. Future WG 12 activities will focus on: a) processes underlying production of crustacean populations, b) comparative analyses of the variety of life history strategies used by crustacean stocks in the North Pacific, and c) methods of assessing crustacean stocks.

FIS Committee members reviewed the interim report:

1. It was noted that if possible, draft reports should be submitted prior to the next FIS meeting.
2. The FIS Committee endorsed the proposal by WG 12 for PICES' co-sponsorship of the ICES and NAFO Joint Pandalid Shrimp Symposium.
3. FIS encouraged participation of North Korean scientists in WG 12.
4. FIS encouraged Chinese scientists to participate in WG 12.
5. FIS recommended that the next interim meeting of WG 12 should be located in the western Pacific. The Chairman of WG 12 in consultation with the PICES Secretariat will determine a suitable location for this meeting.
6. FIS accepted the revised terms of reference for WG 12.
7. FIS accepted the interim report of WG-12 for publication in the PICES 1997 Annual Report.

## WG 3 Inventory

The status of the WG 3 inventory was reviewed. Dr. McKone noted that all information has been received and will be put on the web page in the near future.

### **Scientific activity in the CCCC Program**

Ms. Pat Livingston (Co-Chairman of the CCCC Implementation Panel) reviewed the CCCC Implementation Panel recommendations for scientific sessions in 1998.

1. POC and the BASS Task Team requested a joint symposium on identification of impacts of the 1997-98 El Niño event for the PICES VII Annual meeting.
2. The REX Task Team requested a scientific session that highlights research findings of GLOBEC and GLOBEC-like programs for the PICES VII Annual Meeting.
3. The REX Task Team recommended a two-day symposium on climate effects on small pelagic species to be convened prior to the PICES VII Annual Meeting in Fairbanks, Alaska.
4. The MODEL Task Team recommended that a small follow-up meeting on lower trophic level modeling should be convened prior to the PICES VII Annual Meeting.

FIS supported the proposal for a Science Board symposium on the 1997-98 El Niño to be sponsored by POC and the BASS Task Team. Dr. Gordon Kruse (FIS) will identify an individual with a background in fisheries science who will serve as co-convenor for this symposium.

FIS endorses the proposal for a REX symposium on small pelagic species and climate change in the North Pacific to be convened prior to the PICES VII meeting in Fairbanks, Alaska.

FIS approves the Model Task Team proposal to convene a small workshop on lower trophic level modeling.

FIS recommended that time should be set aside for the CCCC Program to hold scientific sessions. FIS recommended that the topic session for 1998 should be research findings of GLOBEC and GLOBEC-like interdisciplinary research programs in the North Pacific. FIS

recommended that the time allotted to FIS and the CCCC should be combined to allow for a one-day topic session on GLOBEC and GLOBEC-like research programs.

FIS reviewed four suggestions by Dr. M. Stepanenko:

- a. Provide a list of research institutes that conduct CCCC programs.
- b. Determine coordinators from each national institute.
- c. Present national research programs connected with fisheries.
- d. Establish a WG on the coordination of stock assessment activities, inventory assessment methods and determination of priority of methodology development

FIS recognized that items a and b were already being conducted by the CCCC program. FIS agreed to consider the request for lists of national research programs connected with fisheries. However, FIS requests that Dr. Stepanenko specify the kind of marine research programs that should be listed. FIS believes that some of these programs are already identified, but other programs are not normally listed as activities of the CCCC program. Item "d" was considered by FIS under agenda item 4.6.

### **SCOR Working Group 105 activity**

FIS Chairman Prof. Zhang reviewed the report of the activities of the SCOR WG 105.

1. FIS recommends that PICES should provide funds for the FIS Chairman to participate in the next meeting of the SCOR Working Group in Hobart, Australia, January 1998.
2. FIS encourages participation of PICES members in the SCOR-ICES joint symposium on ecosystem effects of fishing, March 16-19, 1999, in Montpellier, France.

### **NPAFC proposal**

FIS discussed the following proposal by NPAFC submitted by Dr. Loh-Lee Low. NPAFC asked PICES about the possibility of adding fisheries catch statistics of non-anadromous fish to the

NPAFC statistical yearbook. FIS supports NPAFC's suggestion to produce a database of fishery statistics for all PICES member nations. FIS also encourages PICES Governing Council to identify a mechanism for data exchange.

### **New Working Groups**

FIS reviewed four proposals for the development of new working groups. Dr. Jeff Napp presented a proposal for the development of a WG on micronekton (jointly sponsored by BIO). Richard Beamish described his proposal for a working group on climate change and shifts in fish production. Dr. Radchenko reviewed the proposal by Dr. Stepanenko for a working group on stock assessment and methodology development. FIS recommended that no new Working Groups should be formed until WG 12 is closer to completing their activities.

### **Future symposia**

FIS recognized the success of the joint BIO/FIS symposium on micronekton. FIS encourages the symposium organizers to convene an inter-sessional workshop to follow-up on selected aspects of micronekton studies. FIS recommended that the inter-calibration and sampling standardization activities proposed could be considered by the CCCC Monitoring Task Team (if approved).

### **Best Presentation Award**

FIS decided that the voting for FIS Best Presentation Award would be just after the FIS Paper Session on the 23<sup>rd</sup>. The Award went to Dr. Jin-Yeong Kim for her presentation titled "Spawner-recruit relationship of anchovy, *Engraulis japonica*, and its environmental factors in the southern waters of Korea".

### **Scientific Program**

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

*Models for linking climate and fish.* (FIS/BIO)

Co-conenors: Michio J. Kishi (Japan, Jang-Uk Lee (Korea) & Patricia Livingston (U.S.A.)

G.H. Kruse. Unraveling relationships between marine environments and fish recruitment: A review of approaches, pitfalls, and potential solutions

J.H. Cowan, Jr., K.A. Rose. Linking climate and fish population/community dynamics: examples of the individual-based modeling approach

M. Kawamiya, M.J. Kishi, N. Suginozawa. Mechanisms of the seasonal variation of chlorophyll in the North Pacific: A study using an ecosystem model embedded in an ocean general circulation model

K.L. Denman, M.A. Pena. A coupled 1-D biological / physical model of the subarctic Pacific Ocean with Ekman upwelling and iron limitation

J.G. Je, R. Ji, W.S. Kim, M.Y. Zhu, S.J. Yoo. Modeling approaches for estimation of carrying capacity in marine ranching system

S. Ito. An estimation of spawning grounds of skipjack in the tropical western Pacific using an OGCM

T. Wada. A population dynamic model for Japanese sardine (*Sardinops melanostictus*) with a positive feed back loop

S.R. Hare. Prewhitening: a cure for the common correlation

R.I. Perry, J.A. Boutillier. Recruitment fluctuations in smooth Pink shrimp (*Pandalus jordani*) off the coast of British Columbia and their relationships with climate variability

B.A. Megrey. Using nonlinear statistical analysis to examine relationships between features of the environment and recruitment variation in walleye pollock

V.V. Navrotsky. The impact of long-term climate variability on exploited prey-predator system

D.W. Welch, B.R. Ward, B.D. Smith, F. Whitney. Changes associated with the 1989-90 ocean climate shift, and effects on British Columbia steelhead (*O. mykiss*) populations

*FIS Committee Paper Session:*

- W.S. Yang, C.I. Baik, S.S. Kim, S.G. Choi, T.Y. Oh, D.N. Kim. Results of the Bering Sea walleye pollock survey by the Korean RV Pusan 851 during May-June 1997
- M. Hirai, T. Goto. Hydrographic structures and their fluctuations of spawning grounds for sardine, *Sardinops melanostictus* in the southern Japan Sea
- M. Tokimura, H. Yamada, K. Yamamoto. Distribution and stock condition of major groundfishes in the East China Sea and the Yellow Sea from bottom trawl survey
- D.N. Kim, C.I. Baik, S.Y. Hong. Distribution pattern of brachyuran and anomuran larvae in the southeastern Bering Sea in June 1995
- I.J. Yeon, C.I. Zhang. Growth and mortality of blue crab, *Portunus trituberculatus*, in the East China Sea
- J.Y. Kim, J.U. Lee. Spawner-recruit relationship of anchovy, *Engraulis japonica*, and its environmental factors in the southern waters of Korea
- X.S. Jin. Variations of fish community structure in the Yellow Sea and the Bohai Sea
- D.Y. Moon, C.I. Baik, J.H. Park, S.J. Hwang, J.B. Kim, H.S. Jo. Incidental catch of juvenile northern bluefin tuna in waters off Korea

## Endnote 1

## Participants

### Canada

Richard J. Beamish  
 Gordon A. McFarlane (for Michael Henderson)  
 Douglas Hay

### China

Qi-Sheng Tang

### Japan

Tokio Wada  
 Akihiko Hara

### Korea

Jang-Uk Lee  
 Suam Kim  
 Chang-Ik Zhang (Chairman)

### Russia

Vladimir I. Radchenko  
 Mikhail Stepanenko

### U.S.A.

Loh-Lee Low

## Endnote 2

### Report of Working Group 12 Crabs and Shrimps

#### Introduction

Working Group 12 (WG 12) held its interim meeting in Nemuro, Japan during the week of September 9, 1997. This was the second meeting of WG 12 but the first in which both North American and Asian members were present. The meeting was facilitated and supported by the City of Nemuro and held at the Nemuro Cultural Center which provided an excellent venue and services.

The working group noted that the PICES region provides approximately 65% of the world's crab landings and 23% of world shrimp landings according to United Nations Food and Agricultural organization statistics (UN/FAO). However large portions of crab and shrimp landings are not identified to species and expertise at the national level is necessary to identify stocks.

The main purposes of the interim meeting were to identify stocks of crabs and shrimps in the PICES region (generally north of 33° North Latitude) and to review trends in abundance. Trends in abundance were cross referenced to zoogeographic provinces to reveal regional patterns. These patterns served as the basis for discussing hypotheses as to the causes for observed trends.

#### Participants

##### Canada

Jim Boutillier  
Glen Jamieson

##### Japan

Hideo Sekiguchi

##### Korea

Sung-Yun Hong  
In-Ja Yeon  
Chang-Ik Zhang (Chairman, FIS)

##### Russia

Boris Ivanov

Vitaly Rodin (Co-Chairman)  
Yuliya Zaitseva

##### U.S.A.

David A. Armstrong  
Robert S. Otto (Co-Chairman)

##### Observers

Makoto Kashiwai (Chairman, Science Board)  
Yutaka Nagata (PICES/CCCC Co-Chairman)  
J. Kittaka (Science University of Tokyo)  
Dr. F. Abrunhosa (Science University of Tokyo)  
E.V. Radhakrishnan (Regional center CMFRI, India)  
S. Ivanov (TINRO, translator)  
J. Armstrong (University of Washington)

Attendance at the first WG meeting (1996) was low (Otto, Armstrong, Boutillier and Jamieson). The 1997 attendance was hence a large improvement. While the meeting was successful in this regard, WG 12 members unanimously agreed that it was desirable for scientists from China and North Korea to attend future meetings.

Landing statistics (UN/FAO, 1991-1994) indicate that about 72% of crab landings and 81% of shrimp landings in the PICES region come from Chinese or North Korean waters. WG12 also noted that, due to their trans-boundary nature, the status of several major stocks could not be described without the advice of scientists from China and North Korea.

#### Review of Terms of Reference

WG 12 considered the terms of reference at the 1996 interim meeting and made recommendations as to changes in them. WG 12 recommendations were not formally acted upon by FIS. Additionally, in 1997 we received information on the Japanese spiny lobster that indicated some importance in the PICES area and further note omission of the California spiny lobster. Accordingly and including 1996

recommendations, **WG 12 proposes the following terms of reference:**

Working Group 12 is established to:

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

Reasons for changes in the Terms of Reference are given in last year's report.

### **Review of status of crab and shrimp stocks**

#### **A. Overview**

The PICES region contains large proportions of the world's crab and shrimp resources. Unfortunately, it is not possible to precisely deduce the importance of these resources from UN/FAO statistics. The PICES region encompasses all of FAO Area 61 (Northeast Pacific), a small part of Area 71 (Eastern Central Pacific) and most of Area 67 (Northwest Pacific). As an approximation, landings from the PICES region would include all landings in Area 61, only U.S. landings from Area 71 and summed landings from Chinese, Japanese, North Korean, South Korean and Russian marine waters from Area 67. This overestimates the importance of the PICES region unless Chinese

waters south of 33° North Latitude are provisionally included. Taken in this way, for the years 1990-1994 the PICES region provided 65% of world crab landings and 23% of world shrimp landings.

Reported crab landings in the PICES region increased at an average rate of 28% per year from 1990 to 1994 while those of shrimp were stable. Most growth in crab fisheries took place in China which accounted for 70.8% of PICES region landings over the years from 1990 to 1994. Unfortunately, 70.8% of Chinese landings are listed as unspecified ("nei") crabs. Some apparent increases in landings may be due to improved reporting. It also unclear what proportion of landings derive from aquaculture as opposed to harvest of wild stocks. Similarly, UN/FAO statistics list only unspecified crustaceans for North Korea. By consequence, nothing is known of stocks or stock structure in Chinese waters and the nature of trans-boundary stocks in the Yellow Sea (China-North Korea-South Korea) and the Sea of Japan (Japan-North Korea-South Korea-Russia) is poorly known.

General North Pacific zoological provinces described in Allen and Smith (1988, NOAA Tech. Rept. NMFS 66) for finfish were found useful by WG 12 and served to structure many of its discussions. These apply to shelf and mesobenthic (200 - 500 m) slope waters only, since zoogeographic provinces in deeper waters are not necessarily the same.

A compendium of 170 overhead projector transparencies that were presented during the meeting was collated and distributed to WG 12 to serve as a basis for future discussions and planning for a subsequent meetings. A brief synopsis of discussions for major stocks follows.

#### **B. Stocks and research approaches and opportunities for experimentation.**

##### **1. Crabs**

Dungeness Crab (*Cancer magister*) have cyclic populations north of central California, with peaks and troughs every 8-10 years. Landings 1970-1996 minimum 5,000 t (1974) to maximum of 26,000 t (1977). A collapse of

central California stock occurred 1956-1970 with little recovery since. British Columbia landings are more consistent from year to year and do not display cyclic patterns observed in California to Washington fisheries. Alaskan landings are not in synchrony with contiguous 48 states of the U.S. or with Canada and landings may be market driven over some portions of the historical series. Since patterns differ between zoogeographic provinces, comparative studies may provide insight into mechanisms of population control.

Hypothesized environmental and ecological effects include elevated temperatures, nemertean worm predation on clutches, salmon predation on larvae, and various cyclic phenomena (cannibalism, upwelling, wind stress, geostrophic flow, fishing effort). Habitat and fishing impacts that effect stocks include dredging to maintain navigation channels and for landfills, foreign species introductions (i.e. green crab, *Carcinus maenus*, competition with Dungeness), ghost pot fishing and fishery handling of sublegal males and females. Fishery selects the largest males and there is the possibility of females not getting bred.

The list of factors used to explain changes in Dungeness crab populations is a fair sampling of factors that are thought to control crab populations in general. Additionally, predation on adults, parasitism and epizootic diseases are known to be important in a number of king and Tanner crab populations.

Four species of king crabs are subjects of major fisheries in the PICES region. They differ in their life history characteristics and hence provide for comparative study of the effects of life history characteristics on population stability. For example, red king crab (*Paralithodes camtschaticus*) are annual spawners with relatively high fecundity and small eggs, while blue king crab (*P. platypus*) are biennial spawners with lesser fecundity and somewhat larger eggs. Both species inhabit the Pribilof Islands and other areas where their dynamics may be explored. Throughout most of the Gulf of Alaska and eastern Aleutians, red king crab populations declined in phase from the

late 1970s until fisheries were closed in 1983. Populations have been at low levels and fisheries have remained closed since 1983. Populations declines soon after the well recognized regime shift of the late 1970's and offer opportunities for retrospective study as well as comparative study with Asian populations that have differing patterns of abundance over time. Comparative study of Bristol Bay and west Kamchatkan populations may be particularly instructive.

Tanner (*Chionoecetes bairdi*) and snow (*C. opilio*) crabs have broad distributions across several zoogeographic provinces and provide research opportunities similar to those for king crabs. Snow crab range from the Beaufort sea to the sea of Japan and also occur in the northwest Atlantic. Since the snow crab inhabits several zoogeographic provinces and its life history is well known, the species presents excellent possibilities for comparative retrospective analysis. Deep water members of the genus are less well known although there are developing fisheries in both Asia and North America. For example, the Japanese Tanner crab or beni zuwai gani, *Chionoecetes japonicus*, is fished in Japanese, South Korean and possibly North Korean waters. Data as presented by the Korean delegates caused some concerned discussion. There appear to be no regulations on this fishery currently, although large catches, 33,000 MT annually and increasing, are reported. In perspective this is the largest known catch of a deep water (>200m) crab species.

The gazami crab (*Portunus trituberculatus*) provides the largest crab fishery in the PICES area. It is found in the Yellow and east China sea in close association with penaeid shrimps. This part of the PICES area has a more tropical fauna than the remainder of the region and provides an opportunity to compare the dynamics of crustaceans from temperate or boreal areas with tropical forms. The two faunal groups are separated only by the Korean Peninsula and hence provide a unique opportunity to study comparative effects of climatic variables.

## 2. Shrimps

Pandalid shrimps are protandric herma-phrodites and larger, older individuals that support fisheries are mostly mature females. Two species dominated trawl fisheries. Ocean pink shrimp, *P. jordani* are distributed from northern California to British Columbia and northern pink shrimp, *P. borealis*, are distributed from British Columbia to the Bering sea. Alaskan trawl fisheries also included *P. goniurus*, *P. hypsinotus*, *P. platyceros* and *Pandalopsis dispar*.

Pandalid shrimp populations and fisheries in Alaska collapsed in the late 1970's and most fisheries remain closed. Very small trawl fisheries for side striped shrimp, *Pandalopsis dispar*, and pot fisheries for spot prawns, *P. platyceros*, still persist in some areas. Spot prawns also are an economically important fishery in British Columbia. The collapse of the pandalid shrimp complex in Alaska was concurrent with the late 1970's regime shift and a sharp increase in predator populations, particularly Pacific cod (*Gadus macrocephalus*) populations. Landings of ocean pink shrimp also declined sharply in the late 1970s and reached their lowest levels in 1983, but in contrast with northern pandalid shrimps, have increased since. Landings of *P. jordani* have undergone two cycles between 1970 and 1995. The recovery of *P. jordani* contrasts sharply with pandalids to the north and is a good topic for retrospective study. Pandalid shrimps occur in the western Bering Sea, the sea of Okhotsk and in the Sea of Japan as far west as Korea providing additional possibilities.

Four species of penaeid shrimps are important in the Yellow Sea. Several of these species are found in southern Japan as well. Peneid shrimps differ from pandalids in that they are not hermaphroditic, are semelparous rather than multiparous and are short lived. Most species complete their life spans in less than two years and frequently within one year, while pandalid shrimps typically live for at least three years and frequently for 7-8 years in northern populations.

There are two stocks of the fleshy prawn, *P. chinensis*, in the Yellow Sea. The Pho Hai Bay stock in Chinese waters and the Korean coastal group both hibernate in the southern Yellow Sea during February and March but return their coastal spawning grounds in spring. The Korean coastal stock spawns April to June, and is fished from September through April. This stock provided the bulk of the Korean shrimp catch during the years 1987 to 1996. Other important penaeid species (*P. japonicus*, *Metapenaeus joyneri*, *Trachypenaeus curvirostris*) differ considerably in their life history patterns and offer opportunities for comparative studies of environmental effects on recruitment. A joint Korean-Chinese study of stock recruitment relationships in the Yellow Sea is being planned. This study would likely be profitable and has the advantages of occurring in a well defined semi enclosed body of water, and with short lived species for which results of comparative studies or experiments become available quickly.

### Plenary Session

#### A. Recommendation as to the International Pandalid Symposium

Sponsored by ICES and NAFO - seeking joint sponsorship by PICES. The last workshop was in Iceland in 1993 and before that in Kodiak in 1979.

Proposal: The convenors want it to be a world-wide conference, could offer a show of support/advertise the event. It will be paid for by the shrimping industry so no financing is being sought. They hope to make the conference a special session of the regular NAFO meetings scheduled for Sept. 1999 in Halifax, Nova Scotia. Mr. Jim Boutillier was asked to serve as the WG 12 representative to these meetings.

B. Scientists from North Korea are asked to participate in this WG 12. Three to four scientists from N. Korea are expected to participate in the science board group at the next meetings. We ask for participation in WG 12 and a recommendation to that effect will be presented.



C. Requesting participation of Chinese delegates. There has been no response from the Chinese delegates as to the last 2 meetings of WG 12. The WG 12 will submit a letter to Mr. Sheng-Min Ren requesting the following: species composition of Chinese catches, proportion provided by aquaculture, catch and effort trends for the primary crab and shrimp species or stocks. We will also solicit opinions as to reasons for observed trends, concerns about pollution or demographic growth impacts.

A copy of the 1997 meeting compendium of information will be provided to illustrate the types of information WG 12 has been considering.

D. Accepted Terms of Reference with additions. We request that the FIS formally consider our revised Terms of Reference, and

either adopt them or provide guidance as to how they should be changed.

E. How to proceed in the future?

1. Suggestion of an Interim Meeting. Time of year to be held was discussed respecting conflicts with other meetings held in Europe mid-July, and travel difficulties expressed by several delegates. It is recommended that the possibility of the Chinese hosting the next interim meeting be discussed with FIS. Otherwise all seemed to agree that August next year is the best meeting time.
2. The 1998 interim meeting should focus on the following:
  - a. Oceanography and recruitment processes (2 days)
  - b. Sampling problems/data analysis, fishery independent sampling (2 days)