

KORDI/PICES/CoML Workshop on “Variability and status of the Yellow Sea and East China Sea ecosystems”

Sinjaee Yoo
Marine Living Resources Research Division
Korea Ocean Research & Development Institute
Sa-dong 1270, Ansan,
Republic of Korea. 425-600
E-mail: sjyoo@sari.kordi.re.kr

Dr. Sinjaee Yoo is the Director of Marine Living Resources Research Division in KORDI (Korea Ocean Research & Development Institute) and is based in Ansan, Korea. Sinjaee received his B.S. and M.S. in Oceanography from the Seoul National University, and his Ph.D. in Ecology and Evolution from the State University of New York at Stony Brook. He has been involved in various research projects including the Yellow Sea Large Marine Ecosystem. He was a panel member of IOCCG and Coastal-GOOS. Over the years, Sinjaee has been involved with PICES, serving on the Biological Oceanography Committee and the MODEL Task Team. His research interests include long-term change in primary production and phytoplankton dynamics in various marine environments.

Background

The Yellow Sea and East China Seas (YS-ECS) are epicontinental seas (Fig. 1) bounded by the Korean Peninsula, mainland China, Taiwan, and some Japanese islands (Ryukyu and Kyushu). Presumably, the YS-ECS ecosystems, with dense population living along the coasts, are amongst the ecosystems in the Pacific that are under the strongest influence of various human activities, such as fishing, mariculture, waste discharge, dumping and habitat destruction. There has also been strong evidence showing a gradual increase in the water temperature in the past decades. Given the variety of forcing factors, complicated changes in the ecosystem are anticipated. Indeed, rapid change and large fluctuations in the species composition and abundance in the major fisheries have occurred. In this respect, it was timely that the YS-ECS ecosystem status was evaluated as a part of the PICES and Census of Marine Life (CoML) efforts of status assessment of the North Pacific Ecosystems. A workshop for this purpose was scheduled in April 2003, to gather scientists who have been working in this region and to discuss and summarize what they learned about the YS-ECS ecosystems during the past. Many scientists expressed interests in participating in the workshop, however, the workshop was postponed twice due to the outbreak of SARS in the spring of 2003. The workshop was finally held October 9, 2003, immediately prior to the PICES Twelfth Annual Meeting in Seoul, and convened by Drs. Sinjaee Yoo and Hyung-Tack Huh (KORDI), and Skip McKinnell and Ian Perry (PICES). A draft chapter on the status of YS-ECS ecosystems for the PICES North Pacific Ecosystem Status Report (NPESR) was written before the workshop based on the contributions



by Drs. Hiroshi Ichikawa, Xian-Shi Jin, Young-Shil Kang, Suam Kim, Jai-Ho Oh, Sinjaee Yoo, and Chang-Ik Zhang, instead of after the workshop as was originally planned. This way, the workshop was more focused on the discussion of the draft.

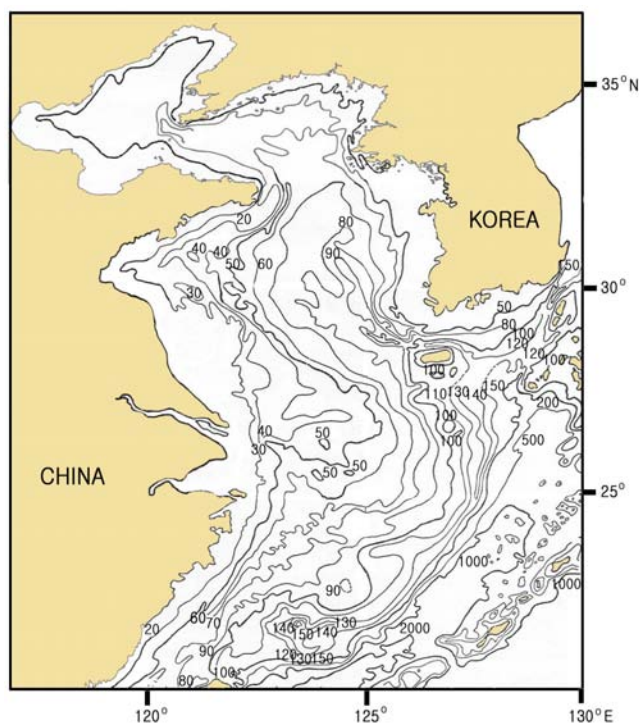


Fig. 1 Geography and bathymetry of the Yellow Sea and the East China Sea.

Overview of presentations

About twenty scientists from all PICES member countries participated in the workshop. Since the workshop was more focused on revising the draft chapter, presentations and discussion were done in a very informal fashion. Dr. Ian Perry (Chairman of PICES Science Board) gave a general introduction to the NPESR project. The objectives, structure and target audience of the report were briefly explained.

Dr. Sinjae Yoo (Republic of Korea) presented the outline of the draft for the YS-ECS chapter. First, geography, topography, circulation, flora and fauna of the region were described as background information. Next, potential critical factors causing change in the YS-ECS ecosystems were identified: environmental contamination, eutrophication, habitat destruction, overexploitation, and changes in the circulation. In addition to climate-related change in the circulation, the building of the Three-Gorges Dam in the upper reaches of the Changjiang River could bring changes to the ecosystem. Possible adverse effects were pointed out such as a decrease in the primary productivity in the vicinity and reduced flushing in the YS. Then, details were described for physics, climate and chemistry of the region. There has been an increase of 1.8°C in the water temperature in February in the seas around Korea during the past one hundred years. The rate of change became greater during the past decade. The nutrient loads into the sea have more than doubled during the last two decades. Data of heavy metals, PCBs, PAHs, and other persistent organic pollutants were shown. Phytoplankton species composition and primary productivity of the region were discussed next. There seem to be still uncertainties in the primary production estimates for both the YS and ECS. It seems interesting that both phytoplankton and zooplankton biomass increased in the YS since the late 1980's (Fig. 2).

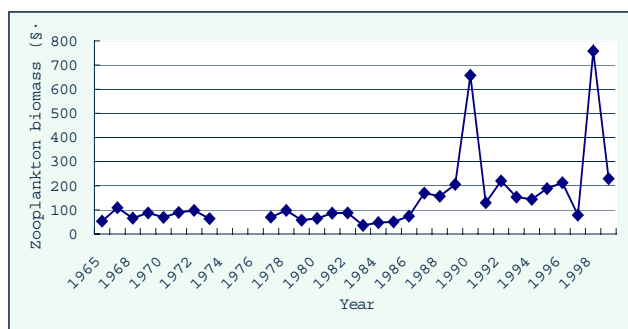


Fig. 2 Time series of average annual zooplankton biomass (mg/m^3) in the eastern Yellow Sea (from bi-monthly surveys during 1965-1999, data by Y. S. Kang).

Another sign of ecosystem change is the abrupt increase in the HAB incidences in Chinese and Korean waters causing

huge economic damages. Concurrently with the changes in the physics, chemistry and lower trophic level, there have been dramatic changes in the higher trophic level in the YS and ECS as evidenced by fisheries data in the past three decades. Such changes can be summarized as follows. First, declines in biomass and catch of demersal species have occurred, and as a result, pelagic species have increased in catch proportions, while demersals have decreased. Second, the catch of pelagics species showed large fluctuations. Third, the average trophic level of fishery catches has gradually decreased, more rapidly in the YS than in the ECS (Fig. 3). Following fisheries data, a brief description was made on the endangered species in the YS.

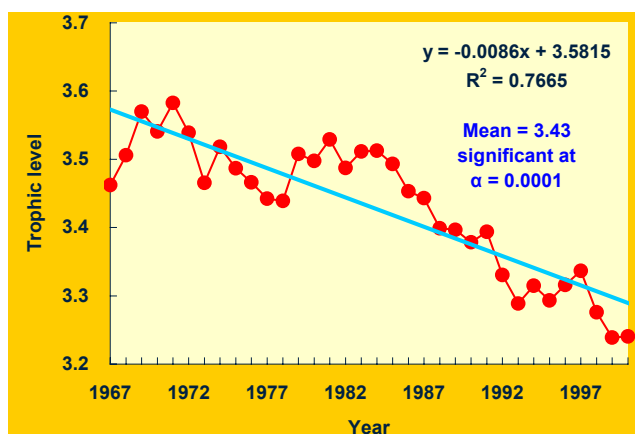


Fig. 3 Time series of average trophic level from the catch of resource organisms in the Yellow Sea (data by C.I. Zhang)

After the presentation of the draft outline, talks were given for each area ranging from climate and physics to fisheries. Dr. Jai-Ho Oh (Republic of Korea) reported on long-term changes in the air temperature in Korean cities. He showed that there has been an increase of 0.11–0.23°C/decade since the 1910's at eight cities. The number of summer days increased by 22, while the number of winter days decreased by 27 days, showing a clear trend of warming. He also presented projections of future acceleration in the temperature rise using the regional climate MM5 model.

The next two presentations were on physical oceanography of the region by Drs. Heung-Jae Lie (Republic of Korea) and Hiroshi Ichikawa (Japan). Dr. Lie discussed the origins of the Jeju Warm Current and Tsushima Warm Current, and seasonality of the coastal currents. Using drifter data, he showed that the Tsushima Current branches from Kuroshio along the shelf edge of the ECS. In the YS, strong cyclonic circulation develops along the coasts in summer, while in winter, southward currents develop along both Chinese and Korean coasts. Dr. Ichikawa summarized the general characteristics and forcing of the regional currents. His talk focused on the inter-annual variation in the Changjiang (Yangtze) River discharge and its influence

on the oceanographic properties in the vicinity. Classification analysis of water masses in the ECS using T, S, nutrients and chlorophyll-*a* was also presented.

After presentations on the physics and climate in the morning session, talks on chemistry and biology followed in the afternoon. Dr. Jae-Ryoung Oh (Republic of Korea) showed results of the pollution surveys in the YS in 2000. Heavy metals, and organochlorine compounds including pesticides, PCBs and PAHs were analyzed from samples of sediments, tissues and liver of fish. Except for a few hotspots, in most of the samples the level of these pollutants was below the known safe values. However, there are no criteria for safety for some chemical species and continued monitoring is necessary.

Dr. Xian-Shi Jin (People's Republic of China) presented Chinese records of dominant species of phytoplankton, zooplankton, and major fisheries species in the YS, ECS and Bohai Sea. The trend of major fisheries species composition paralleled that which was observed in the Korean waters, *e.g.*, pelagics increased while demersal decreased. As an example of large fluctuations in the pelagics, he described the case of Japanese anchovy (*Engraulis japonicus*) which collapsed in the early 2000's. In contrast to the Korean records that showed a doubling trend in the zooplankton biomass in the YS since the late 1980's, the zooplankton biomass in the Chinese side decreased during the same period.

Dr. Ming-Yuan Zhu (People's Republic of China) presented the recent trend in HAB outbreaks in the ECS. The most frequent time of the outbreaks was from May to June. There was a dramatic increase in the reported HAB outbreaks since 2001, partly due to intensified monitoring activities. He also reported on the oceanographic conditions of the outbreaks in 2002. In 2002, 79 events were reported, 55 of which occurred in the ECS and 4 occurred in the YS. It was suggested that changes in the N/P ratio might be important in the HAB outbreaks.

Investigation, using satellite data, on whether there have been real changes in the YS ecosystem over the past two decades was the topic of the next presentation by Seung-Hyun Son (Republic of Korea). He compared data of two ocean color sensors CZCS (Coastal Zone Color Scanner: 1978~1986) and SeaWiFS (Sea-viewing Wide Field-of-view Sensor: 1997~present). On average, higher chlorophyll values were seen in SeaWiFS data. Likewise, water-leaving radiance decreased at 443 nm and increased at 555 nm (Fig. 4). The *in-situ* data showed less evidence of decadal trends, but there were slight increases in temperature and zooplankton biomass, and slight decreases in salinity and Secchi depth.

Dr. Bernard Megrey (U.S.A.) gave a brief introduction to the North Pacific Ecosystem Metadatabase promoted by

NOAA. He demonstrated the metadatabase webpage and asked the audience for future participation.

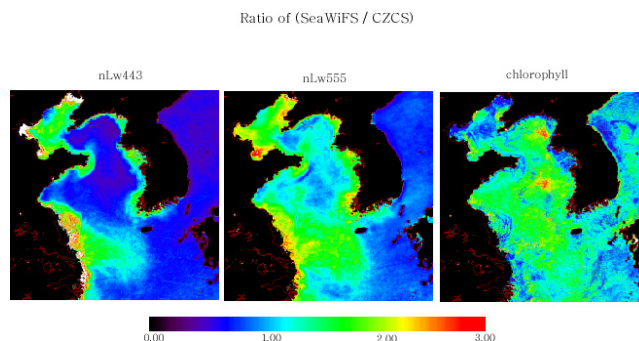


Fig. 4 Comparison of composite bio-optical values from CZCS (1979-1984) and SeaWiFS (1998-2002) (data by S.H. Son).

Discussion

The discussions that followed focused on how to improve the draft of the YS-ECS chapter. The main question was “What is missing and whether such information is available?” A number of items were listed including alien species, parasites, disease and bacterioplankton. Data might be available for these items but too scanty to be representative values. There are some items such as benthos with good data coverage, and certainly should be incorporated in the draft. Also the distribution and productivity of commercial invertebrates, and the impact of aquaculture on natural communities would be valuable information for assessing the ecosystem status. Fish catch data in China as well as in Korea in the draft need to be updated as some pelagic fishes show high frequency fluctuation.

In addition to the missing data, discrepancies were found between datasets. For example, the zooplankton biomass in Korean waters in the YS increased since the late 1980's, while that in Chinese waters decreased in the same period. Sampling details should be compared to interpret such discrepancy. This illustrates the need for comparable sampling methods and gears in the future.

There were different views about the impact of the Three-Gorges Dam on the YS-ECS ecosystems: some think the impact would be substantial, while others believe not. But most participants agreed on the need to monitor the future change. Then there was a suggestion that a PICES Working Group might be needed for this interesting semi-natural macrocosm experiment.

The YS and ECS are ecosystems where you can find complicated action of multiple forcing factors. Will we ever be able to understand what factors contribute, and how much, to the ecosystem change we observe?