Annex 12

REPORT OF THE SEMINAR ON POPULATION RESILIENCE

International Scientific Committee for Tuna and Tuna-like Species
in the North Pacific Ocean

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Introduction

Dr. Hideki Nakano convened the Seminar held during the ISC 12 Plenary. He introduced the four presentations given during the seminar.

The tragedy and thereafter- damage and recovery of Japan's fisheries after March 11 by Dr. Ai Kimoto (National Institute of Far Seas Fisheries)

This presentation outlined damages and recoveries on fishery-related facilities by the Great Eastern Japan Earthquake, laying stresses on tuna fishery. The tsunami bereaved various precious people and properties around Tohoku area. The area is important for Japanese fishery oriented products, and provides roughly half of the Japan total. The number of offshore longline or purse seine vessels did not change much, whereas 25% of driftnet vessels were damaged. The fishery-related facilities, which suffered destructive damages by the tsunami, are slowly being reconstructed. Even though many longline and drift net boats survived, the fishermen could not operate in the same manner as before due to the slow recovery of fishery-related facilities. Thus the target species were partially changed to tunas, and catch of billfishes and sharks would be affected for a next few years. Currently the fishery and fishing industries in Tohoku area have been rebuilding. The information from the ISC about the stock status is quite helpful and plays a key role in their reconstruction. Continuous support from the ISC would be greatly appreciated.

<u>Discussion</u>

The plenary expressed it appreciation for the informative presentation and also their admiration for the resilience of the human population affected by the disaster. It was noted that the percent of the fleet affected by the tsunami depended on where the vessels home ports were located. Vessels from fleets such as the offshore longline and purse seine fisheries were generally not from ports in the areas affected by the tsunami and so few vessels in that fleet were affected. It was added the slowest fisheries sector to recover from tsunami damage appears to be recovery of the processing facilities included in the rebuilding plans of the cities affected by the disaster.

Modeling resilience of fish stocks: binding limitations and open possibilities by Dr. Jon Brodziak (NOAA Fisheries, Pacific Island Fisheries Science Center)

Steepness is the key to understanding the resilience of fish stocks to harvest and environmental change. Steepness (h) is the fraction of unfished recruitment realized when spawning biomass is 20% of the unfished spawning biomass B0. Two approaches to measuring steepness were described. Meta-analysis approaches can be applied to estimate steepness and characterize the uncertainty about its value by combining data from many studies (e.g., Myers, R., Bowen, K., and Barrowman, N. 1999. Maximum reproductive rate of fish at low population sizes. Canadian Journal of Fisheries and Aquatic Sciences 56:2404-2419). In general, a steepness prior, or penalized likelihood, can be developed from Myers et al. (1999) results with an overall prior mean of μh = 0.7 (see, for example, Hilborn, R., and Stokes, K. 2010. Defining overfished stocks: Have we lost the plot? Fisheries 35: 113-120). Some potential limitations of the meta-analysis approach are the bias due to selecting only stocks with assessment data, the lack of independence in the steepness response of groups of stocks that are subject to common sources of environmental variation, and the measurement error in stock-recruitment data. Alternatively, steepness may be directly estimated using life history parameters and information on the reproductive ecology of a fish stock where data are sufficient (Mangel, M., Brodziak, J., and DiNardo, G. 2010. Reproductive ecology and scientific inference of steepness: a fundamental metric of population dynamics and strategic fisheries management. Fish and Fisheries 11(1):89-104). This approach has been applied to estimate mean values of steepness for North Pacific Bluefin tuna (μh = 0.91, Mangel et al. (2010)), Western and Central North Pacific striped marlin (μh = 0.87, Brodziak, J. and Mangel, M. (2011. Probable values of stock-recruitment steepness for North Pacific striped marlin. International Scientific Committee for Tuna and Tuna-Like Species in the North Pacific/Billfish WG, ISC/11/BILLWG-2/11, 13 p.)), and North Pacific albacore tuna (μh = 0.84 to μh = 0.95, Brodziak, J., H-. H., Lee., and M. Mangel. (2011. Probable values of stock-recruitment steepness for North Pacific albacore tuna. International Scientific Committee for Tuna and Tuna-Like Species in the North Pacific/Billfish WG, ISC/11/ALBWG-1/11, 10 p.)). In the approach, the incorporation of stochasticity in survival and other life history parameters allows one to derive probability distributions, not just point estimates, for steepness. This, in turn, makes it possible to directly characterize uncertainty about the probable value of steepness in assessment model results. One potential limitation of the life history approach to estimating steepness is the reliance on estimates of the allometry of larval survival rates based on the meta-analysis of McGurk (1986. Natural mortality of marine pelagic fish eggs and larvae: the role of spatial patchiness. Marine Ecology Progress Series 34:227-242). Last, there was some discussion of the relative merits of the practice of fixing steepness at h=1. The presenter noted that assuming h=1 does not satisfy the assumptions of a Beverton-Holt stock-recruitment curve. This assumption represents a different model and is not a renewal process. In addition, assuming h=1 was characterized as being biologically naïve, very non-precautionary, and the wrong scientific inference. In particular, it was pointed out that an observation that recruitment appears to be independent of stock size does not mean that h=1 with complete certainty (e.g., the recruitment at 20% of unfished spawning biomass is the same as unfished recruitment R0). Instead, the correct scientific inference is that any percentage of recruitment ($0.2 < h < 1$) is possible. This inference is based on the principle of indifference, and in this case, h would have a uniform distribution (tied down at small values near h=0.2 and h=0.99) in the absence of auxiliary information.

Discussion

It was questioned if it is common practice in stock assessment to assume steepness is not measureable. The presenter clarified that although some stock assessments may assume that steepness is not estimable within the assessment model, there are other methods to estimate steepness through meta-analysis or direct estimation approach as discussed in presentation. Other questions centered on which life stage is the most important in determining steepness and how does the environment affect steepness? The presenter clarified that although early life stages are certainly important it is not yet known which stage is the most crucial for determination of steepness. Furthermore, the presenter indicated that although the environment almost certainly plays an important role in determining steepness, more work will be necessary to understand this role. Finally it was also noted that the relationship between M, steepness and F_{SPR} at MSY may indicate that long-lived animals are more susceptible to fishing as a larger percentage of unfished spawning potential corresponds to F_{MSY} than shorter-lived species.

Affect of regime shift on Northern tuna stocks by Dr. Hideki Nakano (National Institute of Far Seas Fisheries)

Long term fluctuations of population size, i.e. hundred years, are known for Atlantic and Pacific Bluefin tuna. Some possibility of regime shift affecting on Pacific Bluefin tuna, albacore and blue sharks which are decadal changes, are discussed. Some similar periodic fluctuations of population are observed among Pacific Bluefin tuna, Japanese common squid and jack mackerel. The similar periodic fluctuations are observed between albacore and blue shark. Stock management options which appropriate for the naturally fluctuated population are shortly introduced.

Discussion

It was questioned about what defines a regime shift and how to detect the shift. It was later defined as an abrupt change in a marine ecosystem from one state to another and that methods to detect these changes can be found in the published literature. Other questions regarded the behavior of target switching by fishermen. Target switching by fishermen implies that consumers will also have to switch their consumption. It was clarified that the behavior of target switching may be classified into two types. The first is switching to a noticeably different species and the second is switching to a very similar species, such as among the various Bluefin tuna species. It was thought that consumers will more easily switch if the new target is a very similar product. It was also thought that education of consumers may influence consumers on what is realistic to expect from fisheries and what is ecologically sustainable. It was also noted that to improve our understanding of the links between ocean and ecosystem dynamics new data will need to be collected and it is unknown how long this will take.

How to establish the sustainable adaptive management of Pacific salmon under the changing climate by Prof. Masahide Kaeriyama (Hokkaido University)

At the present, the global warming has positively affected for increase growth at age-1 and survival of Hokkaido chum salmon. In the future, however, this global warming will affect decrease in carrying capacity and distribution area of chum salmon in the North Pacific Ocean. For establishing the sustainable adaptive management of Pacific salmon with due considerations to conserve ocean ecosystem, we have 3 issues. 1) How can we use the ocean salmons as seafood in the future? 2) What do we need for sustainability of salmons and ocean ecosystem in present and future? 3) How do we establish the sustainable adaptive management of salmons based on the ecosystem approach? In order to answer these issues, we should know that carrying capacity are limited and fluctuated in ocean ecosystem, that salmon fisheries and hatchery programs are emphasized not only the economic efficiency, but also the ecosystem approach. As the education, we need paradigm shift from the traditional fisheries science for only fisheries to the ecological fisheries science for the protection of ocean ecosystems and human food resources in order to be human well-being in future generation. Adaptive management and precautionary principle are essentially important for protecting Pacific salmon under the changing climate.

Discussion

It was noted that selective mortality in salmon from the US west coast has been related to presence/absence of zooplankton. This is different that the selective mortality presented which was due to elevated water temperatures. Another example of selective survival was given in the returns of sockeye salmon in Canada in 2010 which may be related to volcanic fertilization in feeding areas. To the extent that we understand the causes of selective mortality and survival and we can predict the occurrence of these events, they may be useful forecasting changes in marine resources.

Summary

The causes of the larger scale shifts in climate and oceanic conditions are due to varied cause some of which may be outside of the human causation. The role these shifts play in influencing population resilience is an area for research. A combination of groups including ISC, PICES and others will be needed to move towards a more ecosystem management approach.