Toward a New Paradigm of the Fisheries Management

Tsuyoshi Kawasaki
Japanese Study group for Climate Impact and Application

Abstract. Fisheries management has been carried out on the assumption that a fish population is in equilibrium with the fishing effort under the average environmental conditions and hence there must be a maximum sustainable yield (MSY). However, since the simultaneous rise and fall of the interdecadal and global scale of sardine populations was pointed out in the early 1980s, many other similar events of long-term changes in marine populations have been emerging, which is called regime shift. On the other hand, abundant evidence for the regime shift of climate-ocean systems has been obtained recently, which is suggested as the driving force causing the fluctuations in marine organisms. Very recently, it has become clear that even groundfish and tunas often show a tremendous increase in spite of the strong exploitation. These facts strongly show that there are no steady conditions in the oceans and the MSY is nothing but an imaginary criterion. A new paradigm of the fisheries management must be sought on the basis of the regime shift theory.

Keywords: fisheries management, average environmental conditions, MSY, regime shift, new paradigm

1. INTRODUCTION

The traditional fisheries management regime has been based on the assumption that the increment to the stock is balanced with the fishing effort and the effects of variations in external environmental factors are eliminated by averaging over periods of time. If the assumption were right, decision-makers could establish measures to regulate fishing effort to align catch levels to the MSY, or from an economic view, to the MEY. However, several high-profile fisheries management failures such as the Peruvian anchovy, the Pacific halibut and the North Atlantic cod have highlighted the fact that the current understanding and modeling of commercial populations are inadequate, suggesting that the effects of environmental variations must be incorporated in management models instead of ignoring them.

2. BACKGROUNDS OF THE CURRENT MANAGEMENT REGIME

The current bio-economic model called Gordon-Schaefer model stems from two roots. One is an economic model presented by Gordon(1954) that draws upon the agriculture metaphor, looking at fish stocks as equivalent of lands by adopting Ricardo's concept of land rent to fish resources as resource rent. The other is a biological model proposed by Schaefer(1954) that is dependent on the logistic law of population growth, which is applicable only to experimental populations living in a limited space.

The two models were coupled to each other, and the bio-economic model, or Gordon-Schaefer model, was developed, demonstrating the relationship between the development of a population (given certain values for reproduction rates and natural mortality), fishing effort and cost. The model is based on the idea that by manipulating the level of fishing effort, it would be possible both to stabilize stock size at an optimum level and to maximize economic yield from fishing.

3. REGIME SHIFT

Since the simultaneous rise and fall of the interdecadal and global scale of sardine populations was pointed out (Kawasaki, 1983), many other similar events of long-period variability in marine organisms from phytoplankton to predatory fish have been emerging, which is called regime shift.

Since the mid-1970s, the individual growth of Pacific halibut in the North Pacific has decreased and recruitment has increased drastically. Most major flatfish species in the Gulf of Alaska and the Bering Sea increased in concert with other groundfish from the mid-1970s to the mid-1980s (Clark et al., 1999).

Trends in biomass of bluefin tuna and albacore in the northwestern Pacific were reversed from decline to growth and in the opposite way for the bigeye and yellowfin tunas, with an inflection in 1990/91 (Kawasaki, 2002).

Landings of skipjack tuna to fish markets on the eastern Honshu coasts of Japan, which had been on the decline since the mid-1960s, turned to the rise in the mid-1970s to reach a very high level in the late 1990s (Kawasaki, 2002).
The return rate of chum salmon released from Japan had gone up from around 2.0% for the year-classes liberated in the mid-1970s to 4.5% for the 1992 year-class but it dropped to 2.3% for the 1996 year-class (Kawasaki, 2002).
Recent regime shifts of the climate-ocean system in the North Pacific occurred in the mid-1970s, the late 1980s and the late 1990s, which seem to have caused such shifts in the marine ecosystems as occurring for anchovies, sardines, tunas and salmon.

4. REGIME SHIFT AND THE STOCK MANAGEMENT AND ENHANCEMENT

As explained earlier, fluctuations in fish populations are driven just by the global climate change, neither by the fishing effort nor by the enhancement techniques. According to the surplus production model, one of the two major models of population dynamics, established by Schaefer (1954) for the yellowfin tuna fishery in the eastern tropical Pacific, the CPUE is expected to be negatively regressed against the fishing effort. As shown above, however, tuna populations are fluctuating in a manner independent of the fishing effort. The population dynamics has turned out often inconsistent with the real world and its theory needs be reexamined.

A novel discipline is anticipated to be worked out, which could explain and foresee from the historical and geo-scientific viewpoints the variability in the marine ecosystem and fish populations, based on the regime shift theory, toward a new paradigm of the fisheries management.

5. REFERENCES


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