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The current status of west sea fisheries resources and utilization in the context of fishery management of Korea

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ABSTRACT

Many fisheries resources in Korean waters are known to be depleted, and thus annual catch and catch per unit of effort of Korean coastal and offshore fisheries have shown a declining pattern. Moreover, some ecological indices have exhibited continuous declines, indicating degraded conditions in quality as well as quantity of fisheries resources. Considering the current circumstances, in this paper we review the marine ecosystem, fisheries resources, the history of fisheries management, and the present status of assessment and management of Korean west sea (the eastern part of the Yellow Sea) fisheries. Then, we attempt to identify problems and issues for the fisheries management. This paper introduces an ecosystem-based fisheries assessment and management approach as an alternative and applies it to a Korean coastal ecosystem in the west sea, Korea. Policy implications are suggested, which can be drawn from the discussions on the problems and concerns in current fisheries assessment and management in general. These suggestions include an efficient assessment and management system to prevent overfishing, protect biodiversity and habitat quality, and support expanded research, data collection, monitoring, and a multidisciplinary international cooperation with neighboring countries, such as China and Japan.

1. Introduction

In modern fisheries, the main problems are the overexploitation of resources, overcapitalization or overexpansion of fishing fleets, and the negative consequences of fisheries on the survival of marine life and associated habitats. The diverse, dynamic, and complex nature of fisheries management problems necessitate the development of a process that treats them as a set of human interactions to be managed systematically. However, fisheries have been managed often in a setting where full information is lacking on fish population dynamics, interactions among species, effects of environmental factors on fish populations, and the effects of other human activities on fish stocks (Zhang and Marasco, 2003).

According to the most recent Food and Agriculture Organization (FAO) (2010) report, the percentage of underexploited and moderately exploited stocks decreased from 40% in 1974 to only 15% in 2008, whereas that of overexploited, depleted, and recovering from depletion increased 10% in 1974 to 32% in 2008. The percentage of underexploited and moderately stocks was 20% in 2006, but it substantially declined to 15% in 2008, just within the period of two years, which indicates further potential declines in a short period. Recognition of the inherent uncertainty and its potential consequences have led to the adoption of the ecosystem-based fisheries management in various international organizations and advanced countries. In order to conserve our fisheries resources as common assets of human kind, it is necessary to devise a framework that can promptly ensure effective fisheries management systems.

In Korea, there are more than 250 exploited species harvested by about 80 thousands fishing vessels, using 37 (17 for coastal and 20 for offshore) gear types (Zhang and Marasco, 2003). Although knowledge of the status of many species harvested in commercial fisheries is limited, stocks are generally considered to be declining. Several commercially valuable species, such as small yellow croaker (*Pseudosciaena polyactis*), white croaker (*Argyrosomus argentatus*), red seabream (*Pagrus major*), sharp-toothed eel (*Muraenesox*

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cinereus), and some other demersal fish species are considered to be heavily exploited, and, consequently, some of them are depleted due to overharvesting, marine environmental degradation, and a variety of unknown factors (Zhang and Kim, 1999).

A variety of projects are underway to recover depleted fish and shellfish resources in Korea, but these projects are operated separately, not systematically, nor consistently, which is why the recovery efforts have not been very effective (Zhang and Kim, 2010). Conventional fisheries management, with its focus on managing target species rather than on managing for true sustainability in the use of each species within its ecological context, has not been effective. Therefore, there is much interest in using an ecosystem-based approach in the assessment and management of fisheries in Korea.

The purposes of this paper are to review the marine ecosystem, fisheries resources, history of fisheries management, and present status of assessment and management of the Korean west sea fisheries, to identify problems and issues for the fisheries management, to introduce an ecosystem-based fisheries assessment and management approach as an alternative. The approach is applied to a Korean coastal ecosystem in the Korean west sea. Moreover, finally plausible ways to enhance systems involving the management approach in the marine ecosystem are suggested.

2. Korean west sea ecosystem and fisheries

2.1. Physical features and fisheries resources

The Korean west sea (the eastern part of the Yellow Sea) is a large inlet of the western Pacific lying between China and the Korean Peninsula. The area of the Korean west sea proper (excluding the Gulf of Pohai) is 404 000 km^2, and its mean depth is 44 m. Along the west coast of Korea, a relatively high-salinity Tsushima warm current (TWC, a branch of the Kuroshio Current) flows northward (Fig. 1). Whereas, along the continental coast southward-flowing currents prevail, which strengthen remarkably in the winter monsoon period, when the water is cold, turbid, and with low salinity. In spring and summer, the upper layer is warm and diluted by the freshwater from rivers, while the deeper water remains cold and saline (Yellow Sea Cold Water in Fig. 1). When water temperatures begin to drop significantly in autumn, Yellow Sea Cold Water is comparatively warmer than water in the coastal area.

The fauna of the resource populations in the Korean west sea is composed of species with various ecotypes. According to Lee (2004), a total of 339 fish species were reported in Korean west sea, which included 136 Perciformes, 42 Scorpaeniformes, 30 Pleuronectiformes, 25 Tetradontidae, 15 Rajiformes, 14 Clupeiformes, 12

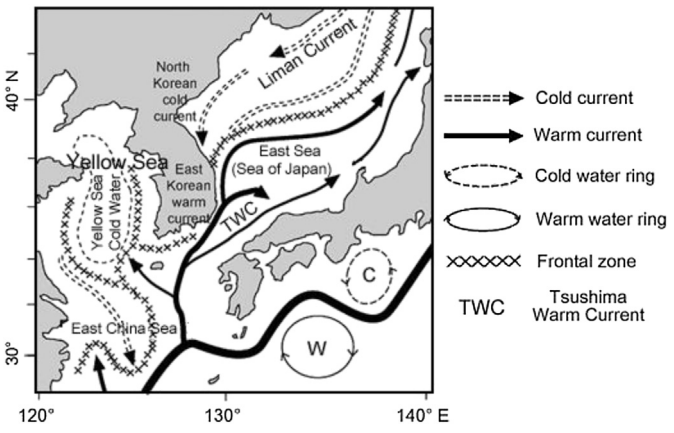

Fig. 1. Physical features around the Yellow Sea.

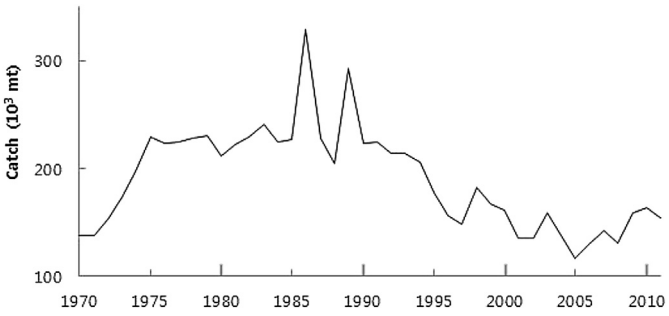

Fig. 2. The annual catches (10^3mt) of the Korean west sea fisheries. (Data from Statistical Yearbooks of MOMAF and MIFFAF).

Anguilliformes, and 9 Carcharhiniformes, belonging to 219 genera and 109 families. Most fish populations migrate offshore toward deeper and warmer waters, and they concentrate mainly in the Korean west sea depression. There are three overwintering areas: the mid- Yellow Sea 34° to 37°N, with depths of 60–80 m; the southern Yellow Sea, 32° to 34°N, with depths about 80 m; and the northern East China Sea. The cold temperature species (e.g., eel-pout, cod, flatfish, and Pacific herring) are distributed throughout these areas, and many warm temperature species (e.g., skates, gurnard, *Saurida elongata*, jewfish, small yellow croaker, spotted sardine, fleshy prawn, southern rough shrimp, and cephalopods) are also found in all three overwintering areas from January to March. In the southern Yellow Sea, all species are warm temperate species (e.g., small yellow croaker, *Nibea alibiflora*, white croaker, jewfish, *Setipinna taty*, red seabream, and butterfish).

2.2. Fisheries

2.2.1. Production

The commercial utilization of fisheries resources in the Yellow Sea dates back several centuries. With the introduction of bottom trawl vessels in the early twentieth century, many stocks began to be intensively exploited by Chinese, Korean, and Japanese fishermen, and some economically important species, such as red seabream declined in abundance in the 1920s and 1930s (Xio, 1960). The stocks remained fairly stable during World War II (Liu, 1979). However, due to a great increase in fishing effort and its expansion to the entire Yellow Sea, by the mid-1960s, nearly all the major stocks were heavily fished. Since then, the composition of the fish catch has changed greatly (Xia, 1978; Liu, 1979; Chikuni, 1985; Kang, 1987; Zhang and Kim, 1999).

The Yellow Sea is known as one of the most intensively exploited areas in the world. It has multispecies and multinational fisheries, and it is fished using multiple types of gear. The number of species harvested by Korean west sea fisheries was 126 species, consisting of 66 fish species, 14 crustaceans, 22 shellfish, 12 mollusks (except for shellfish), and 12 algae species, respectively. The abundance of most species is relatively small, and only about 20 species exceed 10 000 (mt) in annual catch. The resource populations of demersal species, such as small yellow croaker, hairtail, large yellow croaker, flatfish, and cod declined in biomass by more than 40%, when fishing efforts increased threefold from the early 1960s to the early 1980s (Zhang et al., 1993).

The annual catches of Korean west sea fisheries also showed a declining pattern since the early 1990s (Fig. 2). In addition, some ecological indices, such as mean trophic level, have exhibited continuous declines, indicating changes in quality as well as quantity of fisheries resources (Zhang and Lee, 2004).

The Korean west sea fisheries, which are also conducted in tidal flats, account for about 12% of the total Korean coastal and offshore