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The Korean tidal flat of the Yellow Sea: Physical setting, ecosystem and management

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ABSTRACT

The present article provides a regional overview of the Korean tidal flat extensively developed along the West Sea of Korea, encompassing oceanographic features, geology, and biology. In particular, the Korean tidal flat was fully described in the aspects of spatial scale (viz. size), geographical distribution, biodiversity, and local culture. A particular emphasis was given to explain the framework of the coastal management in Korea, in terms of a legal aspect, by highlighting reclamation versus protection issues. First, we described the Yellow Sea by sketching the boundary, ocean and tidal currents, discharges from the major rivers, sedimentology, and the cooperative surveys between Korea and China. Next, the West Sea of Korea, where the offshore boundary often neighbored rather close to coastal zone because of the associating traditional livelihoods, was described to point out certain characteristics of hydrography, coastal landscape, tidal channels, tide, and sedimentary process. Then the Korean tidal flat which is the main topic of this article was introduced by highlighting the geographical distribution, biodiversity of benthic diatoms and macrozoobenthos, artisanal fisheries, and local culture in aspect of ecosystem services in tidal flats. Meantime, the issue of reclamation was mini-reviewed by tracking the chronicle development, aerial coverage, and deteriorated environmental impacts on the coastal ecosystem. Herein, the untiring efforts towards protection of the Korean tidal flat are also included in viewpoints of legal framework and the designation of protected areas. Overall, the present collective description aims an introductory guidance for the individual papers of the special issue on the Korean tidal flat, with provisioning several key maps to be cross-utilized or referred.

1. Introduction

The "*Getbol*" is mentioned several places throughout the special issue including the present article, though not much exposed to the international society (Koh, 1999, 2011). Getbol is one of the several Korean words that represent the scientific term of "tidal flat", but the reason we choose "Getbol" herein was its sociological impact that comes from its origin, i.e., it encompasses the relationship between coastal communities and ecological services of the tidal flat. In particular, the term reflects the culture of communities that depend on artisanal fisheries conducted in and around the given area. The artisanal fisheries that commonly adopted in many tidal flats of Korea involve mostly a manual labor, accordingly the activities are usually limited to the walking distance down to the low water line (viz. within an intertidal zone). Thus, the spatial coverage of Getbol is about the same of intertidal flat, but the two terms differ in that the former refers to "human culture" inclusive, while the latter simply indicates "scientific spectrum." By syllables, "Get" means coastal area, and "bol" represents wide-open or plain field, thus together, "Getbol" can be defined as open field at the coastal area.

Policy report of the Wadden Sea clearly tells that the management of 'tidal area' includes not only intertidal zone but also subtidal zone, as a habitat unit (CWSS, 2010). Because tidal flats and its surrounding waters interact with each other, theoretically or practically, the tidal area should be recognized as a coherent habitat unit. However, Getbol commonly considers the walkable space for local fishermen and beach hikers, thus its boundary has been limited to a space unit for human use only. Such perspective-driven discrepancy seemed to be closely linked to tidal flat related policy between the Korean and the European Wadden Sea. For example, the boundary of tidal wetlands protected areas in Korea is strictly limited to the area falling into the low tide line. Accordingly, the

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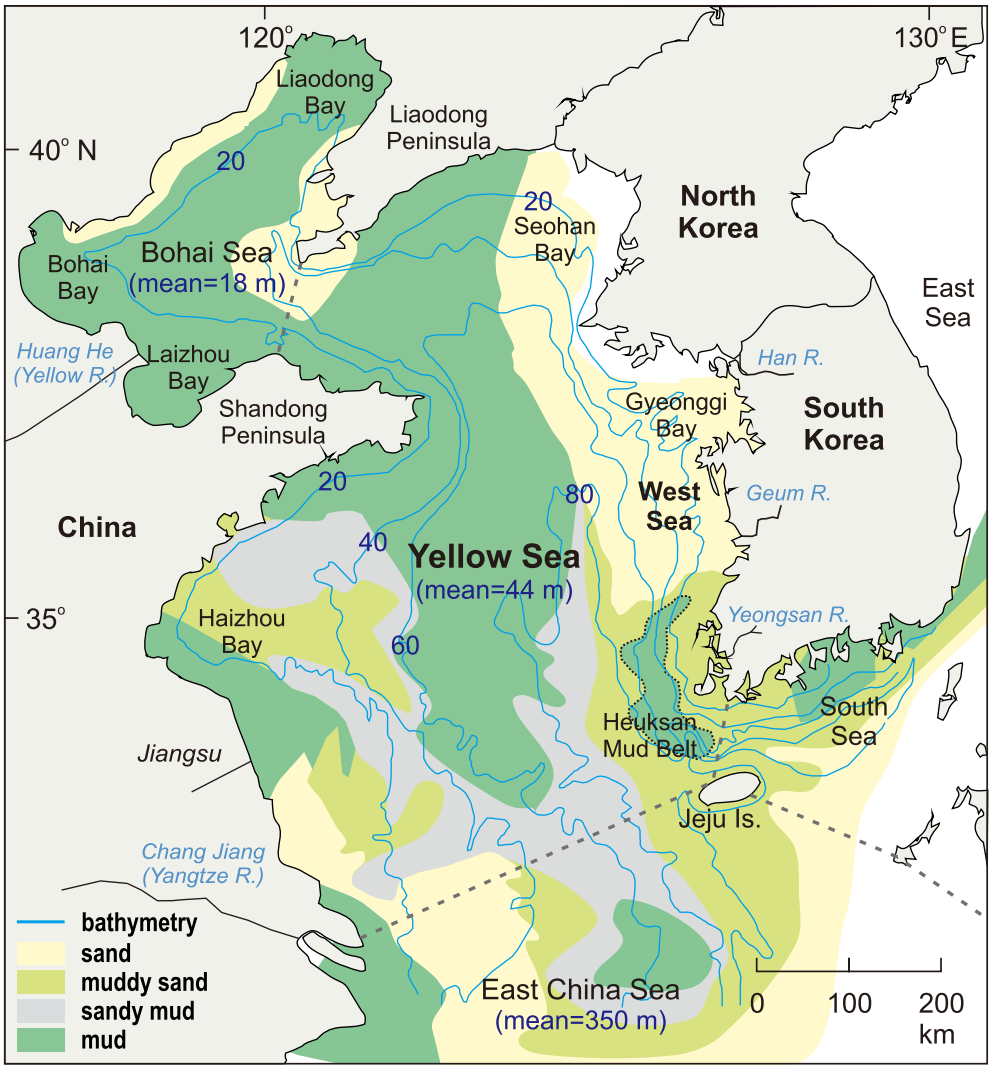

Fig. 1. Map of the Yellow Sea (Section 2) including the West Sea of Korea (Section 3), where tidal flats (Section 4) well developed along the coastline, with the information of the bottom topography.

coastal protection could not cover entire ecosystem of tidal area, rather limited to the sole space being exposed during the ebb tide. In Korea, to expand the boundary of protected area of tidal wetlands from intertidal zone to "tidal area", including subtidal zone, a legal adopting of tidal area for tidal flat would be highly encouraged. For instance, the expansion of tidal flat to cover a water depth of 6 m, which is the definition of the Ramsar "wetland", would be one example.

In the present study, we briefly analyzed the past scientific results in relation to the "Getbol", scientifically tidal flat, by period and subject to find out common or specific interests over the past decades, in quantitative manner. Only the peer reviewed articles published in the international journals are included in this analysis. We could find a total of 209 research papers relating to the tidal flat studies in Korea, since the first report in 1984 (scopus keywords: tidal flat and Korea). The number of papers increased from 10, 37, and to 107 in the periods of before 1990s, in 1990s, and in 2000s, respectively. Only for the last three years, the number of papers reached 55, showing a drastic increase of scientific outcome in more recent years, and it should be noteworthy that 5 papers are related to the issue of the Saemangeum reclamation project, which is also one of our key topics throughout the special issue. In anyhow, among those, the frequently studied subjects were found to be biological (85 papers, 41%), geological (80 papers, 38%), physical (9%), and chemical characteristics (7%). Other minor subjects (6%) relating to the engineering, sociology and policy aspects have been included later since the middle of 1990s. The subject of remote sensing seems to be emerging scientific concern as its scientific application gets more attention in the fields of tidal flat geology and ecology in recent years. One paper in the special issue introduced a case study of thematic mapping as potential use of remote sensing in management of the Korean tidal flats (Ryu et al., 2014a).

The scientific data from the Korean tidal flats were first introduced internationally in the middle of 1980s, with a subject of sediment transport (Wells et al., 1984). The first report relating to the tidal flat biology was also introduced by a foreign scientist, Frey et al. (1987), where macrofaunal zonation on the Songdo tidal flat close to Incheon was studied. Thus, such earlier studies at the beginning stage of tidal flat science in Korea would show certain weakness of scientific independence. It was first in late 1980s that few though, our own scientific results came out, for example Park et al. (1986) reported sediment transport in the Geum River estuary and Koh and Shin (1988) introduced the macrofauna community and zonation in the representative tidal flat of Banwol in Gyeonggi Bay.