Iranian Journal of Fisheries Sciences 15(3) 1246-1253 2016

Ecological classification of southern zones of the Caspian Sea (Mazandaran Province), based on CMECS model

Hoseinzadeh M.A.[1]; Owfi F.[2*]; Gorjian Arabi M.H.[3]; Keshavarz M.[4]

Received: August 2015 Accepted: March 2016

1- Department of Fisheries, Babol Branch, Islamic Azad University, Babol, Iran
2- Iranian Fisheries Science Research Institute (IFSRI), Agriculture Research, Extension and Education Organization (AREEO), Tehran, Iran
3- Department of Fisheries, University of Agricultural Sciences and Natural Resource, Gorgan, Iran
4- Department of Fisheries, Ghaemshahr Branch, Islamic Azad University, Gaemshahr, Iran
*Corresponding author's Email: sillaginid@hotmail.com

Keywords: Surface geology, Biotic cover, CMECS model, Mazandaran Province, Caspian Sea

Introduction

A coastal area is a confluence of land and marine ecosystems and includes the independent biological, ecological, and geological area. Increasing pressure on these areas can decrease the quality of marine habitats, and can even lead to the loss of sensitive habitats (Lund and Wilbur, 2007). In this regard, a "biotope" has been suggested as the most informative operational unit for research and management (Costello, 2009). These biotopes, however, have been specified by the dominant species; they depend on the seabed, they are stable, and sometimes are used synonymously with the word ecology (Madden *et al*., 2008). Habitat classifications are, therefore, most accurate and ecologically relevant at the biotope level because of the direct relationship between the biota and their environment (Andrefouet *et al*., 2003; Capolsini *et al.*, 2003). The Coastal Marine Ecological Classification Standard (CMECS) was developed with the input of over 40 coastal and 20 marine habitat experts and presents a universally accepted standard classification for coastal and marine habitats (Madden *et al*., 2005). CMECS provides a uniform protocol for identification and characterizing ecological units which is intended to allow monitoring, protection and restoration of unique biotic assemblages, endangered species, critical habitats and important ecosystem components (Madden *et al*., 2009). CMECS (Version III, 2009)

included five distinct components including Surface Geology (SGC), Sub-benthic (SBC), Biotic Cover (BCC), Geo-form (GFC) and Water Column (WCC), of which we have only applied SGC and BCC. Component Units come in CMECS VIII organized into a branched hierarchy of four nested levels (Hewitt *et al*., 1998). They include classes, subclasses, biotic groups and biotopes. Biotic Groups are often observational and descriptive defined by obvious structure-forming organisms.

Based on the results of the Environmental Management Plan (EMP) and Integrated Coastal Zone Management (ICZM), the Caspian Sea in the north of Iran, with 873 km of coastline (487 km of coastline belongs to Mazandaran Province) and unique features, is a place for valuable ecosystems such as estuaries, the deltas, wetlands, important wildlife ecologies, etc. (Sharifpour and Owfi, 2007).

Materials and methods

The coastline of this study is located in the mid-eastern part of Mazandaran Province which is 69.275km in length.

The field operation and sampling in this research was conducted in summer and winter 2011. Considering the extent and geomorphology of the covered area, 19 stations within 4 sub-regions (Table 1) were designated using a Garmin Vista CX GPS device.

Table 1: The study area sub- region in the south part of Caspian Sea, Babolsar till Amir Abad Port.

Sub region	Distance (Km)	Start	GPS coordinate	End	GPS coordinate
ZA	9.55	Babolsar parking	N3642390 E05238297	Arab Kheil village	N3643332 E05244457
ZB	17.79	Arab Kheil village	N3643590 E05246227	Joybar / Larim	N3645537 E05256207
ZC	16.665	Siahrod estuary	N3646202 E05258105	Tajan estuary	N3648452 E05306534
ZD	25.27	Nozar Abad (Gohar baran)	N3649465 E05311501	Amir Abad port	N3651241 E05323338

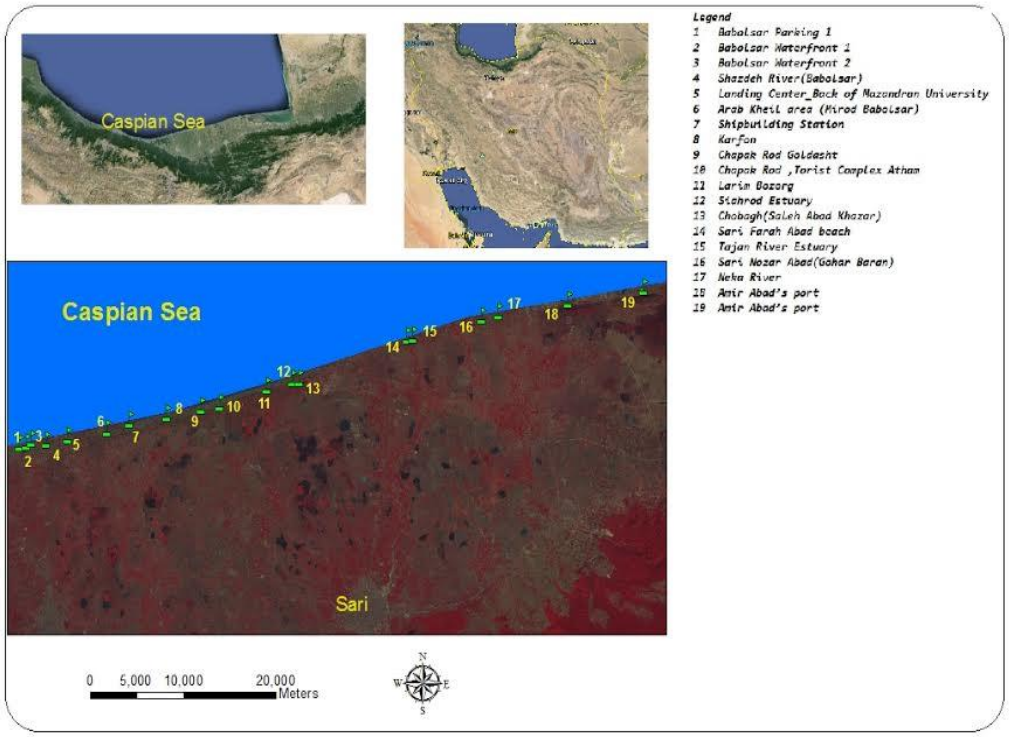

Figure 1: Map of the southeastern part of Caspian Sea: the designated sites from Babolsar to Amir Abad port coastal stretch.

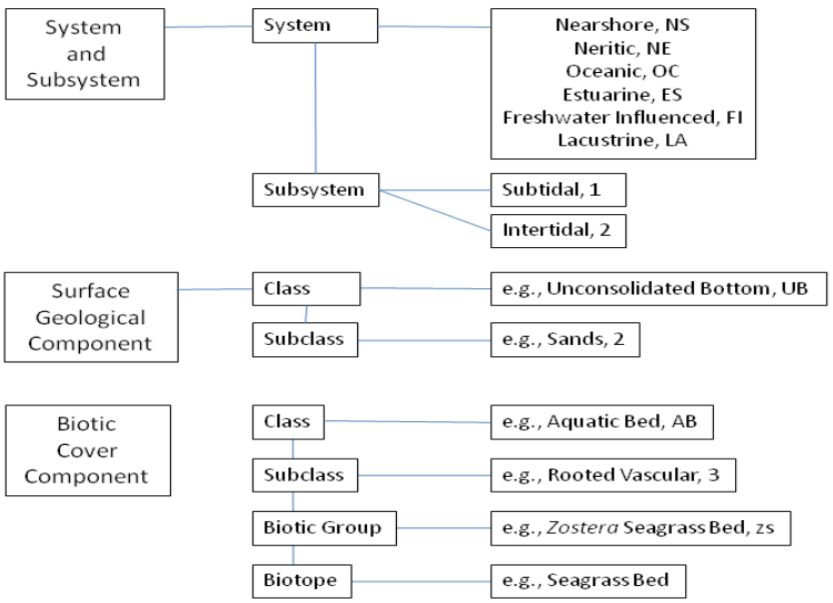

Figure 2: Components and structure of BCC (Biotic Cover Component) and SGC (Surface Geological Component) in the CMECS III model.

Dominant species were determined by sampling during two seasons and we took photos from specimens in their natural environment. Collected specimens were preserved in alcohol and transferred to the laboratory for identification which was done by experienced experts. According to CMECS, the sediment size and biological characteristics were used to categorize habitats within related classes, subclasses and lower levels. We transferred the collected data from the Global Positioning System (GPS) to the computer and sorted and classified the recorded information based on the information forms. The CMECS model was applied based on the BCC and SGC components, using existing data. We classified the eastern coast of Mazandaran Province (Babolsar to Amirabad Port) and then encoded this zone based on the CMECS model.

Results and discussion

Taking the SGC and BCC into consideration, the results of this study can be presented as follows:

Habitat diversity based on the SGC: Based on the composition, particle size and monitoring of substrates, 69.275 km of the coast of the Caspian Sea from Babolsar to Amirabad Port is divided into 2 substrate types of sandy (64.127 km or 92.57%) and rocky–sandy (5.148 km or 7.43%). The Construction coast was only rocky–sandy in the ZA sub region and it was totally sandy in other sub regions.

The highest and lowest abundance belonged to *Gammarus* sp. (Crustacean) and *Abraovata* sp. (Mollusca), respectively. In addition, however, fish and crustacean were not included in the sampling components of this research.

Habitat diversity based on the BCC: Biotic communities were categorized based on CMECS, and also by considering habitat diversity based on Surface Geology Characteristics. All biotic groups were most abundant in the rocky or rocky-sand shores. In order to follow the CMECS model, the codes of dominant communities were determined, the domination criteria was based on the presence during the season. Habitat classification and coding based on the CMECS model: Based on the CMECS model, near shore, freshwater influence and estuarine systems and sub-tidal subsystem are presented with [NS], [FI], [ES] and [1], respectively. The abiotic portion (SGC) [S] in this research is based on hardness or softness of the substrate and is represented by "Unconsolidated Shore" [US] and "Rock Bottom" [RB] classes, which are further divided into "Sands" [2] and "Bed rock" [1] subclasses.

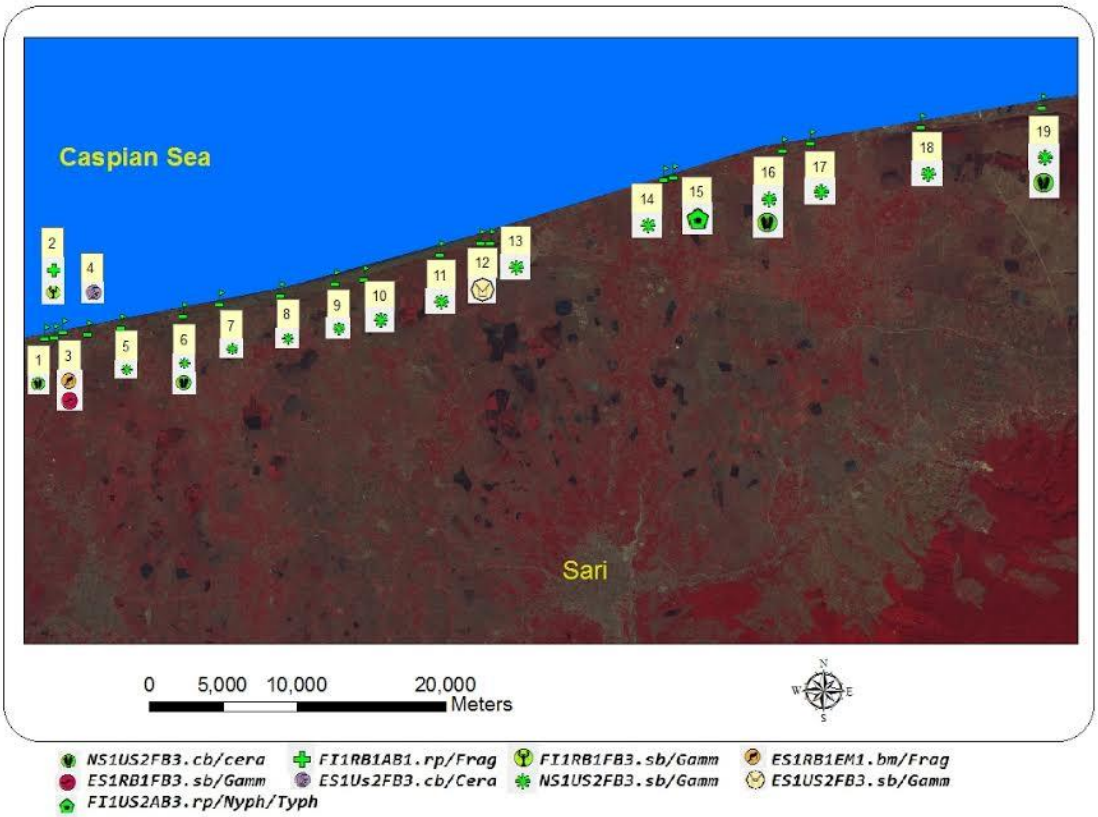

Figure 3: Biotope distributions in the South Caspian Sea (Amirabad port to Babolsar area).

The biotic portion [b] is represented by "Faunal Bed [FB]", "Aquatic Bed [AB]" and "Emergent Wetland [EM]" classes, which are further divided into "In fauna [3]", "Macro algae [1]", "Rooted Vascular [3]" and "Coastal Salt Marsh [1]" subclasses. Nine codes were determined based on the CMECS model in the range of Babolsar–Amirabad port on the southern part of Caspian Sea that are shown with their distributions of biotopes in a map (Fig. 3).

Habitat diversity based on SGC*:* Describing the composition of the substrate surface is a fundamental part of any marine classification scheme. The Surface Geology Component of CMECS is a first-order characterization of the geology that provides context and setting for many marine processes, and provides soft or hard structure for benthic fauna (Madden *et al*., 2009).

In this study 19 stations were recorded and 9 standard codes identified by the encoding system CMECS III. Most of the codes and biotopes have been observed in the ZA Sub - region (Parking one of Babolsar–Arabkheil village) that is due to the non-identical bottom structure. Coastal areas are divided into rocky, muddy and sandy shores based on the sea bed.

We had two kinds of shore based bottom types: 1. Sandy shore: Coast generally had sand bottom but rocks and boulders were located by human on the sandy shore. Shore was totally sandy in ZB, ZC and ZD sub regions.
2. Rocky sandy shore: Rocks and boulders located by human on shore. ZA sub region had rocky a sandy bottom. Owfi (2009) mentioned that most coasts of the Caspian Sea were flat and covered by sand. These results were similar to the results of this study, where the Sandy coast was 64.127 km (92%) of the total coast (69.275 km) of this study.

Habitat diversity based on the BCC: During the second decade of the twentieth century, pioneer studies of marine benthos were initiated (Tait and Dipper, 1998). Compared with the pelagic environment, the sea bed provides a wider variety of habitats and it corresponds to a greater diversity of fauna. Six taxa of fauna and 4 taxa of flora were identified based on the results of this research. Rahimi (2011) stated that crustacean and mollusks had insignificant abundance in all structures, and they had more abundance than other taxa on south Qeshm Island. The abundance of crustacean and mollusks were higher than other taxa in the Caspian Sea too. The ZA sub region that has sandy and rocky-sandy substrate and is located in the western part of the study area had the most biodiversity. Other sub regions (ZB, ZC and ZD) had entirely sandy substrate and low biodiversity. Although differences between communities can often be correlated with differences in sediment size, other factors such as light and turbidity can also influence them (Tait and Dipper, 1998).

Habitat classification and coding based on the CMECS Model: Based on the CMECS definition for biotope, 9 biotopes /habitats were identified and mapped out (see Fig.3). More than 77% of identified habitat was located on the mid-western and the rest was in the mid-eastern part. This distinction is logical due to the heterogeneity of the coast in mid–western part because the number of habitats is related to the heterogeneity of the biological and physical characteristics on sea bed region.

This study area had fewer number of habitats and codes compared with 3 coastal areas: Chabahar-Guatr, North of Qeshm island and South of Qeshm island that had 27 habitats with 13 codes (Shahraki *et al*., 2010), 40 habitats with 32 codes (Rahimi *et al.*, 2011) and 60 habitats with 47 codes (Ansari *et al*., 2011) respectively. This is because 1. The Caspian Sea has less species diversity because it is not connected to the other seas and oceans, and 2. The study area in this research (69.275 km) was smaller than other study areas. This model of classification has a wide range; and because it is still at the beginning, it has a lot of problems; and if it is merged with other models of classification, it will provide a new classification system which may

exclude the defects of the current classification.

In this study, 9 habitats (biotopes) with 9 codes were determined. This habitat is related to bottom diversity. Most biotopes and codes were observed in the ZA sub region (west part study area), so that we had different types of bottom in this sub region. Dreissena sp. from Mollusca and Cladophora sp. from alga can be regarded as the exclusive genera of the "rocky–sandy shores, while Cerastoderma sp. (Mollusca) can be regarded as being the characteristic genus of "sandy shores in this study area (Amirabad port till Babolsar).

References

Andrefouet, S., Kramer, P., Torres-Pulliza, D. and Joyce, K. E., 2003. Multi-sites evaluation of IKONOS data for classification of tropical coral reef environments. *Remote Sensing of Environment,* 88, 128-143.

Ansari, Z.; Seif Abadi, S.J; Owfi, F.; 2011, Ecological classification of tidal areas in the southern of Qeshm island based on the CMECS model using the GIS. MS Thesis, Department of Natural Resources and Marine Sciences of Tarbiat Modarres; Noor (Marin Biology Group), 113P.

Capolsini, P., Andrefouet, S., Rion, C. and Payri, C., 2003. A comparison of Landsat ETMC, SPOT HRV, IKONOS, ASTER and airborne MASTER data for coral reef habitat mapping in South Pacific islands. *Canadian Journal of Remote Sensing,* 29, 187-200.

Costello, M. J., 2009. Distinguishing marine habitat classification concepts for ecological data management. *Marine Ecology Progress Series*, 397, 253-268.

Hewitt, J., S. Thrush, V. Cummings and S. Turner, 1998. The effect of changing sampling scales on our ability to detect effects of large-scale processes on communities. *Journal of Experimental Marine Biology and Ecology.,* 227, 251-264.

Lund, K. and Wilbur, A. R., 2007. Habitat classification feasibility study for coastal and marine environments in Massachusetts. Massachusetts Office of Coastal Zone Management, Boston, MA, 63P.

Madden, Christopher, J.M. Dennis, Grossman, H. and Kathleen, Goodin, L., 2005. Coastal and marine systems of North America: Framework for an ecological classification standard. Version II. Nature Serve, Arlington, Virginia.

Madden, C.J., Goodin, K.L., Allee, R., Finkbeiner, M., Barnford, D.E., 2008. Coastal and marine ecological classification standard (Draft). NOAA and Nature Serve. 77P.

Madden, C.K., Goodin, R., Allee, G., Cicchetti, C., Moses, M., Finkbeiner and D. Bamford, 2009. Coastal and marine ecological classification standard. NOAA and Nature Serv. 107P. Available

online:http://www.csc.noaa.gov/benthic/cmecs/ CMECS _v3 _ 20090824.pdf.

Sharifipour, Rand Owfi, F., 2007. Environmental management of coastal areas (the evaluation of statuesque), Tehran, Ports and Maritime Organization Press, 396P.

Owfi, F., 2009. Geomorphology configured with an emphasis on coastal areas. Department of Natural resources and Marine Sciences of Tarbiat Modarres University of Noor.

Rahimi, M., Seif Abadi, S.J, Owfi, F., 2011. Ecological classification of tidal areas in the southern of Qeshm island based on the CMECS model using the GIS. MS Thesis, Department of Natural Resources and Marine Sciences of Tarbiat Modarres; Noor (Marin Biology Group), 115P.

Shahraki, M., Savari, A., Chegini, V., Owfi, F., Allee, B., Fazeli, N. and Madden, C., 2010. Standard ecological classification (CMECS) of sensitive and vulnerable coastal habitats of Oman Sea (Chabahar-Govatr). *Iranian Journal of Fisheries Sciences*, 18 (**4**), 89-99.

Tait, R.V. and Dipper, F.A., 1998. Elements of marine ecology. Keyword Publishing. Britain, 453P.