## ABSTRACT

Fish stocks that are grown under diverse environmental conditions have different biometric relationships and growth patterns. The biometric length-weight relationship (LWR) is an essential fishery assessment tool, as fish growth is continuous and depends on genetic and environmental factors. The present study attempts to understand the LWR of the flathead grey mullet, *Mugil cephalus* Linnaeus, 1758, from different locations. The study area encompassed its distribution in the wild across freshwater location (one), coastal habitats (eight locations), and estuaries (six locations) in India to determine the relationship between various environmental parameters. Specimens ($n$ = 476) of *M. cephalus* were collected from commercial catches and the length and weight of individual specimens were recorded. Monthly data from the study locations were extracted for nine environmental variables from the datasets downloaded from the Physical Oceanography Distributed Active Archive Center (PO.DAAC) and the Copernicus Marine Environment Monitoring Service (CMEMS) over 16 years (2002 to 2017) on the Geographical Information System platform. The parameters of the LWR, intercept 'a' and slope or regression coefficient 'b', varied from 0.005321 to 0.22182 and 2.235 to 3.173, respectively. The condition factor ranged from 0.92 to 1.41. The partial least squares (PLS) score scatter plot matrix indicated differences in the environmental variables between the locations. PLS analysis of the regression coefficient and environment parameters revealed that certain environment variables *viz.*, sea surface temperature, salinity, dissolved oxygen, nitrate, and phosphate, played a positive role. However, chlorophyll, pH, silicate, and iron played a negative role in influencing weight growth across various locations. The results revealed that the *M. cephalus* specimens from three locations, Mandapam, Karwar, and Ratnagiri, possessed significantly higher fitness to their environment than those from the other six locations. The PLS model can be used to predict weight growth under the various environmental conditions of different ecosystems. The three identified locations are useful sites for the mariculture of this species considering their growth performance, the environmental variables, and their interactions. The results of this study will improve the management and conservation of exploited stocks in regions affected by climate change. Our results will also aid in making environment clearance decisions for coastal development projects and will improve the efficiency of mariculture systems.


**Keywords:** Regression coefficient, Condition factor, Fitness, Conservation, Management, Biology, Mariculture