Modeling the Trajectories of Resilience and Collapse of Renewable Marine Resource

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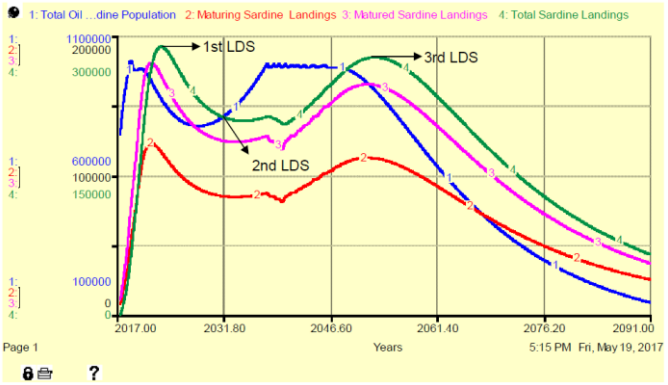
Extended Abstract

Introduction

Fish population is a renewable resource and they naturally regenerate. Unfortunately, overexploitation of fisheries has resulted in the depletion in stocks of many fish species all over the world. Overexploitation of fisheries is a widely discussed issue since last several decades (Bueno, 2012). The failure to prevent fish stock collapse and conservation of marine fishes will lead to the depletion of the fish species and finally its extinction. In this paper, we study the oil sardine (Sardinella longiceps) fishery system along the Malabar Coast of India. Understanding and analysing the possible pathways by which the oil sardine fishery system can become unsustainable and enter the trajectories of collapse is the main aim of the present research towards understanding resource sustainability. The present study mainly aims to 1) conceptualize the Malabar Coast oil sardine fishery system to understand the feedback dynamics prevailing in the system, 2) find out whether there is any change in feedback loop dominance that can result in the counterintuitive behaviour of the system, 3) find out whether there are chances of extirpations to occur to oil sardine population in the future, 4) find the possible trajectories of collapse that can occur to oil sardine population in the future, and 5) find out the tipping points at which the collapse of the oil sardine stock can possibly occur along the Malabar Coast of India. The present research also attempts to study the ability of the oil sardine fishery system to be resilient to any

unexpected socio-ecological condition changes in the long run. The study utilizes system dynamics methodology for simulating the Malabar Coast oil sardine system.

The simulation results show that there are three prominent loop dominance shifts occurring in the oil sardine system off the Malabar Coast. The first loop dominance shift (LDS) took place in the first time horizon with the tipping point in the year 2023 with the maximum oil sardine landings. After 2023, the sardine stock and the sardine landings were found to deplete slowly up to 2031. The last two loop dominance shift occurred in the second time horizon. The second loop dominance shift occurred in the year 2031 which saw the revival of the depleting sardine stock and landings. The oil sardine stock and landings entered the path of revival which started in 2031 and continued up to the year 2052. The third loop dominance shift occurred around the year 2052 when the oil sardine stock and landings permanently entered the trajectory of collapse which continued into the future. This in turn points towards the possibility of occurrence of the system failure phenomenon of 'tragedy of the commons' usually cited as one of the main reasons for fishery collapse across the seas (Moxnes, 1998). This modeling effort can aid in improved prediction of population dynamics thereby allowing for more effective stock management. Moreover the present modeling venture can aid the policy makers towards regulating the fishing efforts thereby not exceeding the sustainable levels which can otherwise become a threat to the fish consuming population.



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