11th Conference on Dynamical Systems Applied
to Biology and Natural Sciences DSABNS 2020
Trento, Italy, February 4-7, 2020

GAME THEORY OF FISHERIES MANAGEMENT

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Fish populations subject to heavy exploitation are expected to evolve over time smaller average body sizes. In this work we use evolutionary game theory to show how fisheries management should be adjusted to mitigate the potential negative effects of such evolutionary changes.

We present the game of a manager versus a fish population, where the former adjusts the harvest effort and the net size to maximize profit, while the latter responds by evolving their size at maturation to maximize their fitness. We analyze three strategies: i) ecologically enlightened (leading to a Nash equilibrium in game-theoretical terms); ii) evolutionarily enlightened (leading to a Stackelberg equilibrium) and iii) domestication (leading to team optimum). In order to determine the impact that incorporating evolution into the management decision framework can have in terms of profit, we calculate the manager's profit at the three equilibria. Domestication results in the largest size for the fish and the highest profit for the manager. With the Nash approach the manager tends to adopt a high harvest rate and a small net size that eventually leads to smaller fish. With the Stackelberg approach the manager selects a bigger net size and scales back the harvest effort to preserve both the long term size of the fish and the profit.

Overall, our results encourage fishery managers to take evolutionary dynamics into account and advocate the use of evolutionary game theory as a tool for providing insights into the eco-evolutionary consequences of exploiting evolving resources.

 ISBN: 978-989-98750-7-4