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Bioeconomic modeling for the sustainable exploitation of three key marine species in Morocco

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This study aims to deepen the understanding and optimize fishing activity in Morocco by holistically integrating biological and economic aspects. On the biological front, we examine the rivalry between three marine species: sardine, mackerel, and tuna, and the need to preserve the balance of their biomass. On the economic side, we focus on maximizing fisherman's profits.

We develop a biological equilibrium model for fishermen operating in the Atlantic region, where the three species coexist. These competing species exhibit their natural growth represented by logistic curves. We propose a mathematical model that takes into account the density and competition between species to explain population dynamics. Integrating human intervention adds a realistic dimension to our modeling. Fishermen specifically target all three species, thereby influencing population dynamics based on their fishing activities. This approach allows us to explore the effects of human-nature interaction on the biological equilibrium of sardine equilibrium of sardine, mackerel, and tuna populations.

Keywords: mathematical modeling, biological equilibrium, optimization techniques
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References

- [1] É. Meuriot, Les Modèles Bio-économiques d'Exploitation Des Pêcheries Démarches et Enseignements, *Rapports économiques et juridiques de l'IFREMER*, 1987.
- [2] F. E. Bendahou, N. Baba, Y. El Foutayeni, N. Achtaich, Impact of pollution on sardine, sardinella, and mackerel fishery: a bioeconomic approach, *Communications in Mathematical Biology and Neuroscience*, 2023:55, 2023.