جامعة عبد المالك السعدي
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Université Abdelmalek Essaadi

Centre des Etudes Doctorales Sciences et Techniques
&
Sciences Médicales

THESIS DEFENSE

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CANDIDATE FOR DOCTOR SCIENCES AND TECHNIQUES

Combined Impact of Current and Future Environmental Factors on the Spatio-Temporal Structuring and Distribution of the European Sardine (Sardina pilchardus (Walbaum, 1792)) and the Atlantic Horse Mackerel (Trachurus trachurus (Linnaeus, 1758)) in the Southern Alboran Sea (Moroccan Mediterranean): A Machine Learning inference approach for management evaluation plann

Date :	**Saturday, February 24th, 2024**
Time :	**15 :00 pm**
Location :	**Conference Room, Building F, FST - Tangier**

Committe Members		
Pr. Mohcine BENNANI MECHITA	FST - Tangier	Chair
Pr. Hicham CHAIRI	FP - Larache	Reviewer
Pr. Mohamed FIHRI	FS - Rabat	Reviewer
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Pr. Khadija ABOUMARIA	FST- Tangier	Examiner
Mrs. Sana EL ARRAF	INRH - Tangier	Guest
Dr. Mohammed MALOULI IDRISSI	INRH - Tangier	Co-supervisor
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ABSTRACT

The European Sardine and the Atlantic Horse Mackerel are small pelagic fish that occur in the Southern Alboran Sea (Moroccan coast) and have an important socio-economic value. The world's fisheries terrible condition, with overfishing and environmental degradation pushing stock to unsustainable levels. While sustainable management is paramount, traditional single species approaches are insufficient. Ecosystem models have emerged as powerful tools to understand the complex interaction between fish populations, their environment, and human activities. The Moroccan main ports landing logbook from 2009 to 2022, satellite environmental data of multiple actual, and two climate scenarios variables: RCP 2.6 and RCP 8.5 were used in this thesis. The Generalized Additive Models (GAMs) were used to analyze the relationships between LPUE, Effort, and various environmental factors for both species. The first part of this work aims to identify the significant factors that influence catch variability and predict a spatial-temporal distribution in the Southern Alboran Sea for both species. We claim that Phytoplankton concentration and Sea Level Anomaly were the significant parameters explaining the spatio-tempoal changes of the Sardine and the Horse Mackerel, respectively. Regarding model significance, the correlations were respectively 76% and 77.4% for Sardina pilchardus and Trachurus trachurus. The predicted spatial distribution shows that the European Sardines prefer areas near coastlines throughout the spawning season and the rest of the year. In contrast, the Atlantic Horse Mackerel prefers areas near coastlines during the spawning season and migrates to the open ocean for most of the year. The second part of the thesis investigates the influence of climate scenarios on the Landing per Unit Effort (LPUE) and Effort to develop future potential landings for both species. It also compares the proportion change to the 2010 - 2022 average in the Southern Alboran Sea between 2022 and 2100. Phytoplankton and Sea Surface Temperature were identified as the main drivers of the Sardine LPUE. Moreover, the Sea Level Anomaly and Sea Surface Temperature influenced the Horse Mackerel LPUE. The Sardine potential landing increases by the end of the 21st century by +15% under RCP 8.5 and +80% under RCP 2.6 compared to the 2010-2022 average. Furthermore, the Atlantic Horse Mackerel potential landings are projected to increase under RCP 2.6 by +200% and decrease by -100% significantly under RCP 8.5 compared to the 2010 – 2022 average by the end of the 21st century. This thesis highlights the importance of considering environmental factors in managing small pelagic fisheries and emphasizes the need for adaptive management strategies and conservation measures to ensure their sustainability under a changing climate.

Keywords: Sardina pilchardus, Trachurus trachurus, Southern Alboran Sea, environmental data, Generalized Additive Models (GAM), RCP 2.6, RCP 8.5