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Co-Exploitation of Fish Stocks Balancing Commercial and Recreational Fisheries

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Introduction

The management of mixed-use fisheries, that is fisheries that are co-exploited by commercial and recreational fishers, poses many challenges. For instance, commercial and recreational fisheries often have different management objectives, and the differences in goals and behaviours increase with the diversity of stakeholders. The sustainable management of mixed-use fisheries requires monitoring and managing both its commercial and recreational components, because the combined action of both sectors is responsible for the total fishing mortality induced on a stocks.

Fisheries play a crucial role in providing food security, employment, and economic growth around the world. However, the sustainable management of fish stocks is a complex task, particularly when commercial and recreational fisheries co-exploit the same resources. This article explores the pros and cons of such co-exploitation, shedding light on the challenges and opportunities it presents for fisheries management. Fisheries play a crucial role in providing food security, employment, and economic growth around the world. However, the sustainable management of fish stocks is a complex task, particularly when commercial and recreational fisheries co-exploit the same resources. This article explores the pros and cons of such co-exploitation, shedding light on the challenges and opportunities it presents for fisheries management.

A common precondition for sustainability in fisheries is the existence of regular stock assessments. Stock assessments employ a variety of methods depending on the data available. The most reliable data-rich methods, such as virtual population analysis and statistical catch-at-age models, require data on catch, effort, and the age/length/weight composition, preferably from both the fishery users as well as from independent scientific surveys. The management of industrial commercial fisheries appears to become increasingly effective due to the presence of frequent and high-quality stock assessments, with many assessed stocks showing rebuilding from previously overfished states. However, the collection of data required for such assessments is costly, and therefore, high-quality data to pursue stock assessments are rarely available for many small-scale commercial and recreational fisheries. As a result, mixed-use fisheries often face a severe lack of data, preventing the application of stock assessment practices common to industrial commercial fisheries.

Increased Fishing Pressure

When there is insufficient data available for performing a traditional data-rich stock assessment, the fishery is usually referred to as data-poor or data-limited. Many small-scale commercial and recreational fisheries are characterised as such, with aggregated catch or landings data often being the only form of data available. One alternative to traditional stock assessment is to infer stock status from trends in catch data, as is done in stock status plots. However, because catches do not necessarily track changes in underlying biomass, such catch-based methods can result in incorrect conclusions. To overcome this problem and still be able to make predictions on stock status using aggregated catch/landings data, increasingly sophisticated models have been developed that either rely on population dynamics models or statistical correlations with data-rich assessed stocks. These data-poor models are referred to as catch-only models (COMs). COMs designed to estimate stock status time series can be divided into two broad categories: mechanistic and empirical COMs.

Mechanistic COMs fit a population dynamics model to the catch data and make assumptions regarding parameter values to make up for the lack of other data. Mechanistic COMs include models such as “catch maximum sustainable yield” (Catch-MSY) and “state-space catch-only model” (SSCOM). Empirical COMs use information from data-rich assessed stocks to find statistical associations between catch, stock status and other covariates. Empirical COMs include models such as “modified panel regression model” (mPRM) and “Zhou boosted regression tree” (zBRT). COMs are not as accurate in predicting stock status as data-rich statistical catch-at-age models, but they offer a temporary stepping stone when the absence of some data currently prevents a full data-rich assessment. In particular, statistical models that ensemble the estimates of individual COMs provide the best assessment of stock status based on catch data alone.

Fish Catch Time

In addition to using quantitative models to determine the status of data-poor stocks, assessments based on traditional

ecological knowledge of local residents or local resource users have also been performed. Although individual perceptions may conflict with scientific findings, such local knowledge may be one of the few sources of information on the development history of many fisheries. Furthermore, studies that have compared traditional ecological knowledge with independent stock assessments have often found that model outcomes align with local understanding and that local users can approximate scientific understanding of ecological relationships in fish stocks. Thus, the knowledge of local residents can be used to evaluate whether scientific and stakeholder perspectives agree.

This study aims to demonstrate how COMs can be used in an ensemble approach to assess the status of data-poor mixed-use fish stocks. For this, a northern pike Esox lucius L. (henceforth "pike") fishery in the coastal lagoons around the island of Rügen in the western Baltic Sea, Germany, is used as a case study. This coastal pike stock is targeted by both recreational and commercial fishers, but regular stock assessments are lacking, and disparate perspectives about stock status have emerged among stakeholders that contribute to local conflict. To help solve these issues, the status of the coastal pike stock in the lagoons around Rügen is assessed using seven different COMs, and a state-of-the-art ensemble model approach is used to account for individual model biases. Furthermore, local stakeholder perceptions on the development of the stock are collected to compare stakeholder perspectives with the assessment results. Thus, using a practically relevant example of an ongoing management dilemma in a mixed-use coastal fishery, this study demonstrates how COMs can be used as an initial method for the assessment of data-poor mixed-use stocks, being aware that it is not a perfect substitute for more data-rich approaches.