Sustainability and resource productivity




Design for Sustainable Fisheries — Modeling Fishery Economics

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Introduction

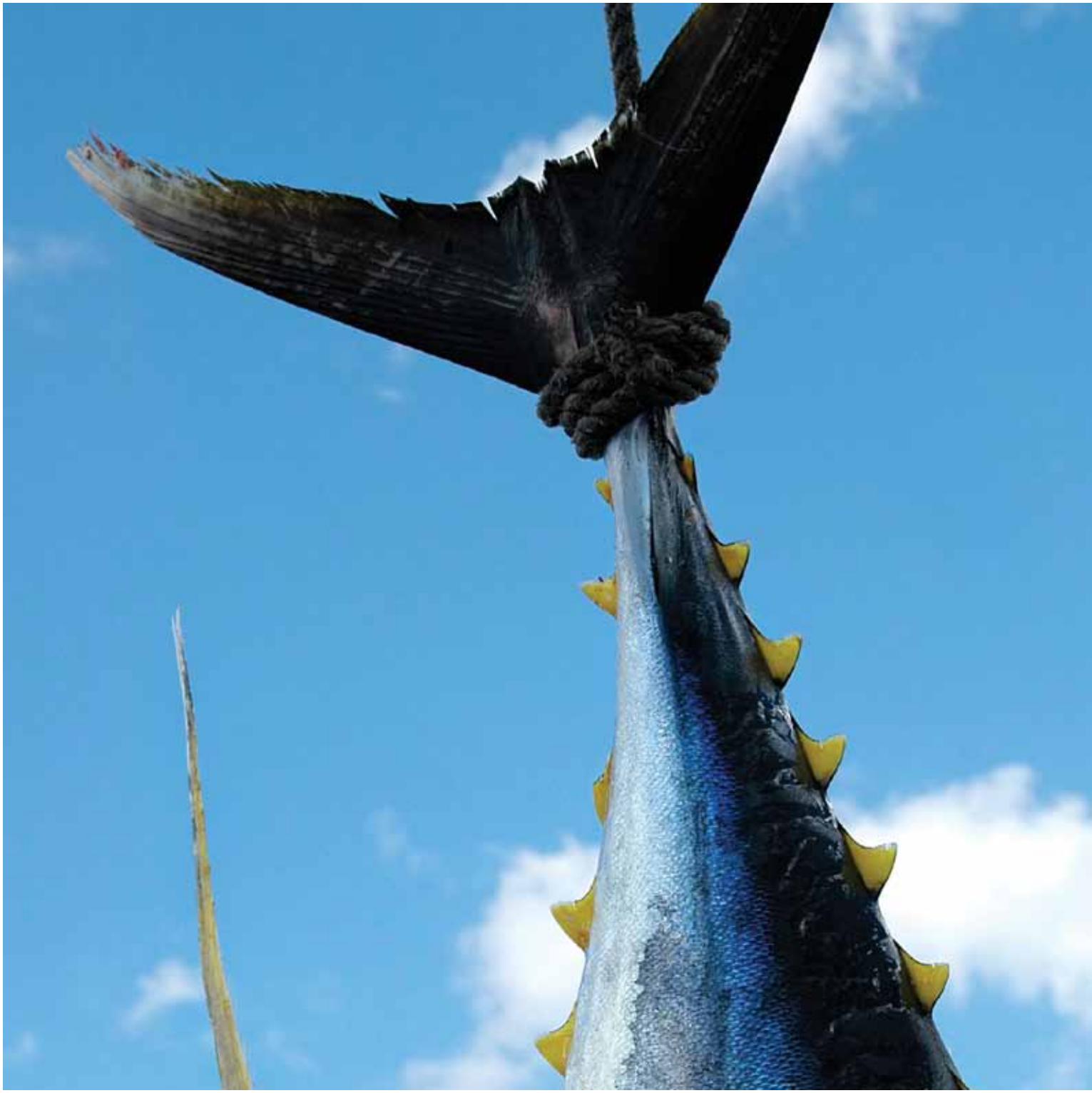
Fisheries provide employment for 180 million people worldwide and represent a significant percentage of the animal protein consumed globally, particularly in developing countries.[1] Fish and fishery products are one of the most widely traded agricultural commodities with exports worth more than $85 billion in 2008.[2] But marine fisheries today are under pressure. While fisheries in some developed countries are recovering, overfishing has impoverished the state of the marine ecosystem globally. According to Food and Agriculture Organization (FAO) data, 30 percent of fish stocks are currently considered overexploited,[3] with another 50 percent considered fully exploited.[4] In addition to being both a biological and a food-supply tragedy, the erosion and subsequent collapse of fisheries pose an immediate economic threat to fishers and others whose livelihoods depend on fishing. This threat extends beyond fishers to all participants along the value chain whose economic activity represents an estimated $500 billion per year.[5] There have been a number of studies highlighting the fact that the economic contribution from the world's marine fisheries is significantly smaller than it could be if fisheries were managed to their maximum sustainable yields. The World Bank estimates annual lost revenues to be $51 billion per year; other estimates range from $46–$90 billion per year.[6] Establishing biologically and economically sustainable fisheries is clearly desirable and necessary. However, achieving sustainable fishing practices is not a straightforward task as there are significant challenges that ultimately inhibit their realization, especially in making the transition to sustainability, as reducing catches and introducing new fishing practices to allow fish stock to recover are often necessary — which generally mean hardship for some stakeholders, albeit temporary.

That said, only a limited amount of research has been done to explore the challenges of a transition to sustainable fisheries in detail, particularly regarding the economic implications for the different players along the value chain. While there has been extensive biological modeling, there has been little work that focuses on the biological implications of a transition to sustainability and adds the economic modeling of different players in the value chain, enabling the exploration of scenarios that are realistic both biologically and economically. This report helps fill these gaps, presenting a methodology for identifying and evaluating pathways to sustainable fisheries.

The methodology is demonstrated by exploring the biological and economic impact of different pathways to sustainability for three different fisheries: East Atlantic bluefin tuna, Gulf of Mexico red snapper, and tropical grouper — each of which are either in imminent danger of collapse, or face significant challenges to achieving sustainability. This methodology could also be beneficial for understanding the economic value and sustainability of other fisheries.

The intention of this report is to engage all stakeholders in discussions that explore the best means of establishing sustainable fisheries around the world, based on a clear understanding of the options and their biological and economic implications. It is not the intention of this report to make recommendations.

1. FAO, *The State of World Fisheries and Aquaculture*, 2010.
2. Andrew J. Dyck and U. Rashid Sumaila, "Economic impact of ocean fish populations in the global fishery," *Journal of Bioeconomics*, 2010, Volume 12, Number 3, pp.227-243.
3. Overexploited refers to fisheries producing catches beyond their maximum sustainable limits, and fully exploited refers to fisheries where fishing levels are at or close to the maximum sustainable limits.
4. FAO, *The State of World Fisheries*, 2010. Analysis by CEA suggests that this may be an optimistic assessment of the state of global fisheries, with some assessments putting the level of overexploited fisheries as high as 70 percent. For a detailed review of the debate on the state of global fisheries and further academic references, see Chapter 1 of upcoming Design for Sustainable Fisheries report by CEA, 2011.
5. FAO, *The State of World Fisheries and Aquaculture*, 2010.
6. World Bank, *Sunken Billions* 2008. For additional references, see also: FAO 1993, Garcia and Newton 1997, Sanchirico and Wilen 2002, Wilen 2005.



Executive Summary

While transitioning to sustainable fisheries is crucial, there are at least three root causes that explain why it is so challenging. First, since achieving sustainable fishing typically requires a reduction in fishing effort and changes in fishing practices for some period of time, there are usually short-term financial losses throughout the value chain. Those players who — often for subsistence reasons resulting from a lack of alternative opportunities — place a higher value on short-term benefits may be less concerned about driving a fishery to collapse than about losing short-term harvests. Second, even when a fishery reaches a sustainable state, its economic and other benefits may not be evenly distributed among different players: in many cases fishery restoration creates winners and losers as some players will benefit from the long-term solution and others will carry an increased burden as a result of more sustainable practices. Third, data gathering and adequate fishery management are usually necessary to achieve sustainable fishing, however in many areas these are difficult to put into action . Without an indication of the health of the fish stock, even the fishers with the best intentions can overfish since they do not know when they are overfishing. Ineffective management of global fisheries is likely to result in the depletion of the shared resource, meaning unrecoverable ecological and economic losses.

To help address these challenges, we devised a methodology that can compare both the biological and economic impact of the different choices available for managing the different fisheries of the world. We collaborated with leading fishery experts from UC Santa Barbara and Eco-Analytics group to carry out the underlying biological modeling, and we led the overall analysis and contributed to the economic modeling for the bio-economic model. To illustrate the methodology and see how the model can provide a clear understanding of transition options to help stakeholders in their efforts to establish sustainable fisheries, we examined three fisheries in detail.

In each case outlined below, detailed field research was conducted to understand both the specific stakeholders concerned and the value chain dynamics. Using in-depth biological and economic modeling, we explored different potential future management scenarios, starting with a Business as Usual (BAU) scenario and comparing it with different transition paths to a sustainable state. By analyzing these scenarios, we could highlight the significantly different biological and economic outcomes.

- The study of the bluefin tuna (BFT) in the East Atlantic and Mediterranean provides an example of a fishery that is on the verge of collapse due to the species' high level of biological vulnerability, overfishing, and Illegal, Unreported, and Unregulated (IUU) fishing. We modeled three different scenarios: one in which current practices continue, a second where IUU fishing is eliminated, and a third where the fishery is closed completely to allow recovery. The first sees the collapse of the fishery within the next 2–5 years, along with the industry's profits. The second and third both return the bluefin tuna fishery to a sustainable path. Closure of the fishery brings about the fastest and most assured recovery of the bluefin tuna, but would be the most economically challenging transition path in the short term as both fishers and tuna ranches would see significant losses.

- The Gulf of Mexico red snapper case study provides an example of a fishery that has implemented an Individual Fishing Quota (IFQ) for its commercial sector and is on the road to recovery. But the speed of recovery and potential economic benefits are impeded by overfishing and dead discards in the recreational sector. The analysis examined five different scenarios, ranging from Business as Usual (BAU), to reducing the number of dead discards, and a combination of fewer discards and adherence to the Total Allowable Catch (TAC) limit imposed by the Gulf of Mexico Fishery Management Council (GMFMC). This target was set with the goal of reaching sustainability by 2032. The analysis showed that BAU would mean failing to meet the 2032 sustainability target. Full adherence to the TAC by all players and a 60 percent decline in the discard mortality rate could see the fishery reach sustainability in just five years, with all players benefiting.

- The third study is hypothetical due to lack of comprehensive biological and economic data on a tropical fishery. The case looks at a tropical grouper fishery using the biological characteristics of grouper and making assumptions on fishing practices based on data from a variety of fisheries in the Coral Triangle.[7] In this hypothetical case, the fishery starts in a relatively pristine state. However, a combination of overfishing and destructive fishing practices — due to a lack of management and appropriate incentives throughout the value chain — is driving the fishery and the eco-system to collapse. We looked at three different scenarios. The first assumes BAU, with only artisanal fishers fishing the waters. Nevertheless, the fishery collapses by 2029. The second models the entry of large-scale operators, which accelerates the collapse and sees short-term profits of local fishers halved within five years. The third excludes large-scale operators from tropical grouper fisheries at the same time as constraining harvests by artisanal fishers, helping the grouper fisheries return to economic and biological sustainability by eliminating destructive practices (such as the use of toxic chemicals) and maintaining fishing at a sustainable level. Under this scenario, profits for artisanal fishers are maximized in the long-term (20 years).

All three case studies had a number of issues that many fisheries have in common, including lack of data, IUU, overcapacity, and lack of ownership incentives.

Three key insights arose, which can guide the future evolution of the methodology and its application in the context of fisheries management.

First, stakeholder dynamics and root causes of key issues within specific fisheries are not always obvious and both in-depth field research and economic modeling are required to understand them.

Second, there are many different pathways to achieving the biological objective of sustainability, and modeling can help in: (1) providing a holistic view of the winners and losers in the value chain during a transition; (2) comparing the biological and economic impact of different transition pathways; and (3) identifying new management solutions with the smallest burden on the involved players.

Finally, to perform the economic analysis and construct the most effective solutions, a variety of experts need to be engaged in the debate — biologists, NGOs, fishery managers, government, multilateral agencies, value-chain players, and others — who all bring different insights into the dynamics of a fishery.

7. The Coral Triangle refers to a geographic area in Southeast Asia encompassing Indonesia, Malaysia, Papua New Guinea, and the Philippines, considered to be one of the most important marine biodiversity hotspots in the world.

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