TURFtools: A Community Inclusive Management Design Tool for Small-Scale Fisheries

Team: Jennifer Macy, Kaia Joye Moyer, Rodrigo Oyanedel, Salvador Rodriguez van Dyck, Keith Shattenkirk | Advisor: Chris Costello

The Problem Facing Small Scale Fisheries

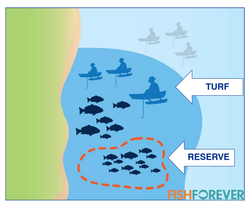
- Small-scale fisheries provide roughly half of the global fish catch and contribute the primary source of protein for 3 billion people worldwide. Yet, they tend to be in relatively poorer condition than larger, more thoroughly managed fisheries.
- These fisheries are particularly vulnerable to overfishing due to limited regulations and minimal enforcement in developing nations where they most commonly reside.
- Improving the management of these fisheries presents a significant opportunity to increase the productivity and health of marine ecosystems and build more resilient communities.

One Proposed Solution: TURF-Reserves

- Territorial Use Rights for Fishing (TURFs) paired with marine reserves (TURF-Reserves) have been proposed as a viable management strategy to combat overfishing in many small-scale fisheries.

What are TURF-Reserves?

TURF-Reserves provide fishers with exclusive long-term access to defined fishing areas (TURFs) while restricting critical areas from fishing pressures (Reserves), allowing fishers to benefit from exclusive fishing rights and spillover from reserves. This form of management has been shown to incentivize stewardship of marine resources.



The Importance of Design

- A critical challenge in TURF-Reserve implementation is design. Community participation in the design process is valuable, however, incorporating feedback into a science-based decision-making framework is difficult. While a wealth of scientific marine spatial planning tools exists, many small-scale fisheries are located in areas where scientific data is limited and the use of highly technological tools is not feasible.
- TURFtools addresses this challenge, combining local ecological knowledge and the best available scientific data to allow communities to compare spatial management design options by assessing the relative ecological and socio-economic outcomes of each. By improving the stakeholder inclusive management design process, TURFtools aims to help provide long-term security for both fishers and the resources on which they rely.

Project Objectives

- Provide a tool to support TURF-Reserve design decision-making, including:
  - A spatially explicit bio-economic model that evaluates tradeoffs between TURF-Reserve design options, and
  - An integrated, user-friendly interface and communication platform
- Tailor the tool for initial application in the Fish Forever Philippines TURF-Reserve initiative, and provide a customizable framework for broader global application thereafter

How TURFtools Works

1 Input Data

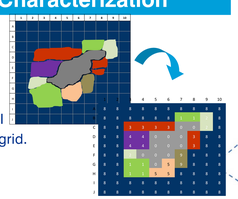
Species Information

The model considers biological, spatial, and economic characteristics of up to five (5) target species, utilizing local ecological knowledge and supplemented with a life history database from scientific literature.

Target Species Inputs
Leopard Grouper
a) Adult Range
1000
b) Species Growth Rate
0.650
c) Illegal Harvest
Average
c) Price
92
d) Cost
52

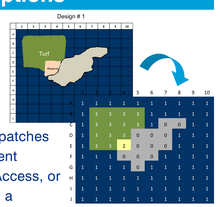
Habitat Characterization

Community habitat maps, including critical species habitats and conflicting uses, are translated into the model as a color-coded 10x10 grid.



Design Options

Up to five (5) community-driven TURF-Reserve spatial design options may be entered and saved in the model. In each design, non-land patches are assigned a management scheme (Reserve, Open Access, or TURF) that correlates with a specific fishing policy. These designs will be evaluated relative to a status quo, or no design, scenario.

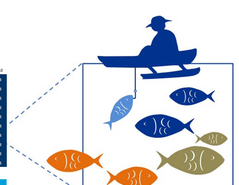


2 Run the Model

General Dynamic Equation

The TURFtools model utilizes a system of equations based on those commonly found in fisheries modeling literature and useful in data poor scenarios.

Spatial Interaction over Time

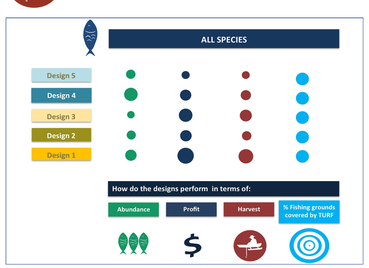


Each of the 100 patches in the 10x10 grid in the Excel tool is followed over 20 years, where annual harvest and illegal harvest, as well as annual growth and dispersal (summarized as settlement) are recorded. Stock biomass moves between patches based on typical adult home range.

3 View Outputs to Evaluate Designs

The model evaluates the relative performance of design options based on the biological, economic, and spatial inputs. Output metrics include species-specific harvest, abundance, and profits as well as design-specific metrics such as reserve size, spawning areas protected, among others. Metrics are communicated through the following icons.

Abundance | Profit | Harvest | Design Metric

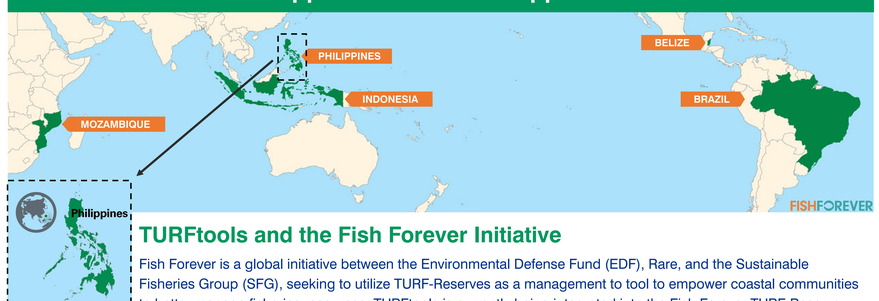


TURFtools offers several output visualization options, each customizable to display the species and metrics of interest. These visualizations, such as the charts above, are designed to facilitate community dialogue in the evaluation of tradeoffs between design options.

From Local Knowledge to Quantitative Analysis

TURF-Reserves can encourage stewardship and empower fishers to better manage their resources, leading to increased catch, healthier marine ecosystems, and a more secure economic future. TURFtools incorporates site-specific biological, spatial, and economic data into a stakeholder-driven TURF-Reserve design process. The tool includes a supplementary life history database that provides information for those inputs in which local data may not be available. Model outputs reflect the relative performance of different designs across a range of metrics and can be used to engage stakeholders in conversations regarding tradeoffs between determined goals and objectives. Each output chart is customizable based on community interests and priorities. TURFtools uses an Microsoft Excel platform because of the program's ease of adaptability, limited technological expertise barriers, and availability in the field, all of which support its incorporation into the community-driven design process.

Application in the Philippines



TURFtools and the Fish Forever Initiative

Fish Forever is a global initiative between the Environmental Defense Fund (EDF), Rare, and the Sustainable Fisheries Group (SFG), seeking to utilize TURF-Reserves as a management to tool to empower coastal communities to better manage fisheries resources. TURFtools is currently being integrated into the Fish Forever TURF-Reserve design process in the Philippines. As other sites begin the TURF-Reserve design and implementation process, TURFtools is expected to be used in other Fish Forever countries.

Fish Forever Philippines

Nearly half of the Philippines population lives on the coast, where fisheries have shown signs of exploitation as far back as the 1960s. A total of 16 communities are currently engaging in Fish Forever, 4 of which are currently beginning the TURF-Reserve design process. TURFtools underwent iterative testing, including two weeks in the Philippines working with field staff to refine the model, interface, and accompanying guidance documentation to ensure TURFtools is appropriate and effective in the field.

Future Global Application

EDF'S Fisheries Solution Center (FSC)

FSC designs and develops innovative fishery management tools and strategies that reverse overfishing and restore our oceans to abundance. The center works extensively with rights-based management, including TURFs. TURFtools provides an addition to FSC's fisheries toolkit where it will be made available at FSC's discretion to fisheries managers and communities worldwide.

Acknowledgements

We are incredibly thankful for the generous amount of technical knowledge, communication, and resources that our client, Fish Forever partners, and Bren School staff and faculty provided over the course of our project. Specific thanks go out to Dr. Chris Costello, Sarah Poon, Michaela Clemence, Gavin McDonald, Dr. Reniel Cabral, Emilie Litsinger, Erica Cunningham, Dr. Jake Kritzer, Janelle Mueller, Roquelito "Lito" Mancao, Rizalier 'Jun" Arnolo & Julius Guirjen.