Application of TURFtools

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 strategy to empower coastal communities to better manage their resources. TURFtools is currently being integrated into the Fish Forever TURF-Reserve design process in the Philippines, and 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, with the first 4 sites beginning the TURF-Reserve design process now.

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

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

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Overview

TURFtools is a user-friendly Microsoft Excel tool that incorporates best available science, local ecological knowledge, and social objectives to facilitate community-driven management decisions. The tool is currently being applied in the Philippines as part of the global Fish Forever initiative and was designed for application in a variety of fishery contexts worldwide.

Motivation

Photo credit: Kaia Joye Moyer

Small-scale fisheries provide roughly half of the world's catch and contribute the primary protein source for almost 3 billion people globally. Small-scale fisheries are particularly vulnerable to overfishing due to limited regulations and minimal enforcement in the developing nations where they often 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.

Project Objectives

- Support TURF-Reserve design decision-making process by creating tool to evaluate tradeoffs between TURF-Reserve design options.

- Tailor the tool for initial application in the Fish Forever Philippines initiative, and provide a framework for global application.

One Proposed Solution: TURF-Reserves

Territorial Use Rights for Fishing paired with marine reserves (TURF-Reserves) have been proposed as a viable management strategy to combat overfishing in small-scale fisheries. TURF-Reserves provide 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 has been shown to incentivize stewardship of marine resources.

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 often 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 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 design process, TURFtools aims to help provide long-term security for fishers and the resources on which they rely.

Photo credit: Rodrigo Oyanedel

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 |
| c) Illegal Harvest |
| Average |
| c) Price |
| 92 |
| d) Cost |
| 52 |

Habitat Characterization

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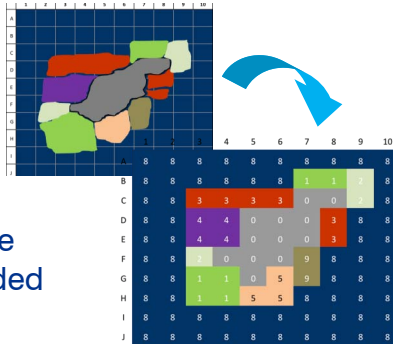
Design Options

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 in the 10x10 grid are assigned a management scheme (Reserve, Open Access, or TURF) that correlates with a specific fishing policy. These designs are then evaluated relative to a status quo, or no design, scenario.
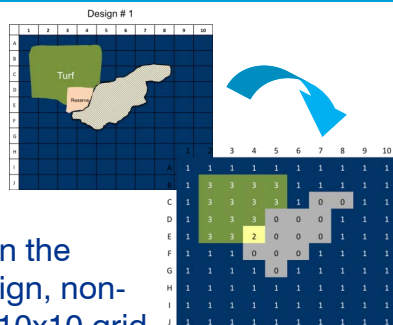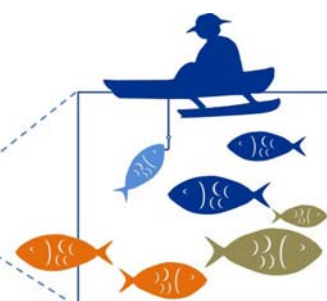
2 Run the Model

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.

Biomass This Year − Legal Harvest − Illegal Harvest + (growth + dispersal / Settlement) = Biomass Next Year

Spatial Interaction over Time

Each of the 100 patches in the **10x10 grid** in the Excel tool are followed over 20 years, where annual legal and illegal harvest, as well as annual growth and dispersal are recorded. Stock biomass moves between patches based on typical adult home range.
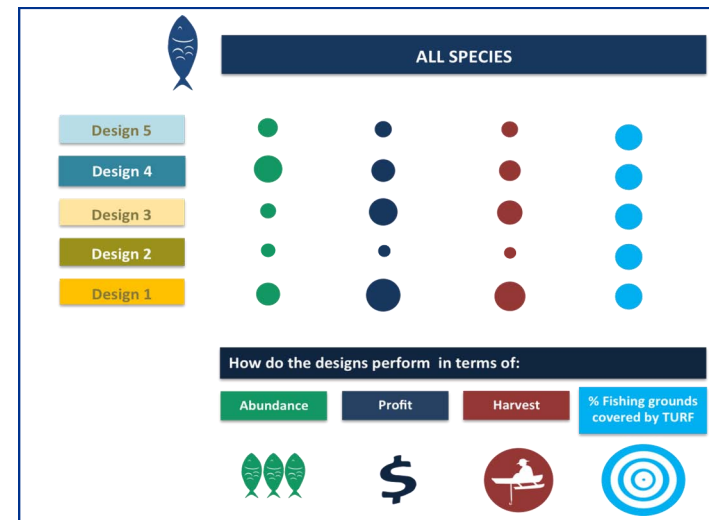
3 View Outputs to Evaluate Designs

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

Harvest

Profit

Design Metrics

ALL SPECIES

Design 5
Design 4
Design 3
Design 2
Design 1

How do the designs perform in terms of:

Abundance | Profit | Harvest | % Fishing grounds covered by TURF

ALL SPECIES

Profit (vertical axis) vs Total Harvest (horizontal axis)

Design 1 | Design 2 | Design 3 | Design 4 | Design 5

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 Ecological Knowledge ➡ To Quantitative Analysis

Photo credit: Jennifer Macy

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.