LENFEST OCEAN PROGRAM

A scientific summary
September 2024

SUPPORTING SCIENCE AND COMMUNICATING RESULTS.

IMPLEMENTING ECOSYSTEM-BASED FISHERIES MANAGEMENT IN INDONESIA

To move from ecosystem approaches in fisheries management (EAFM) to ecosystem-based fisheries management (EBFM), managers, scientists, and fishing communities need to adapt current management systems rooted in single-species assessments and integrate new or additional ecosystem indicators in these assessments. In a previous project on Benchmarks for Ecosystem Assessment, an expert Working Group made of scientists, managers, and policymakers from four countries—United States, Chile, Australia, and India—identified three indicators that characterize ecosystem structure and function: topology, resiliency, and distortive pressure. These indicators can be collated from existing data and assessed under current management infrastructure. When combined, they produce an Ecosystem Traits Index (ETI) score that signals ecosystem health, allowing managers to more easily identify when an ecosystem is under stress and what actions they should take.

In this project, the Lenfest Ocean Program is supporting a team of researchers and practitioners led by Dr. Irfan Yulianto and Dr. Heidi Retnoningtyas with Rekam Fisheries Resource Center of Indonesia, to better align Indonesian fisheries with the principles of EBFM by integrating indicators of ecosystem structure and function into the management of small-scale fisheries in Saleh Bay, Indonesia.

FISHERIES MANAGEMENT IN SALEH BAY

In Indonesia, waters are divided into 11 Fisheries Management Areas (FMAs), each of which require a Fisheries Management Plan (FMP) describing the status of fish stocks, fisheries management goals, and recommended implementation steps. At a provincial level, FMPs are adapted for local needs through a Fisheries Management Plan of Action (FMPoA). In this step, managers seek stakeholder input crucial to developing management goals and implementation objectives. Saleh Bay is located in the West Nusa Tenggara Province in Indonesia in FMA 713. Encompassing a variety of important coastal ecosystems including coral reefs, seagrass beds, and mangroves, the area provides vital habitat for various fish resources and supports main fishing grounds for over 5,000 fishers from 26 coastal villages. Fishers and managers here are eager to extend the current fisheries management system beyond single-species management to better reflect the multi-species nature of these fishing areas. In this project, the research team will work with local managers and stakeholders to incorporate ecosystem indicators into the FMPoA for Saleh Bay.

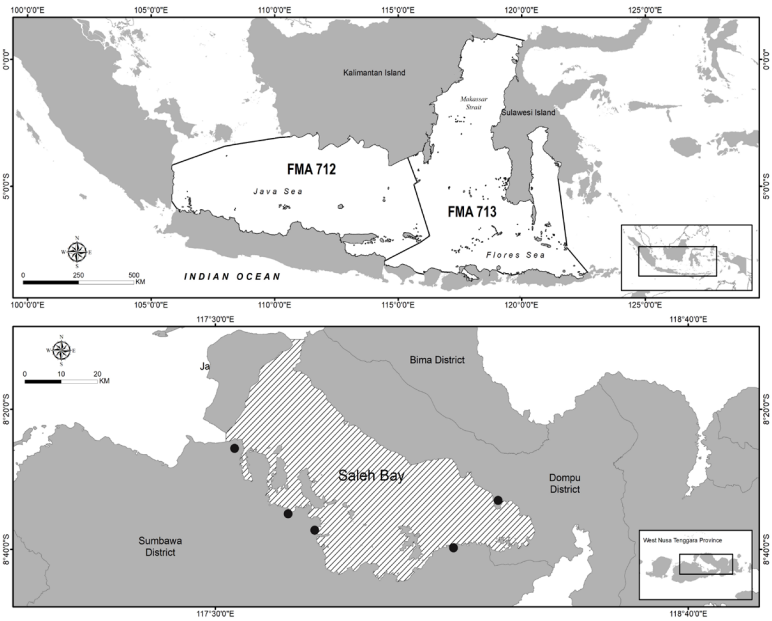


Figure 1

Map showing Fisheries Management Area 712 (Java Sea) and 713 (Makassar Strait and Flores Sea) in Indonesia (above) and the main fishing landing sites (black dots) in Saleh Bay, West Nusa Tenggara (below).

APPLYING ECOSYSTEM INDICATORS TO FISHERIES MANAGEMENT

One important finding of from the Benchmarks for Ecosystem Assessment Working Group is that the identified ecosystem indicators can be used alongside current fisheries data and management systems. Here, the research team will employ existing fisheries data from multiple years of surveys to calculate ecosystem indicators and recommend harvest strategies that promote the sustainability of ecosystem health.

The research team will begin by gaining a better understanding of the current ecosystem state by conducting a principal component analysis (PCA) that describes changes to catch composition over time alongside interviews with key stakeholders from fishing communities about their knowledge of change and threats to fished species and associated habitats. The research team will then produce heatmaps that show how catch composition of species has have shifted over time and what factors drove the shift(s). Next, the research team will define the topology, resiliency, and distortive pressures of the past and current ecosystem states to illuminate overall ecosystem structure- that is, how species are connected, the stability of those connections, as well as the functions each species provides. See the executive summary "Moving from A to B" for more information.

To understand system structure—or topology—researchers will construct a food web model using the Ecopath with Ecoism (EwE) tool and then conduct a criticality analysis to identify "hub species." Unlike "keystone species", hub species are those which have greater connections to others in the food web and are therefore a critical node that should receive special management attention.

Researchers will evaluate the resilience, or strength, of the ecosystem structure by calculating a resilience index (e.g., strong, partial, or no resilience) for the ecosystem in past and recent years. This will allow researchers to better classify current ecosystem resilience in relation to previous years and then, identify a desired ecosystem state which can produce desired harvest rates.

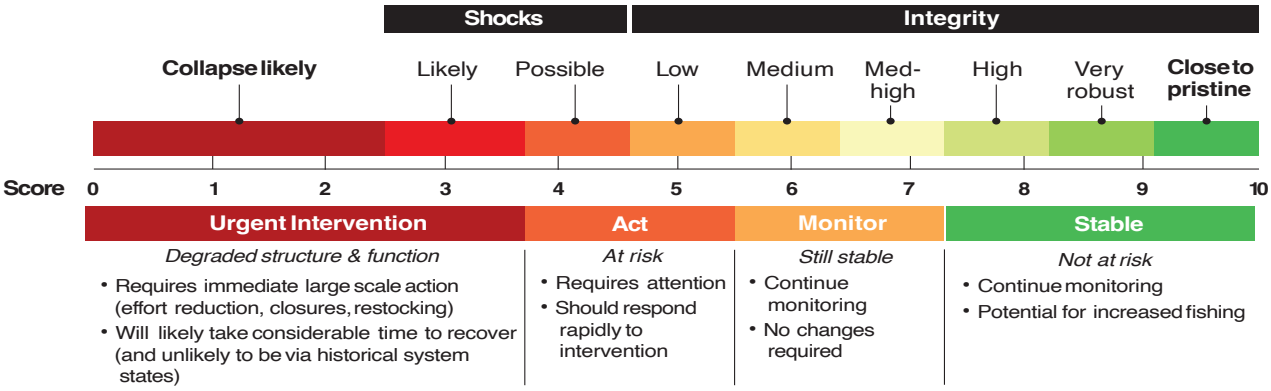
The research team will then identify where fishing pressures (i.e., distortive pressures) are strongest on the current ecosystem structure by calculating a "green band" of fishing pressure that signifies acceptable fishing limits. By plotting current harvest rates on the chart with the 'green band', scientists can identify where fishing pressure is either too high (above the green band), acceptable (within the green band), or low (below the green band), in which case there would be scope for increasing fishing.

Results from all indicators will be combined to produce an Ecosystem Traits Index (ETI) score for the ecosystem. Researchers can do this for ecosystem states through time and plot the ETI score on a chart to demonstrate how the ecosystem state has or has not changed. This will also highlight the current ecosystem state and signal whether management action is needed (Figure 2).

Figure 2

ETI CAN ACT AS A WARNING SYSTEM

Think, a forest fire warning system, but for ecosystems. A high ETI score signals a healthy ecosystem structure and function. A low score indicates one or more indicators are out of balance and this requires further investigation- taking a closer look at each indicator will help managers understand where action is needed and what actions to consider.



A NOTE ON USING ETI

ETI scores are a basis for a broader discussion among scientists, decision-makers, and stakeholders of fishery performance in terms of stock, economic, and social objectives. The scores can be used to signal how an ecosystem is responding to fishing and management decisions over time, as well as predict how an ecosystem might respond to a management decision (e.g., proposing the use of different gear types). ETI can also be paired with other information to inform harvest levels- for example, scientists can calculate Multispecies Maximum Sustainable Yield (MMSY) alongside ETI to estimate the level of sustainable allowable catch for a system or large group of fish species. Throughout the project, the research team will convene trainings and meetings with managers at the provincial and national levels of government as well as key stakeholders in fishing communities to share key findings, receive feedback, and discuss final recommendations.

Research Team

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