EVALUATING ADAPTIVE MANAGEMENT STRATEGIES FOR CLIMATE-RESILIENT FISHERIES

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BACKGROUND

Global fisheries are an important food source, providing 15% of the average per capita animal protein intake for over 2.9 billion people.

Fisheries provide economic value, employing 43.5 million people in primary fish production and yielding exports valued at $85.9 billion.

Despite their social and economic significance, over 33% of global fisheries are currently classified as overfished. In reality, it is likely that number is much larger due to a lack of available data.

Furthermore, climate change is now altering marine ecosystems and fish populations in a variety of ways, all of which may result in changes to maximum sustained yield (MSY).

AS A RESULT, GLOBAL FISHERIES STAND TO LOSE UP TO 50% OF GROSS REVENUES IN THE FACE OF SEVERE CLIMATE CHANGE AND CONTINUED OVERFISHING.

THE FISHE PROCESS

The Framework for Integrated Stock and Habitat Evaluation (FISHE) is an 11-step framework designed by EDF to assist data-limited fisheries managers evaluate management options with limited inputs.

Ultimately, the framework helps managers address three main questions:

What is the state of your resource? ▶ What is your response? ▶ How often will you repeat this?

PROBLEM

While FISHE was designed to capture the dynamic nature of fisheries, it was not specifically designed to address the expected environmental changes stemming from global climate change.

OBJECTIVES

1. **DETERMINE** IF FISHE WILL CONTINUE TO PERFORM AS EXPECTED UNDER VARIOUS CLIMATE CHANGE SCENARIOS
2. IF NOT, **IDENTIFY** WHY, AND **RECOMMEND** WHAT REVISIONS COULD SIGNIFICANTLY IMPROVE ITS PERFORMANCE

AS LIVELIHOODS AND FOOD SECURITY DEPEND ON HEALTHY FISHERIES, IT IS IMPERATIVE THAT FISHE CONTINUES TO OFFER SOUND SCIENTIFIC GUIDANCE IN THE FACE OF CLIMATE CHANGE

APPROACH

Our team developed a model to test different management actions on fishery outcomes, made up of three components:

- **Biological** to track the growth of the fish stock over time
- **Climate** to incorporate the effects of climate change on the fish stock
- **Management** to simulate FISHE management actions.

MODEL INPUTS

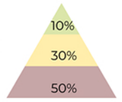
BIOLOGICAL	CLIMATE	MANAGEMENT
Population dynamics model	+ Climate change effects	+ FISHE management actions

MODEL OUTPUT: 200,000+ simulations of fish stocks over 100 year periods

WITH THIS MODEL, OUR TEAM ASSESSED THE ABILITY OF DIFFERENT MANAGEMENT ACTIONS TO MITIGATE THE EFFECTS OF CLIMATE CHANGE.

1: Sampling Accuracy

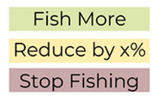
It's impossible to know exactly how many fish are in the water, but managers can make estimates. We tested the impact of investing resources to make better estimates on fishery outcomes. We compared three levels of sampling accuracy - 50%, 30%, and 10% sampling error.



2: Reductions in Fishing Pressure

One common action available to fisheries managers in response to a poor fishery status is to reduce the amount of fishing that is allowed.

We tested and compared a range of reductions in fishing pressure, from 5% to 50% reductions.

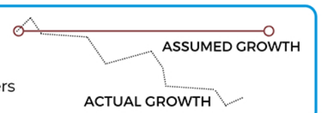


3. Assessment Frequency

Repeating the process of estimating the status of the fishery and instituting a management action more often means a fishery manager is more likely to correct a past poor decision with a better one. We tested and compared assessment frequencies of every 20, 15, 10, 5, and 1 years.

4: Climate Change Anticipation

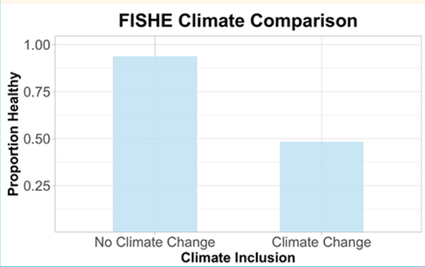
We simulated fisheries managers that took climate change into account when making decisions by assuming the growth of the fish stock would change in some way to due to climate effects. In this test, managers were perfect in their climate response.



FINDINGS

OBJECTIVE 1:

FISHE climate comparison. Fishery biomass was tracked over a 100-year time period without climate change and with climate change. We assume a 10-year assessment interval and good sampling accuracy (10% error margin). When a fishery is estimated to be experiencing too much fishing pressure, it is reduced by 15% until the next assessment.



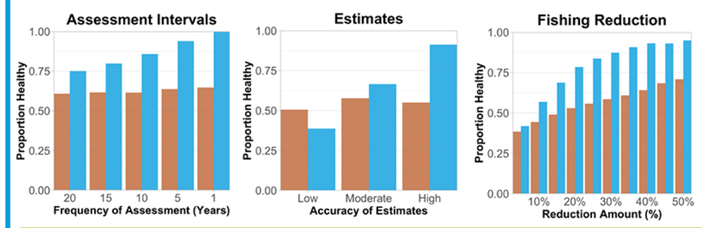
OUR FINDINGS SHOWED THAT FISHE WILL NOT PERFORM AS EXPECTED UNDER VARIOUS CLIMATE CHANGE SCENARIOS.

For this scenario in our model, 90% of fish stocks managed using FISHE were healthy after 100 years without climate change while less than 50% were healthy with climate change incorporated.

OBJECTIVE 2:

More aggressive use of traditional management actions (improving sampling accuracy, increasing assessment frequency, and further reducing fishing pressure) can improve outcomes, but alone are not sufficient to maintain sustainable fisheries in the face of climate change. By perfectly anticipating climate change, however, FISHE performs almost as well as it would without climate change.

OUR RESULTS INDICATE THAT REGARDLESS OF THE MANAGEMENT ACTION, ANTICIPATING THE EFFECTS OF CLIMATE CHANGE ON YOUR FISHERY GENERALLY IMPROVES OUTCOMES.



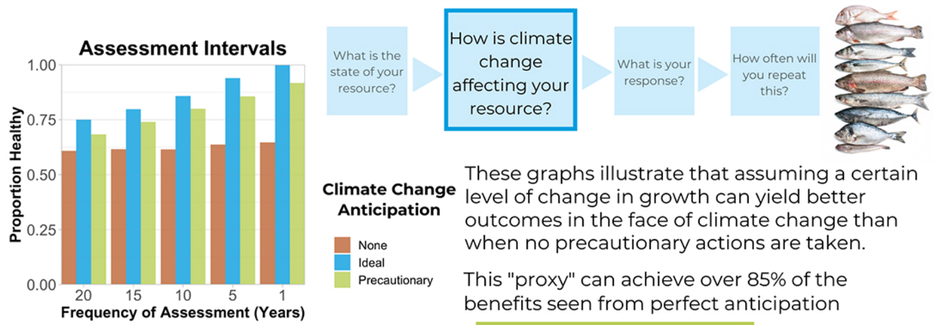
In the figures, no climate change anticipation corresponds to a fishery where growth is considered consistent, and ideal climate change anticipation corresponds to a fishery where changes in growth due to climate change are considered with perfect accuracy.

However, understanding how fish are responding to climate change is challenging in any real-world scenario, especially data-limited ones. Can FISHE be adapted to capture the benefits from anticipating climate change?

RECOMMENDATIONS

A REGIONAL PROXY FOR CLIMATE CHANGE ANTICIPATION

We recommend that EDF incorporate an additional management question into FISHE: How is climate change affecting your resource? Different geographies will experience different severities of climate effects. Taking a precautionary approach, fisheries managers can institute a climate change anticipation "proxy" - an assumed change in the growth of the fish stock - that is scaled to the expected severity of climate change in their region.



These graphs illustrate that assuming a certain level of change in growth can yield better outcomes in the face of climate change than when no precautionary actions are taken.

This "proxy" can achieve over 85% of the benefits seen from perfect anticipation

CONCLUSION

Climate change is affecting how fast fish grow and where they can be found, but how quickly and severely these impacts are occurring is uncertain and varies across species and regions. Our project provides EDF with evidence that precautionary management can improve outcomes despite the uncertainties of climate change and provides a framework for testing strategies that improve outcomes and promote more climate resilient fisheries.

THANK YOU

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