Adaptive Fishery Management in Belize

Training Module #4
• Deep dive into adaptive fishery management (AFM)
Why is adaptive management important for data-limited fisheries?

- Fisheries are dynamic systems
- Available data is often incomplete, uncertain, and accompanied by biases
- Full statistical stock assessments are often not possible
A multi-indicator framework for adaptive fishery management in Belize

1. Define social, ecological, and economic goals
2. Identify key target species for management
3. Select performance indicators, reference points, and assessment methods
4. Define harvest control rules
5. Collect and manage data
6. Run Assessments
7. Interpret results
8. Adjust fisheries management controls
9. Adaptive cycle
Key features of this framework

• Process of designing the framework is collaborative and stakeholder-driven

• Harvest control rules are transparent and objective

• Uses multiple performance indicators

• Uses performance indicators appropriate for available resources and technical capacity

• Local stakeholder knowledge is incorporated throughout the entire process
A national adaptive management framework

Setting sustainable, science-based, adaptable Total Allowable Catch (TAC) limits for conch and lobster
1. Goals

End open access

Prevent decline in fisheries and increase abundance to protect the health of the Mesoamerican Reef

Improved livelihoods and a prosperous industry

Encourage collaboration between managers, fishermen, and NGOs

Improve overall management of fisheries, including compliance with international commitments
2. Identify Targets

1. Define social, ecological, and economic goals

2. Identify key target species for management

3. Select performance indicators, reference points, and assessment methods

4. Define harvest control rules

5. Collect and manage data

6. Perform assessment methods

7. Interpret assessment results

8. Adjust fisheries management controls
### 3. Performance Indicators & reference points

**Performance indicators** provide information about the current performance of the stock - they indicate how things are going.

A **target reference point** is a numerical value that indicates that the performance of a stock is at a desirable level.

A **limit reference point** is numerical value that indicates that the status of a stock is unacceptable (e.g. highly overfished).

<table>
<thead>
<tr>
<th>Step</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Define social, ecological, and economic goals</td>
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<td>Adjust fisheries management controls</td>
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3. Performance Indicators & reference points

### Available Data

<table>
<thead>
<tr>
<th>Available Data</th>
<th>Who Collects the Data</th>
</tr>
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<tbody>
<tr>
<td>Underwater Visual Survey</td>
<td>Government NGOs</td>
</tr>
<tr>
<td>- Density</td>
<td></td>
</tr>
<tr>
<td>- Species identification</td>
<td></td>
</tr>
<tr>
<td>Length Composition Survey</td>
<td>Government NGOs</td>
</tr>
<tr>
<td>- Species composition</td>
<td></td>
</tr>
<tr>
<td>- Size and weight</td>
<td></td>
</tr>
<tr>
<td>Catch Reporting System Total landings</td>
<td>Fisherman (logbooks) Government</td>
</tr>
<tr>
<td>- CPUE</td>
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</tr>
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3. Performance Indicators, reference points

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### Conch
- Density ratio
- Density (juveniles and adults)
- Shell length
- Lip thickness
- Percent mature
- CPUE (early and late season)
- Previous Season’s Catch

### Lobster
- Density ratio
- Density
- Tail Weight
- Carapace Length
- Percent Mature
- CPUE (early and late season)
- Previous Season’s Catch
3. Performance Indicators & reference points

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<tr>
<th>Performance Indicator</th>
<th>Reference Point</th>
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<tbody>
<tr>
<td>Pre-season adult and sub-adult patch density</td>
<td>Target – Average over last 10 years</td>
</tr>
<tr>
<td></td>
<td>Limit – 88 individuals/Ha</td>
</tr>
<tr>
<td>Previous season’s total catch</td>
<td>Average over last 10 years</td>
</tr>
<tr>
<td>Pre-season average shell length</td>
<td>Average over last 10 years</td>
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<tr>
<td>Early and late season CPUE</td>
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<tr>
<td>Previous season’s average tail weight</td>
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A harvest control rule translates the interpretation of assessment results into adjustments in fisheries management measures that control fishing.

It’s important to agree on these before performing fishery assessments.
Scientists and managers work with fishermen and other fishery actors to define harvest control rules.

These rules guide managers and tell them what to do in case the indicators are near or below targets and limits.

“IF we find that our fishery is doing X, then we will do Y”

Examples:

• If all indicators show that stock is abundant and productive, fishing mortality can remain the same
• If all indicators show that stock is in decline, fishing mortality will be reduced by X% (depending on severity)
<table>
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<tr>
<th>Indicators</th>
<th>Stock Status</th>
<th>Action</th>
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<tr>
<td>&lt; Target Reference Points</td>
<td>overfished</td>
<td>Increase harvest controls</td>
</tr>
<tr>
<td>= Target Reference Points</td>
<td>stable</td>
<td>Maintain harvest controls</td>
</tr>
<tr>
<td>&gt; Target Reference Points</td>
<td>performing better than targets</td>
<td>Relax Harvest Controls</td>
</tr>
<tr>
<td>&lt; Limit Reference Points</td>
<td>in danger</td>
<td>Close Fishery</td>
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Compare Performance Indicators to Target and Limit Reference Points and Adjust Harvest Controls

- **Indicators < Target Reference Points** → Stock is overfished → Increase harvest controls
- **Indicators = Target Reference Points** → Stock is stable → Maintain harvest controls
- **Indicators > Target Reference Points** → Stock is performing better than targets → Relax Harvest Controls
- **Indicators < Limit Reference Points** → Stock is in danger → Close Fishery
## Compare Performance Indicators to Target and Limit Reference Points and Adjust Harvest Controls

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<td>Stock is in danger</td>
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- **Indicators < Target Reference Points**
  - Stock is overfished
  - Increase harvest controls

- **Indicators = Target Reference Points**
  - Stock is stable
  - Maintain harvest controls

- **Indicators > Target Reference Points**
  - Stock is performing better than targets
  - Relax Harvest Controls

- **Indicators < Limit Reference Points**
  - Stock is in danger
  - Close Fishery
4. Harvest Control Rules

**Harvest Control Rule:** Generally, what we want to do under certain scenarios in order to meet our goals

- “Reduce fishing pressure”
- “Don’t catch babies”

**Harvest Control Measure:** Actual mechanism through which we will accomplish the harvest control rule (e.g. catch limit, gear restriction, RBM)

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What are fisheries management measures?

Direct Measures:
- **How much:** Catch limits

Indirect Measures
- **Who:** Licenses
- **Where:** Spatial closures
- **When:** Seasonal closures
- **How:** Effort Controls; Gear Restrictions
- **What:** Size and sex-specific regulations

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4. Data

Data collection programs need to be tied to goals, assessment methods and management needs to save money and time, and to provide useful data.

Identify information gaps in priority fishery related to assessment and management, adapt & continue current sampling regime:
FISHERY DEPENDENT DATA

Catch monitoring
- logbooks from fishers & samplers to cross-check logbooks and fill in gaps
- At-sea, Landings, Markets

Intent: collecting data regularly on bycatch and landed catch.
You participate in collecting these data regularly. Every time you complete a logbook or trip ticket report, or talk to a sampler, you are providing data that may ultimately make it into an assessment.
FISHERY INDEPENDENT MONITORING

Measures of Abundance/Diversity/Size – help to estimate the fish in the sea or the unfished stocks

- Scientific surveys in the field
- Visual Surveys
4. Connecting data to performance indicators and data streams

Whenever possible, use multiple performance indicators from multiple independent data streams.

**Data Streams**

<table>
<thead>
<tr>
<th>Fishery Independent</th>
<th>Length-Composition Survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fishery Dependent Length-Composition Survey</td>
<td></td>
</tr>
<tr>
<td>Catch Reporting System &amp; Boat Intercept/Landing Site Survey</td>
<td></td>
</tr>
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**Fishery-independent data**
- Scientific survey of length frequencies
- Scientific survey of densities
- Scientific survey of habitat distribution
- Scientific survey of catch per unit effort

**Fishery-dependent data**
- Knowledge about how fisheries interact with stocks
- Catch data
- Length frequency
- Catch per unit effort
- Estimated stock size
- Selectivity of the fishery
4. Connecting data to performance indicators and data streams

Choosing indicators: think about the management goals and the available data

<table>
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<tr>
<th>Goals</th>
<th>Indicators</th>
<th>What it indicates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustainable yields</td>
<td>Fishing mortality (F)</td>
<td>How much fishing pressure is occurring</td>
</tr>
<tr>
<td></td>
<td>Froese indicators</td>
<td>How many fish caught are of sufficient age to reproduce.</td>
</tr>
<tr>
<td></td>
<td>Average length</td>
<td>What length is the most commonly caught.</td>
</tr>
<tr>
<td></td>
<td>Total capture</td>
<td>Total amount of fish caught.</td>
</tr>
<tr>
<td></td>
<td>Density</td>
<td>How many of the target stock there in an area.</td>
</tr>
<tr>
<td>Strong fishery profits</td>
<td>Catch per unit effort (CPUE)</td>
<td>Amount of fish caught per unit of effort (e.g., day, hours).</td>
</tr>
<tr>
<td>Healthy stocks and ecosystems</td>
<td>MPA density ratio</td>
<td>Ratio of fish density outside:inside a no take zone.</td>
</tr>
<tr>
<td></td>
<td>Spawning potential ratio (SPR)</td>
<td>Percentage of the stock’s full reproductive potential</td>
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### 6. Collect and manage data

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### Available Data

#### Conch
- Underwater Visual Survey
- Length Composition Survey
- Catch Reporting System (Catch and effort)

#### Lobster
- Underwater Visual Survey
- Length Composition Survey
- Catch Reporting System (Catch and effort)
7. Perform assessments

- **Length data**
  - Catch curve
  - Spawning potential ratio
  - Mean length (LBAR)
  - Froese sustainability indicators

- **Catch and effort data**
  - Trends in catch
  - Trends in CPUE
  - Mean weight

- **Underwater visual survey data**
  - Coral reef indicators
  - MPA density ratio

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Interpret and verify results; draw on the knowledge of fisher, MA manager, scientists, government agencies, and others.
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Science to action

Adaptive cycle

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Questions?