BELIZE FISHERIES PROJECT

Fisheries Journalism Workshop

April 12, 2024

Fisheries Science and Management: What it means and how it works

Graeme Parkes, MRAG Americas

Text box colour coding

- General Fisheries Science Stuff

- Belize Fisheries Stuff

Fisheries: Some Basics

- Fisheries are a **Renewable Resource** – you can keep catching fish* as long as you don't catch too many too quickly.
- Fisheries Science seeks to understand how much fishing a population can sustain in the long term without becoming "overfished".
- Fish Biology investigates fish abundance, how they live, grow, reproduce and die.
  - Some grow faster and live shorter lives
  - Some grow slower and live longer lives
- Fisheries Science looks at the interactions between the fishers and the fish
- In a well understood and properly managed fishery you can fish less, but catch more over the longer term:
  - 10% of a larger stock is more than 50% of a smaller (and shrinking) stock

* Note that when we talk about "fish" we are referring to all kinds of marine animals that are harvested (including conch, lobster etc.)

What is Fisheries Science?

Triple Bottom Line: Environmental, Financial and Social (Planet, Profit and People)

- **Questions for Fisheries Science:**
  - Where is the fishing happening?
  - What fish are the fishers trying to catch (**target stocks**) and how much?
  - What fish are being caught at the same time (**bycatch**) and how much?
  - How many **fish** are there?
  - How many **fishers** are there?
  - How many **fishing licenses** are there?
  - What types and how many **fishing vessels** are actively fishing?
  - What types of **fishing gear** are being used and how effective are they?
  - How do different vessels and gears **interact** (e.g. artisanal vs. industrial fleets)?

Fishing Mortality

Fishing Effort

Catch per Unit Effort (CPUE)

Catchability

What is Fisheries Science?

Triple Bottom Line: Environmental, Financial and Social (Planet, Profit and People)

- **Questions for Fisheries Science**:
  - How do the fish species being caught **interact** with each other and other species?
  - Is the target species an important **prey** for other species?
  - What protected species are being killed by the fishing gear (**Incidental mortality**)?
  - What **habitat impacts** are caused by the fishing gear?
  - What kinds of **pollution** result from fishing (including carbon footprint)?
  - How is the marine environment **changing** over time?
  - What other **ecosystem impacts** and interactions are happening due to fishing?

Ecosystem Effects

Climate Change

What is Fisheries Science?

Triple Bottom Line: Environmental, Financial and Social (Planet, Profit and People)

- **Questions for Fisheries Science:**
  - What is the **cost** of fishing?
  - Where and how are the fish **landed** and sold?
  - Where and how are the fish **processed** and sold?
  - How are the fish transported?
  - Who buys the fish?
  - Is the market local, regional or international?
  - What are the **prices** for different fish and fish products?
  - What do fishers do, besides fishing?
  - How much do coastal communities rely on fishing?
  - What will be the impacts on the community of changes/reductions in fishing opportunities?

Economics

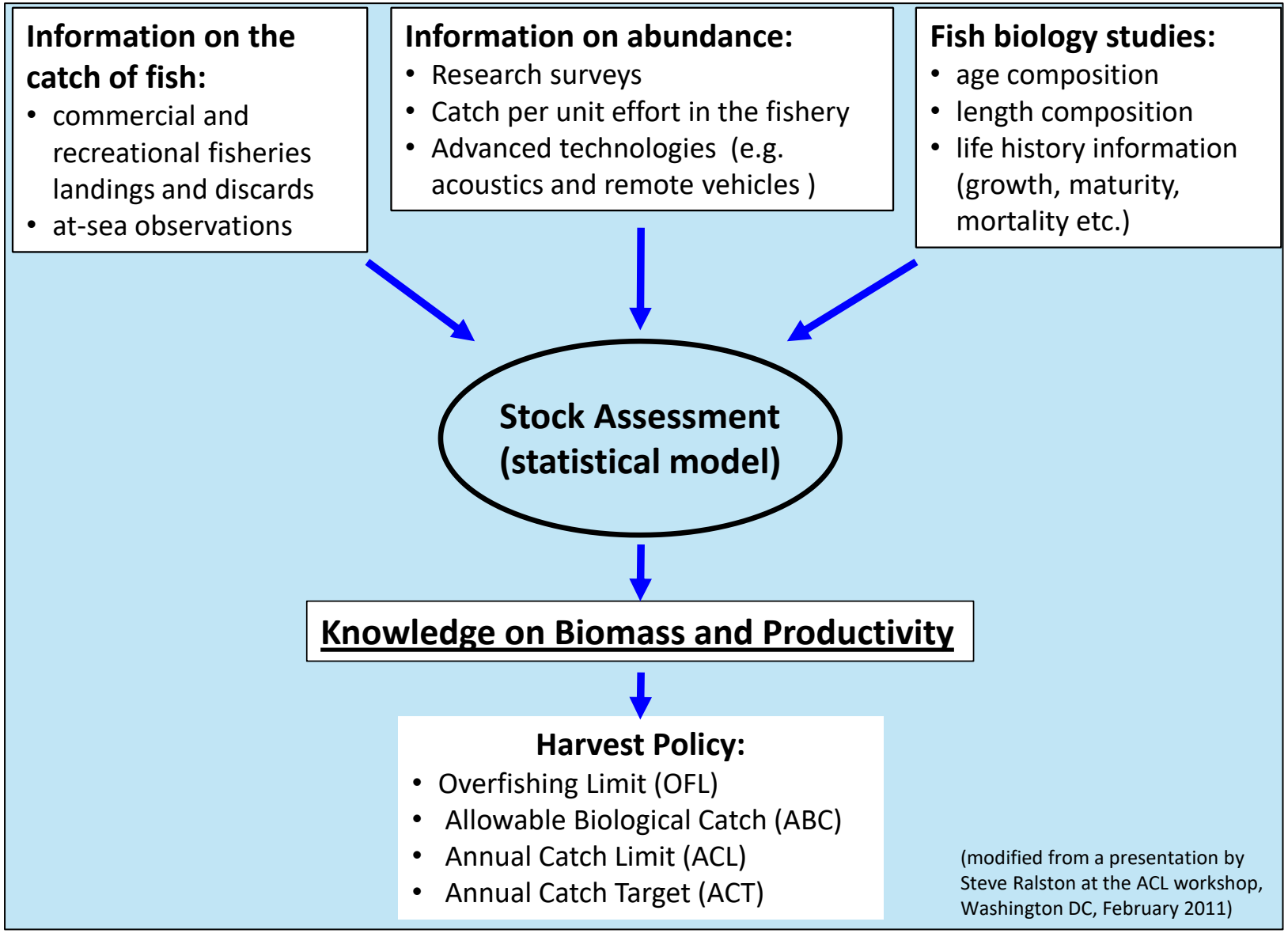
Market and supply chain

Fishing Dependent Communities

Social Impacts

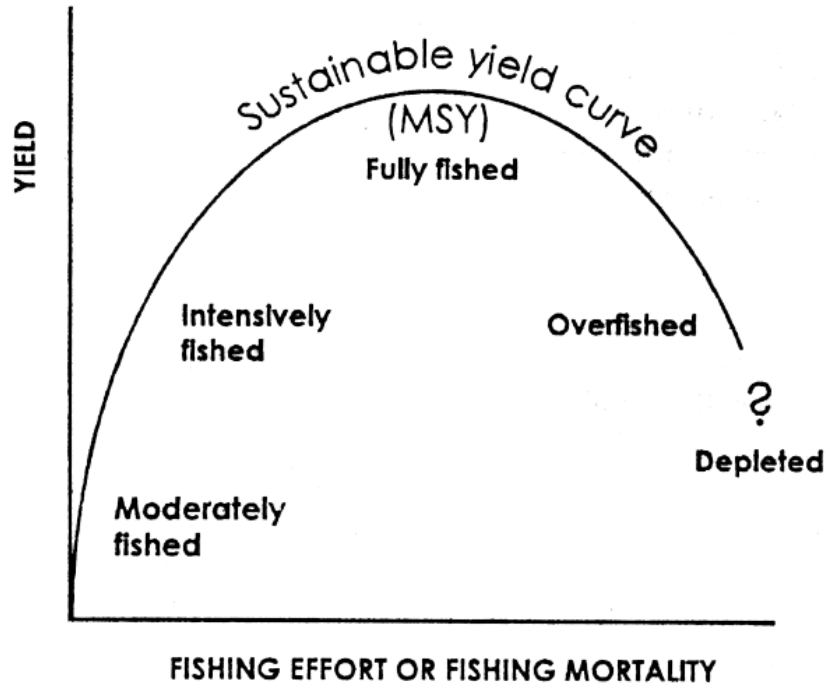
Doing Fisheries Science

- Measure
- Assess
- Forecast
- Manage
- Monitor
- Repeat



Maximum Sustainable Yield

- High catch levels that substantially reduce stock size increase the risk of reduced or failed recruitment.
- Science aims to identify the highest possible annual catch that can be sustained over time:
- **Maximum Sustainable Yield (MSY)**.
- Science is also needed to manage (reduce) the risk that this limit is exceeded.
- **Catch limits** often used to avoid catches that exceed MSY.



Fisheries Management with Uncertainty

- Science is a key component of all responsible and rational decision making in sustainable fisheries management.
- The role of fisheries scientists is to provide fishery managers with the information and advice they need to make good choices in managing fisheries:
  - Acceptable levels of risk
  - Effects of uncertainty
  - Scientific Integrity
- "All models are wrong, but some are useful"

George E. P. Box 1919-2013

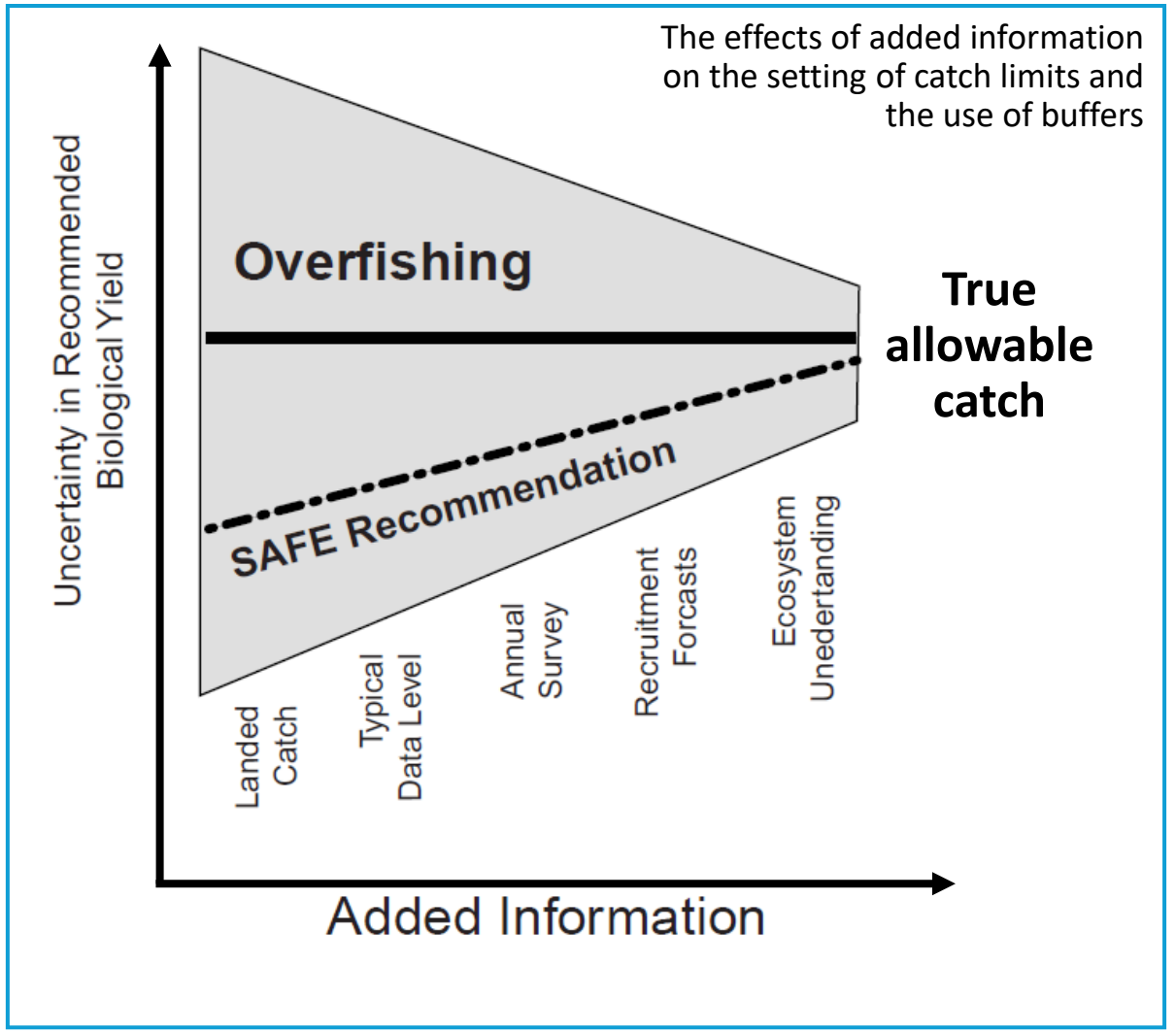


Figure 2 from Marine Fisheries Stock Assessment Improvement Plan (SAIP). 2001. Report of the National Marine Fisheries Service National Task Force for Improving Fish Stock Assessments. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-F/SPO-56, 69 p., 25 appendices.

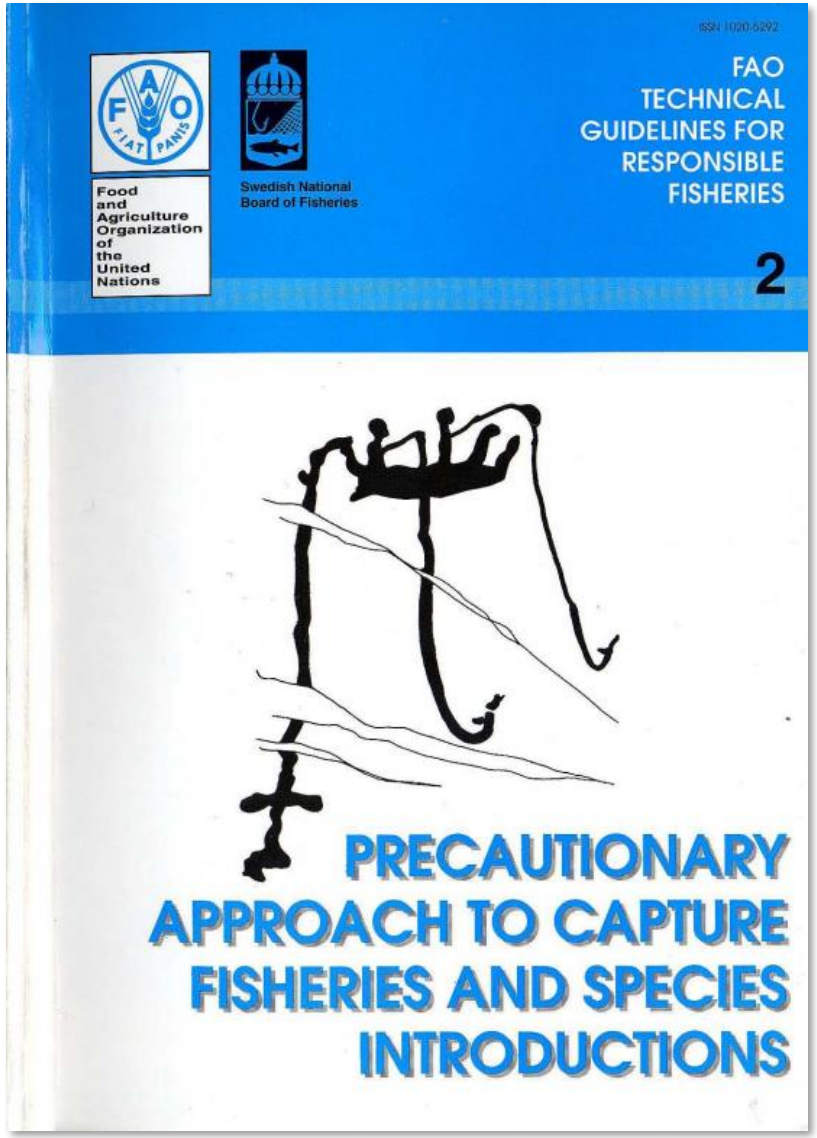
(Still) the Current Problems in the Management of Marine Fisheries

- Too much fishing (**Overfishing**);
- Too many fishers and fishing boats (**Overcapacity**);
- A failure to take the **ecosystem effects** of fishing into account; and
- A failure to enforce **unpalatable but necessary reductions** in fishing effort on fishing fleets and communities.

Management authorities need to develop legally enforceable and tested **harvest strategies**, coupled with appropriate **rights-based incentives** to the fishing community.

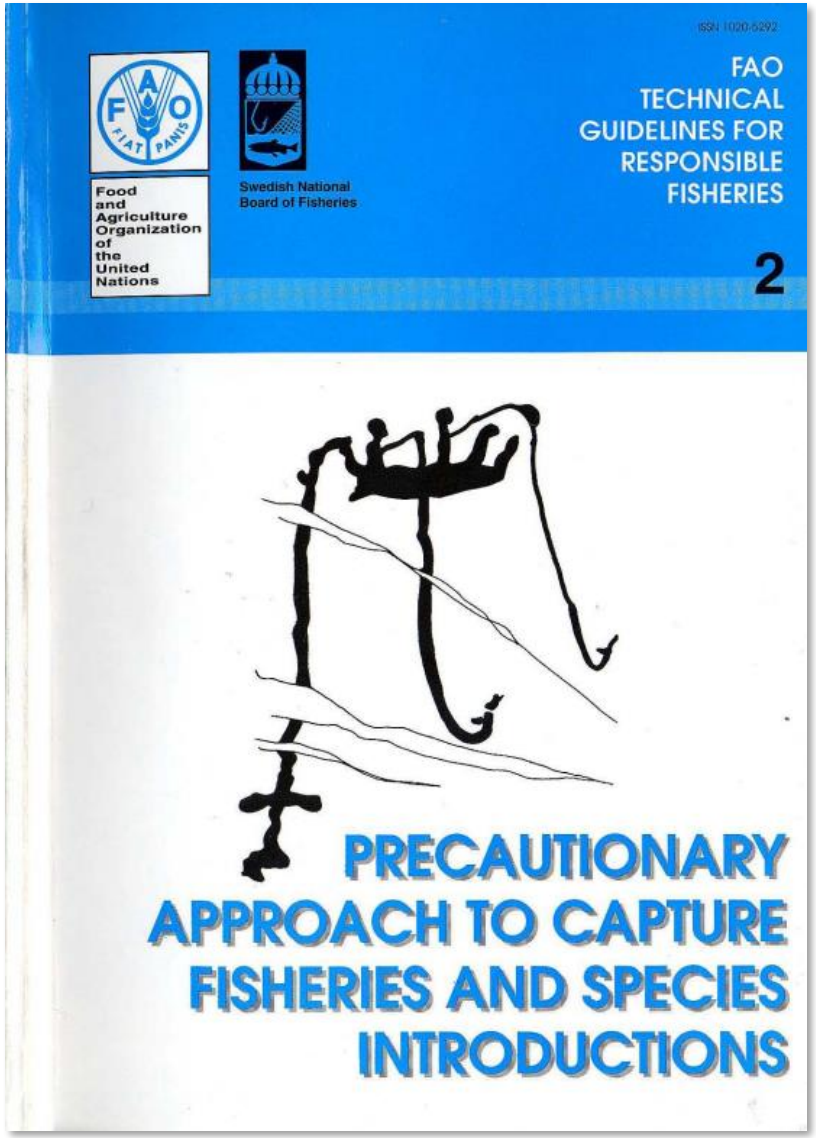
J. R. Beddington, D. J. Agnew, and C. W. Clark (2007) Current problems in the management of marine fisheries. Science. 2007 Jun 22;316(5832):1713-6. doi: 10.1126/science.1137362.

Precautionary Approach (FAO 1996)



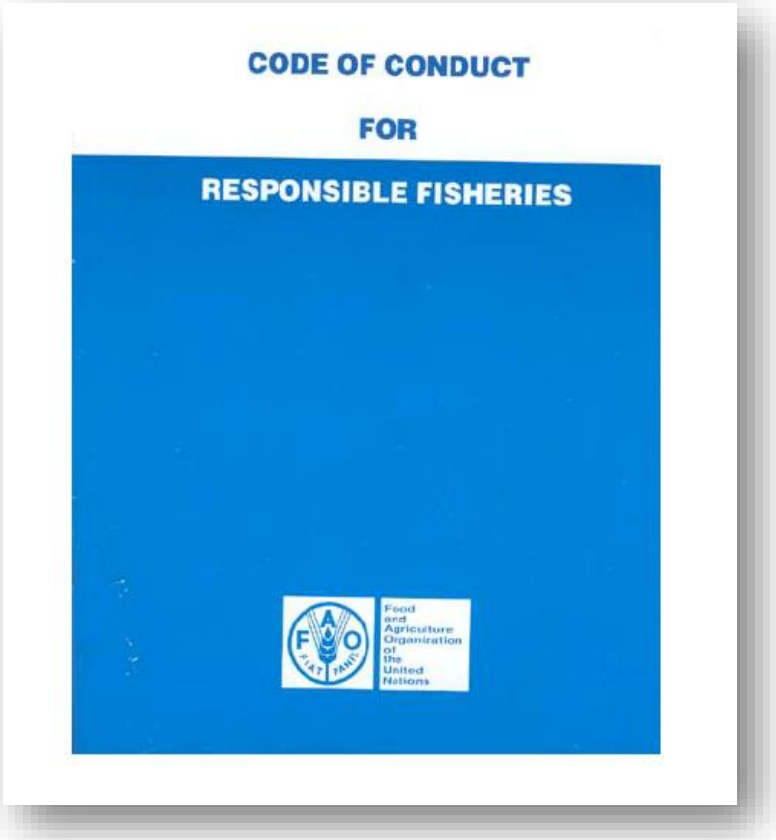
- Requires the reversal of the burden of proof: human actions are assumed to be harmful unless proven otherwise.
- Prescribed by the FAO International Code of Conduct for Responsible Fisheries (1995) for all fisheries.
- Most problems in fisheries result from insufficient precaution in management regimes when faced with high levels of uncertainty.
- Changes in fisheries systems are only slowly reversible, difficult to control, not well understood, and subject to changing environmental and human values.
- Climate change increases uncertainty

Precautionary Approach (FAO 1996)



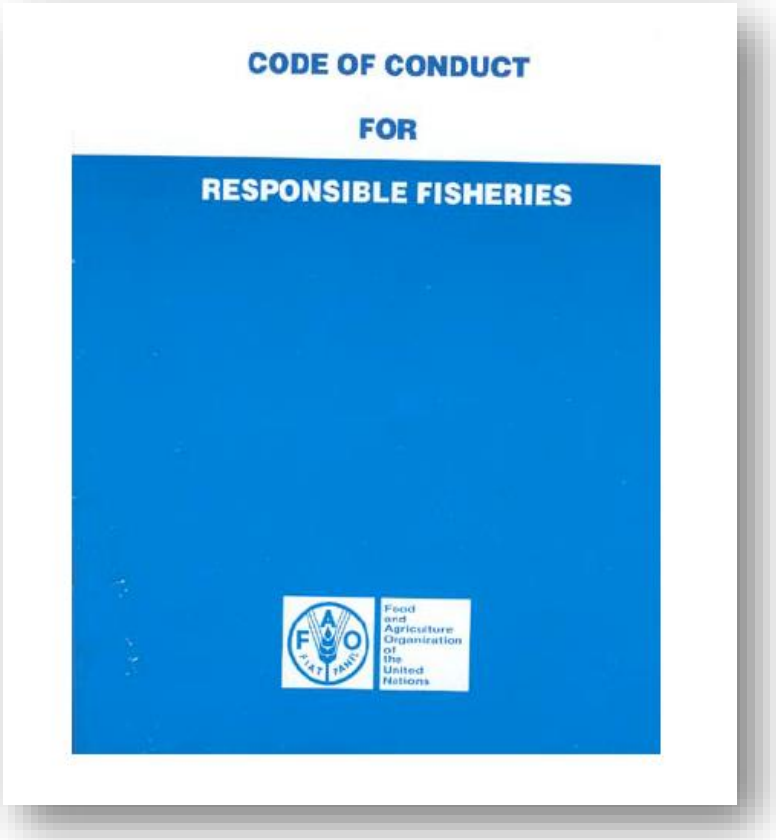
- Needs of future generations
- Prior identification of undesirable outcomes
- Initiation of corrective measures without delay
- When impacts are uncertain conserve the productive capacity of the resource
- Match fishing capacity with fishing opportunities
- All fishing requires prior management authorization
- Established legal and institutional framework

Best Scientific Evidence Available



- "**Best scientific evidence available**" is the international standard for decision-making (CCRF 1995), including for the application of the **Precautionary Approach.**
- **Scientific Integrity** is required throughout the process
- The fisheries management system needs to commission science and solicit scientific advice so that it:
    - **(i)** **receives** the best scientific evidence available; and
    - **(ii)** **acts** on that advice in a transparent and responsible way.

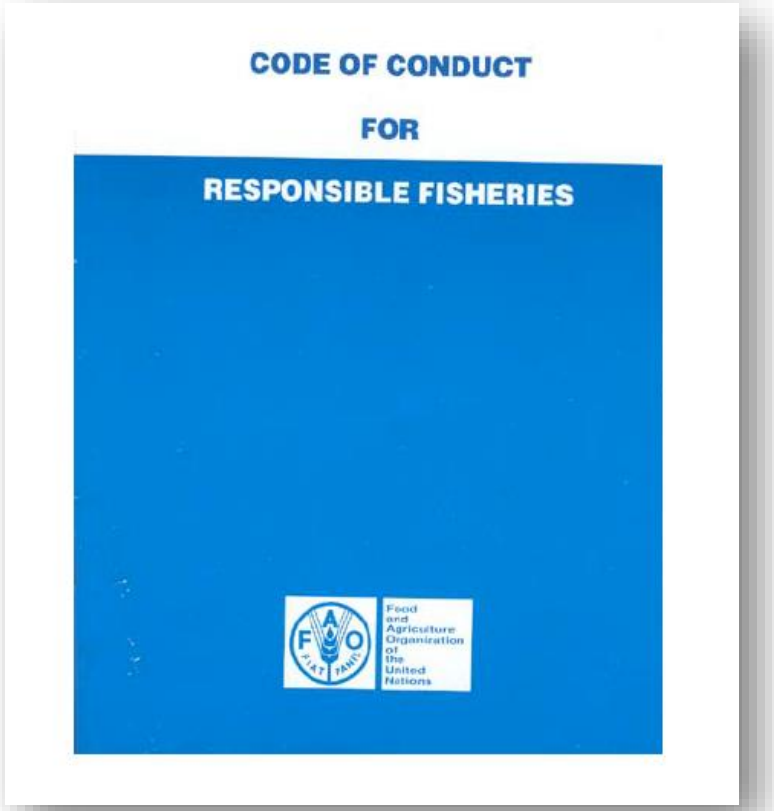
Best Scientific Evidence Available



Receiving the best scientific evidence available requires, *inter alia*:

- questions to be clearly stated;
- scientific investigation to be objective and well designed;
- reliable data collection and analysis;
- results to be analysed logically, documented clearly, and subject to peer review;
- Sufficient and secure funding; and
- Review and Reassessment.

Best Scientific Evidence Available



Acting on the best scientific evidence requires, *inter alia*:

- **Management policy** with well-defined goals (like MSY);
- **Capacity** to implement policy;
- Understanding of the consequences of making decisions in the face of **Uncertainty**;
- **Transparent decision-making** procedures;
- **Stakeholder** involvement in setting acceptable risk levels;
- **Fishery Management Plans**; and
- effective **Monitoring, Control and Surveillance**.

Belize Fisheries Management Policy

Policy Components

laws, regulations, decrees, orders, and guidance.

Belize:

- Fisheries Resources Act No.7 of 2020
- Coastal Zone Management Act Chapter 329 (Revised Edition 2020)
- National Protected Areas System Act No. 17 of 2015
- Trade in Endangered Species (CITES) Act No. 3 of 2023
- High Seas Fishing Act, 2013 (No. 26 of 2013)
- Environmental Protection Act, 1992

FAOLEX Database https://www.fao.org/faolex/background/en/

Belize Fisheries Resources Act 2020

Follows international best practice:

- Precautionary Approach
- Best information available
- Maximum Sustainable Yield (MSY)
- Stakeholder consultation
- Transparency
- Fishery Management Plans

Capacity to Implement Policy

Including:

- institutions,
- statutory bodies,
- human resources,
- equipment,
- expertise,
- stakeholder participation,
- stable funding, and
- continuity.

Belize has:

- Established authority to manage fisheries;
- Management organizations with regional focus; and
- Control and compliance mechanisms;

But needs:

- Increased human resources, e.g. enforcement personnel and presence;
- Improved stakeholder engagement;
- Sufficient and consistent budget allocation for management and science; and

Capacity needs are increasing: e.g. approximately 1000 additional fishing licenses in 2022.

Harvest Strategy

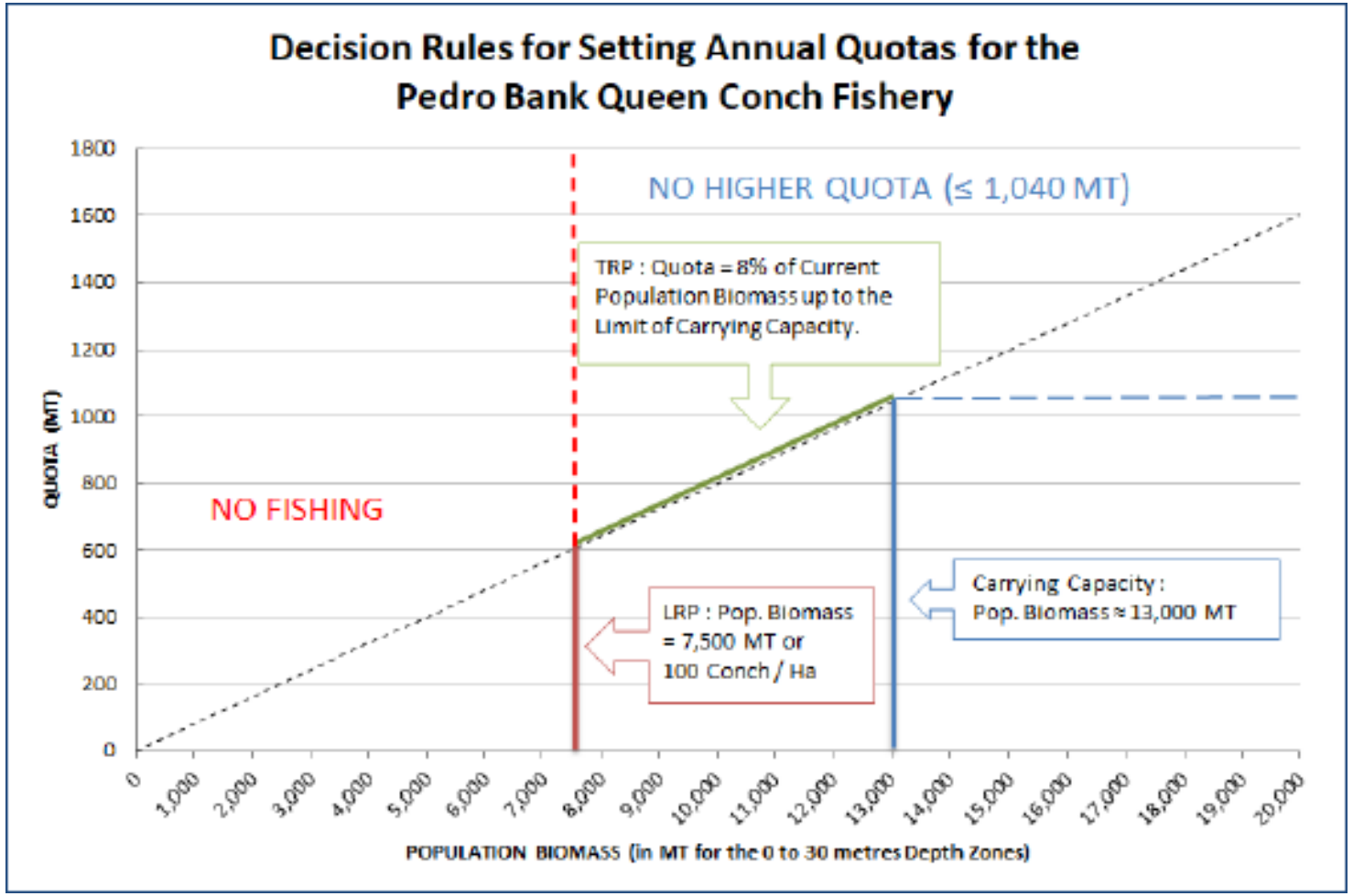
A well-designed, transparent, agreed system that ensures the long-term health of fisheries by establishing guidelines for how much fishing can take place under changing conditions

Belize does not have this for any fishery to date.

Jamaica queen conch example

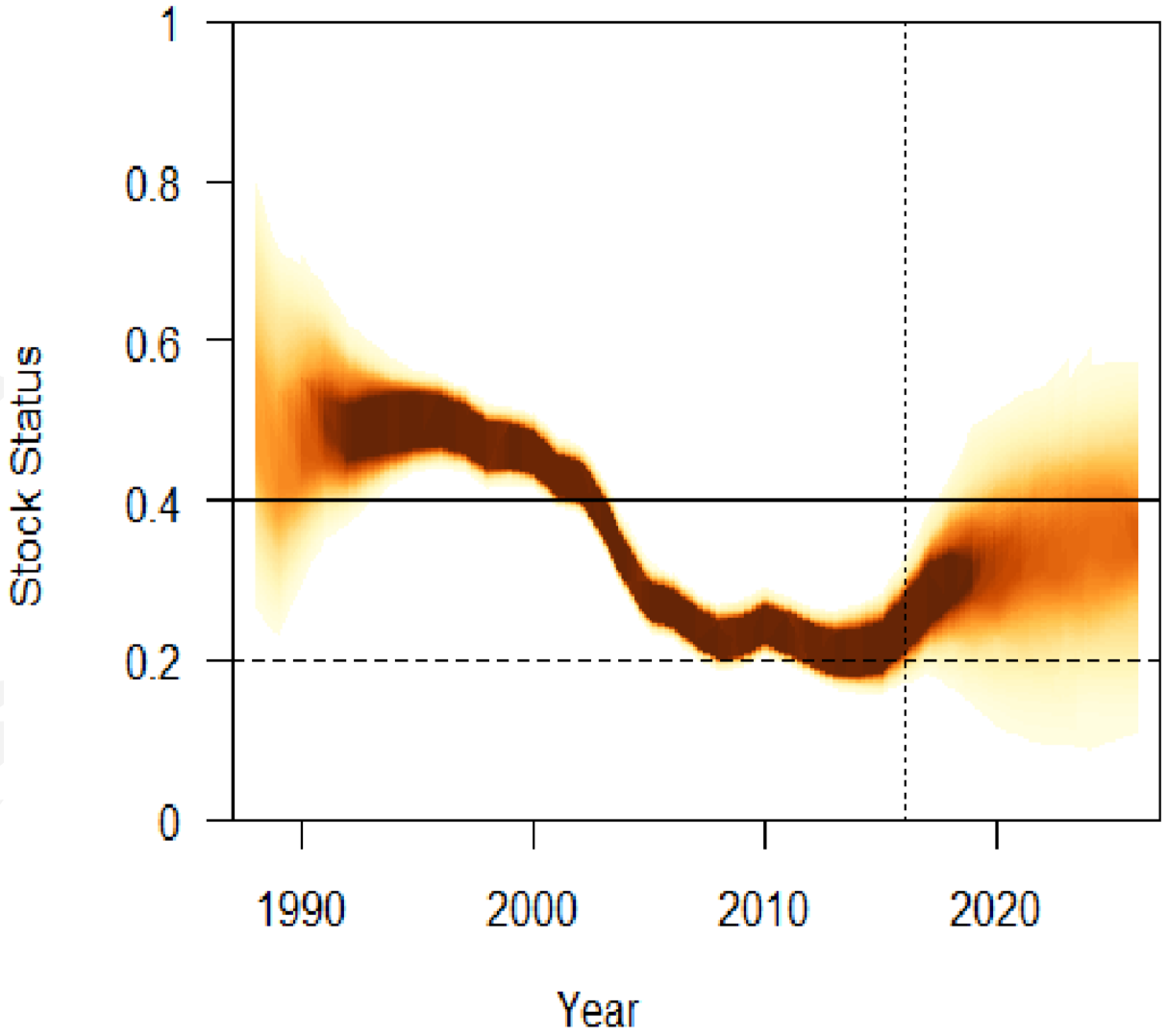
Harvesting of immature conch illegal, (shell length less than 22 cm or does not have a flared lip).

Stock declines in 2016-2018 resulted in seasonal closure in 2019 and 2020, with a real recovery and a reopened fishery in 2021



Bahamian Lobster Fishery

- The minimum legal size for landing lobster is 5.5 inches ~5 oz. tail and carapace at least 3 ¼ inches
- No catching of berried females
- No SCUBA
- Direct limit on exports that is based on the assessment of stock abundance each year
- **Now MSC Certified**



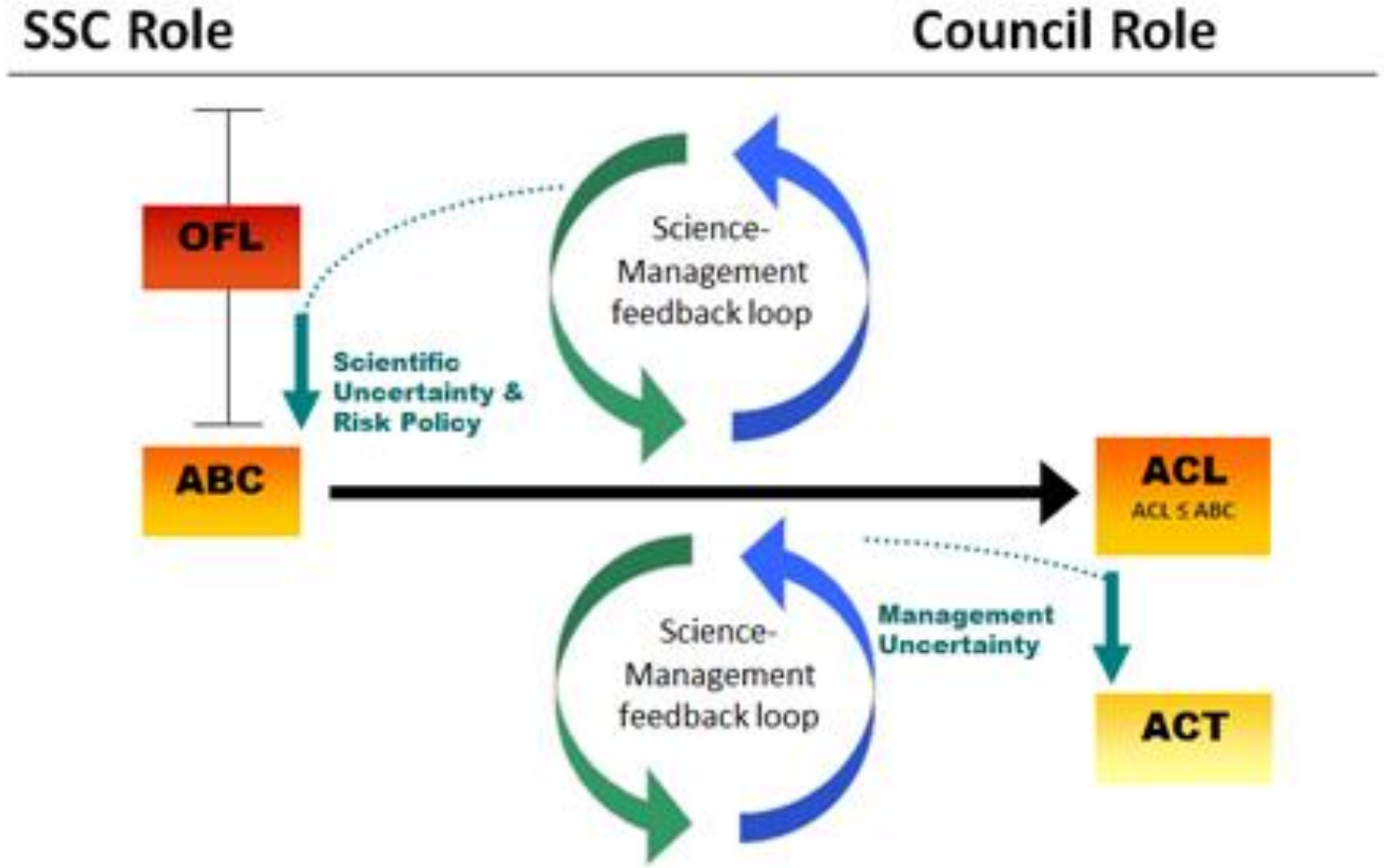
Catch limits Accounting for Uncertainty (US example)

- **Scientific Uncertainty**: uncertainty in scientific advice on fishing impacts
- **Management Uncertainty**: uncertainty in the implementation of management measures like catch limits

OFL = Overfishing Limit;
ABC = Acceptable Biological Catch;
SCL = Annual Catch Limit;
ACT = Annual catch Target.

By definition, where there is uncertainty:

OFL ≥ ABC ≥ ACL ≥ ACT



https://www.fisheries.noaa.gov/insight/setting-annual-catch-limit

Stakeholders

Successful decision-making in fisheries requires:

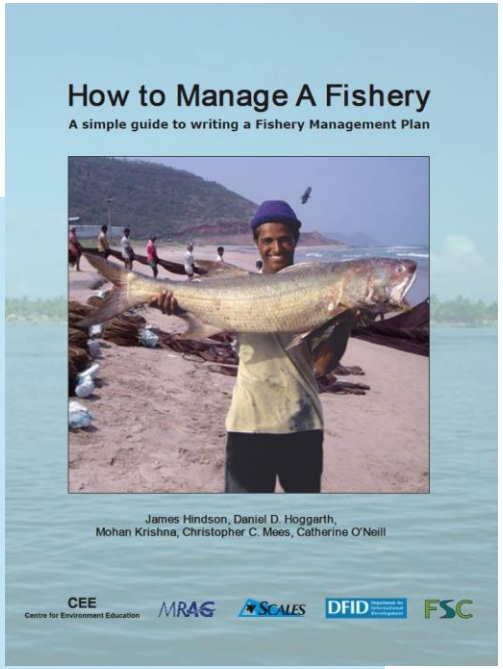
- Ample opportunity for input from a broad range of stakeholders, and
- Transparent consideration of and responsiveness to that input.

• Fishers and their representative organisations, • Fishing dependent industries, • Recreational fishing, • Fishing communities, • Native peoples,	• Management agencies, • Civil society organisations (e.g. environmental non-governmental organizations), and • Other citizens

Fishery Management Plan

- A common component of most fishery management regimes.
- A fishery management plan (or FMP) forms the basis of the management strategy and the record of management measures and underpinning science.

Typical FMP contents page:



Monitoring Control and Surveillance

Monitoring of catch and effort for:

- implementation of management measures; and
- stock assessment and other science.

Control of the fishery through:

- Establishing the regulatory framework for the fishery; and
- Licensing/permitting of fishers and/or vessels to assert management authority

Surveillance of the fishery to:

- Detect and prevent IUU fishing
- Protect legitimate fishers

Illegal, Unreported and Unregulated (IUU) Fishing

Illegal:

- fishing without permission (unlicensed), in a closed area, or closed season;
- fishing with a prohibited gear or for a prohibited species; or
- fishing in another way that contravenes the laws governing fishing.

Unreported:

- fishing that has not been reported, or mis-reported to relevant authority in accordance with established regulations;
- usually a condition of licensing.

Unregulated:

- fishing in areas or for fish that have no applicable conservation or management measures governing the activity and reporting.

Surveillance and Enforcement

Large scale fishing:

- At sea patrolling; remote surveillance
- Vessel Monitoring Systems
- Fishery officers boarding vessels to conduct inspections (expensive)

Small scale fishing:

- Inspections at landing sites (less expensive)
- Supply chain monitoring
- Self-reporting

Deterrent:

- Imposing fines and other sanctions (loss of license/vessel) sufficient to discourage IUU fishing.
- Probability of capture is often low; sanctions need to be high.

Fisheries Journalism Workshop

April 12, 2024

Fisheries in Belize:
The Science and Pathways to Sustainability

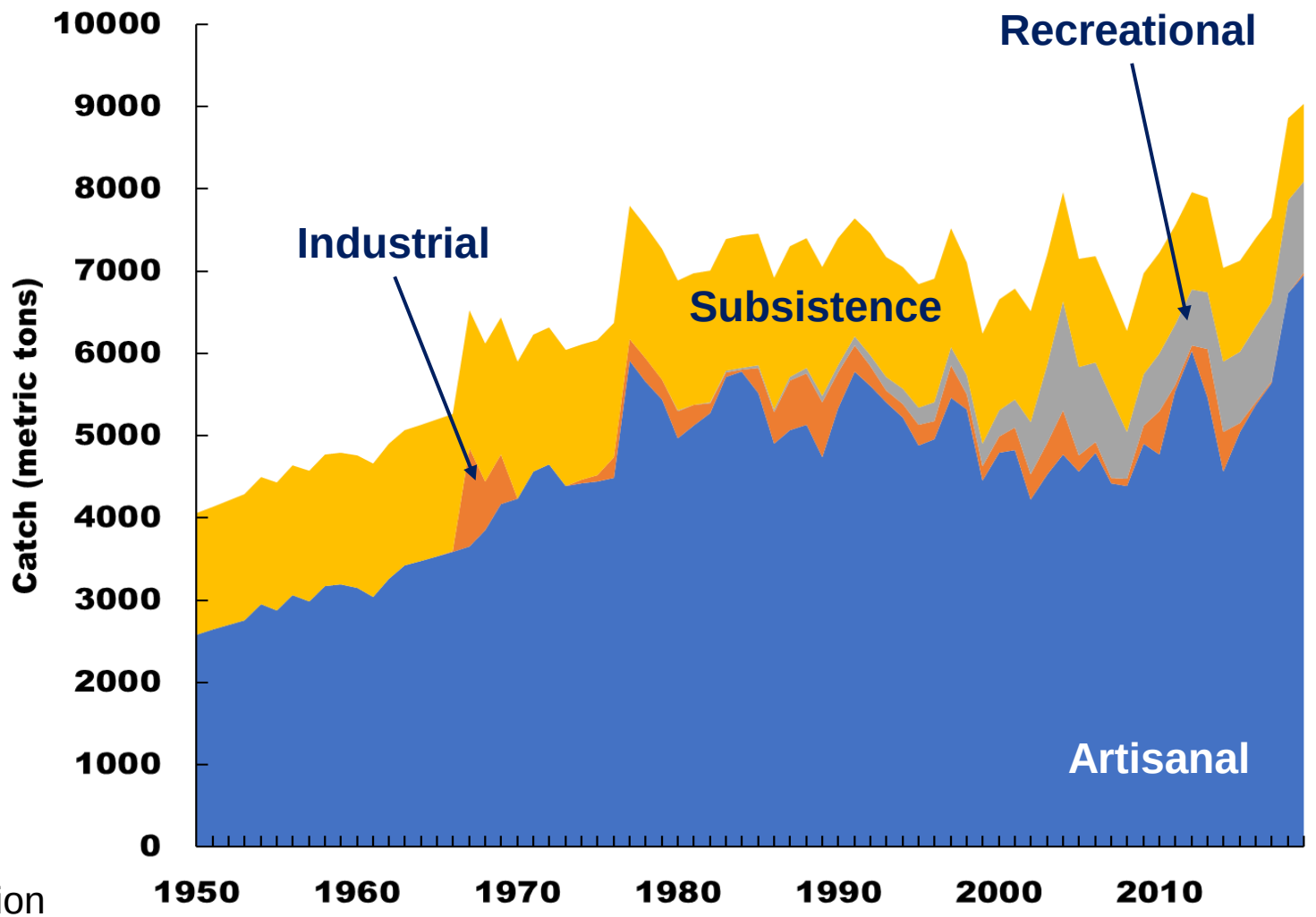
Graeme Parkes, MRAG Americas
Deng Palomares, Sea Around Us

Belize Fisheries Project

Funded by the Summit Foundation

Reconstructed Belizean marine fisheries catches*

- Catches within the EEZ of Belize are dominated by artisanal (67%) and subsistence (22%) fisheries.
- Industrial and recreational fisheries made up only 11%, with the former currently absent.



* See: www.seaaroundus.org
23 of 443 sources were used for this reconstruction

Belizean marine catch over time by species (I)

Queen conch and spiny lobster make up a third of these catches.

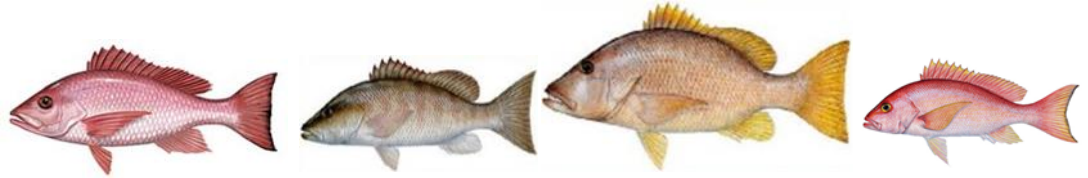
21% of the catch

10% of the catch

Snappers make up a quarter of these catches

Yellowtail Mutton Lane

23% of the catch



Red Grey Dog Silk

3% of the catch

Belizean marine catch over time by species (II)

- Other species included in these assessments:

Crevalle jack

Horse-eye jack

King mackerel

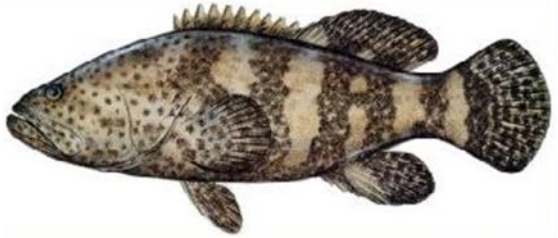
8% of the catch

Great barracuda

2% of the catch

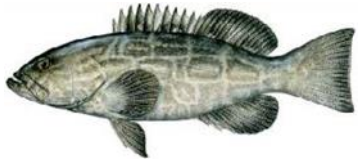
Snook

2% of the catch



Goliath grouper

Nassau Grouper

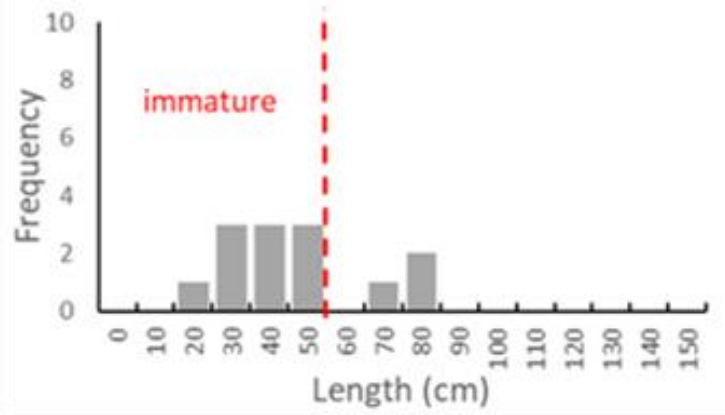


Black grouper

<1% of the catch

Review of existing knowledge: Nassau Grouper

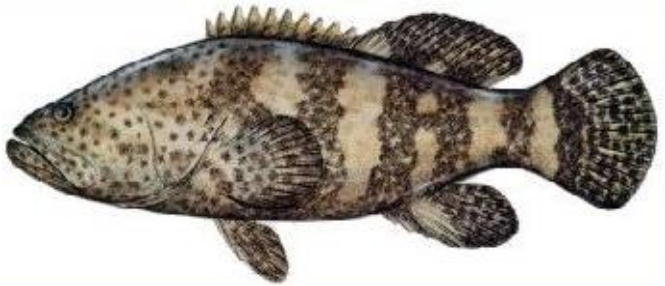
- Heavily exploited since the 1920s. Management intervention, although with adequate size limits, came too late.
- Stock is depleted.



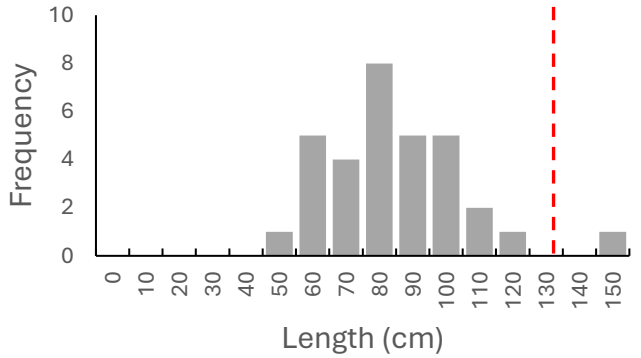
Review of existing knowledge: Goliath and Black Groupers

- In similar conditions as Nassau grouper

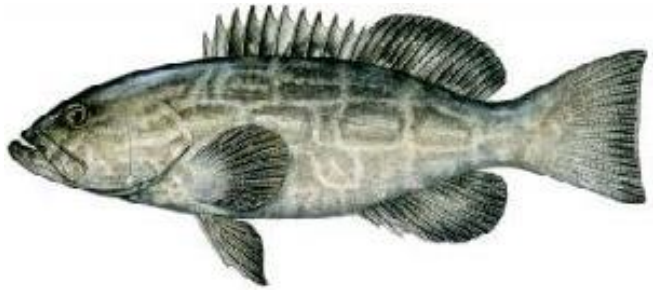
Goliath



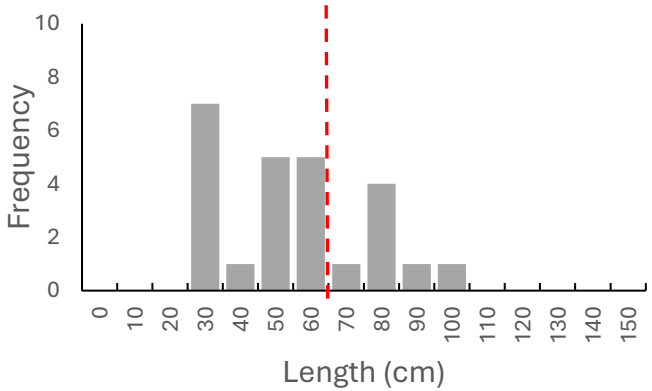
Max: 250 cm/360 kg



Black



Max: 150 cm/45 kg



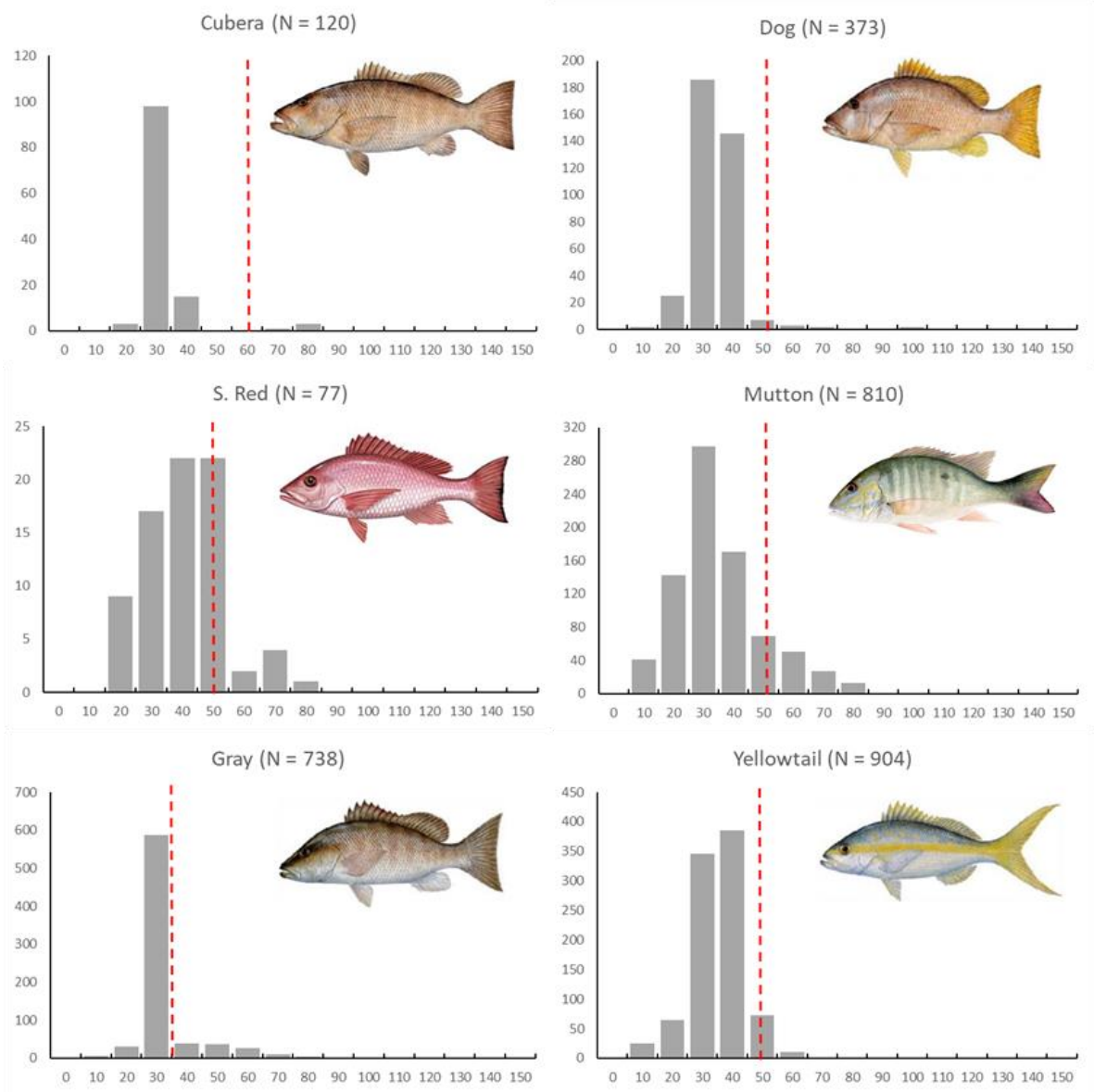
Review of existing knowledge: Snappers

Red

Cubera

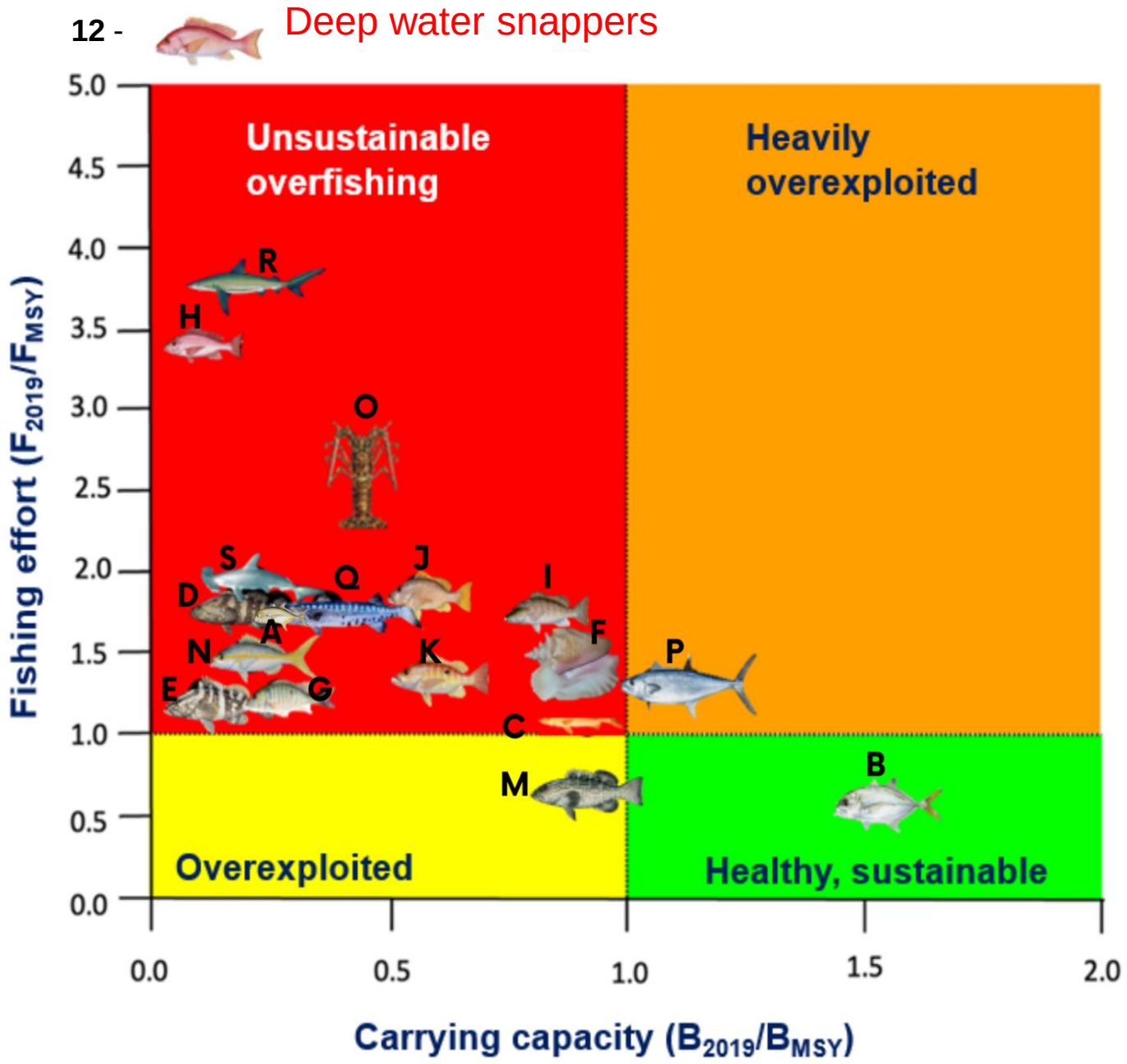
Mutton

Lane



Summary of results

A. Crevalle jack
B. Horse-eye jack
C. Common snook
D. Atlantic goliath grouper
E. Nassau grouper
F. Queen conch
G. Mutton snapper
H. Southern & Northern red snapper
I. Grey snapper
J. Dog snapper
K. Lane snapper
L. Silk snapper
M. Black grouper
N. Yellowtail snapper
O. Caribbean spiny lobster
P. King mackerel
Q. Great barracuda
R. Caribbean reef shark
S. Scalloped hammerhead

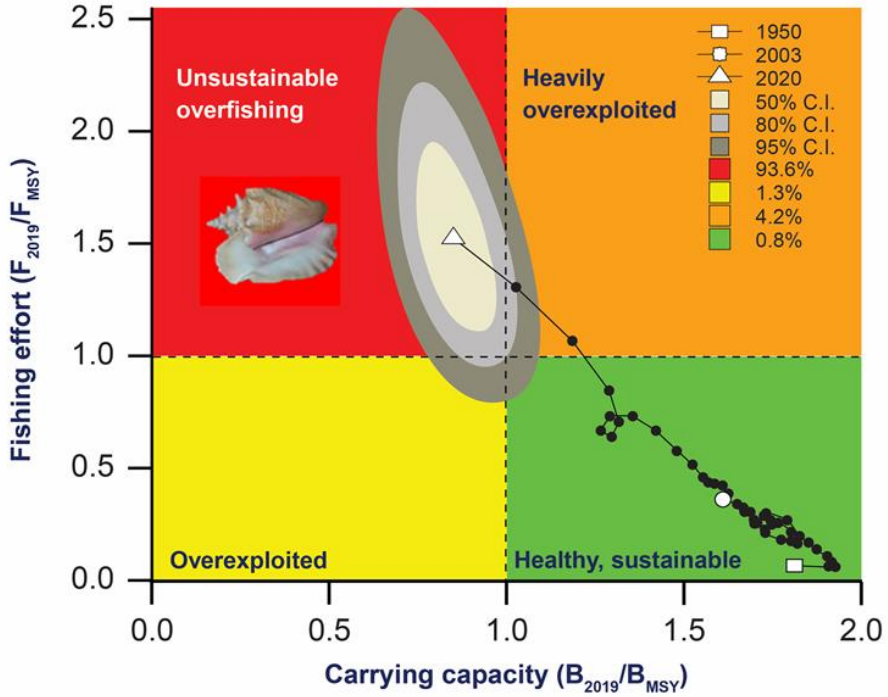


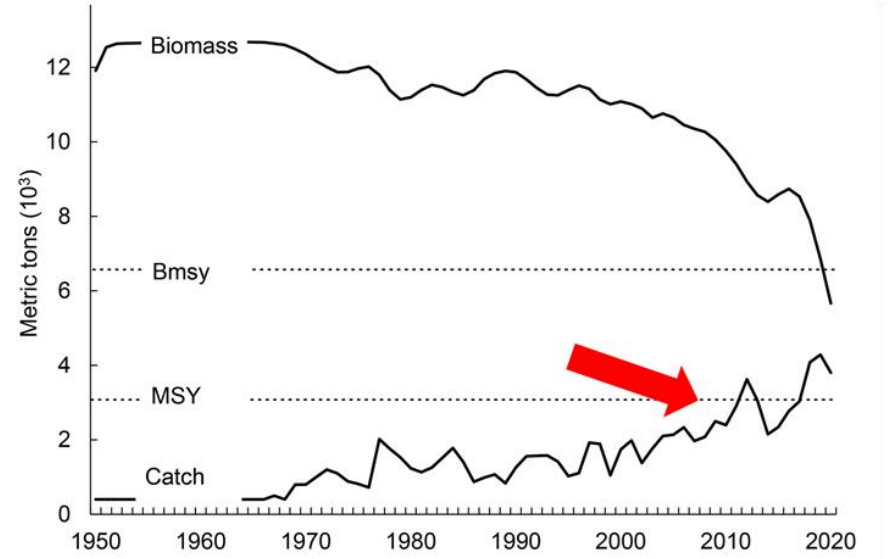
Results for the queen conch

Top: evolution of the queen conch fishery, from start year (1950; white square) in the green zone to the most recent year (2020, white triangle) in the red zone in the last few years.

Bottom top line: evolution of the biomass of queen conch left in the water with respect to the healthy biomass indicator (Bmsy)

Bottom lower line: evolution of the catch extracted from the queen conch population with respect to MSY (maximum sustainable yield) with red arrow indicating catches surpassing this sustainable limit.



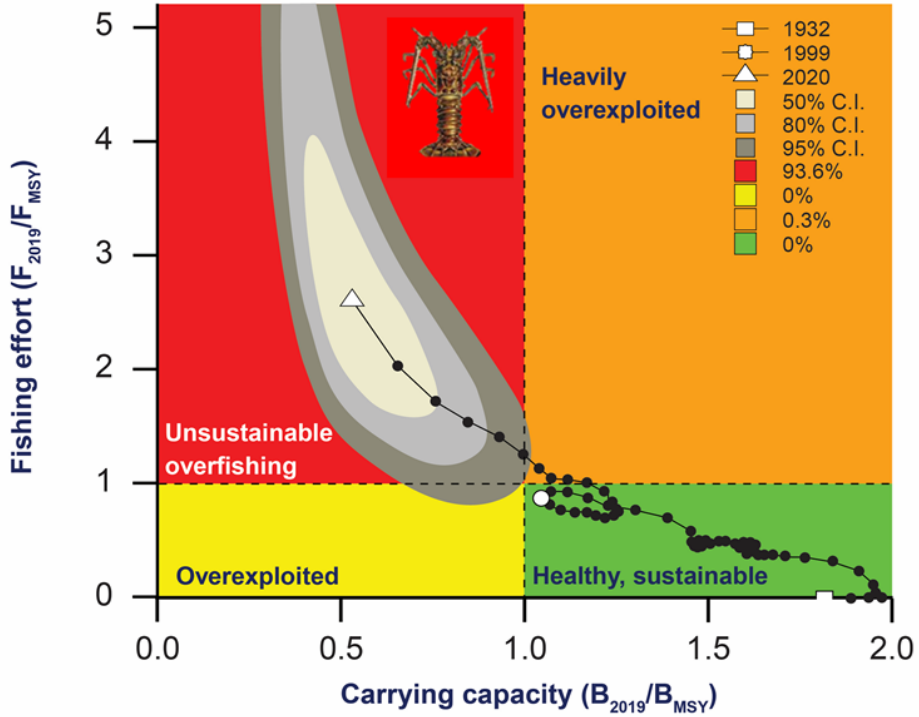


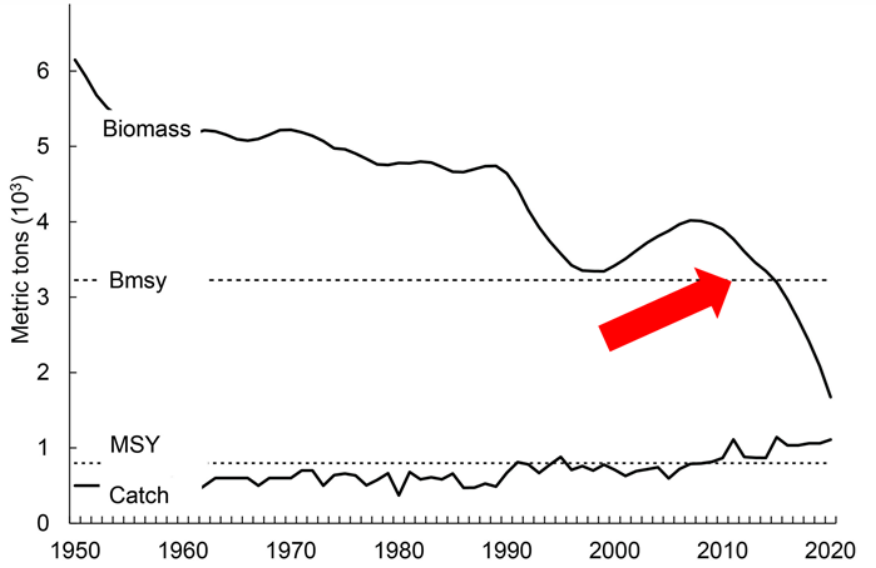
Results for the Caribbean Lobster

Top: evolution of the Caribbean lobster fishery, from start year (1932; white square) in the green zone to the most recent year (2020, white triangle) in the red zone for almost a decade.

Bottom top line: evolution of the biomass of lobster left in the water with respect to the healthy biomass indicator (Bmsy) with the red arrow indicating rapid decline to near collapsed biomass.

Bottom lower line: evolution of the catch extracted from the lobster population with respect to MSY (maximum sustainable yield).





Summary of Main Findings Across all Fish Stocks

- Seventeen of 20 species taken in Belize's fisheries, including the queen conch and Caribbean spiny lobster, are "in the red", meaning they are overexploited.
- Fishing pressure is too high.
- Biomass is too low.
- Biomass will decrease further and catching fish will get harder.
- Management changes are needed to move species back into the green zone

- This is a common situation for fisheries without robust management.
- Goal: enabling sustainable fishing and supporting fishers' livelihoods.

Goal: Ensure the fishery is sustainable in yield (catch) and provides sustainable livelihoods

Keep the level of fishing controlled so that the stock can at least replace itself year after year.

- Manage the fraction of the stock removed each year
  - Limit the catch or the effort or the area that can be fished, or all three together
- Ensure there are sufficient spawners and spawning habitat for reproduction
  - Make sure enough young grow to spawning age and beyond before capture
  - Protect larger highly productive females that produce the most young
  - Prevent destructive fishing practices that harm habitat

Maximize catches by balancing growth, spawning potential and fishing pressure

Most common tools and what they do

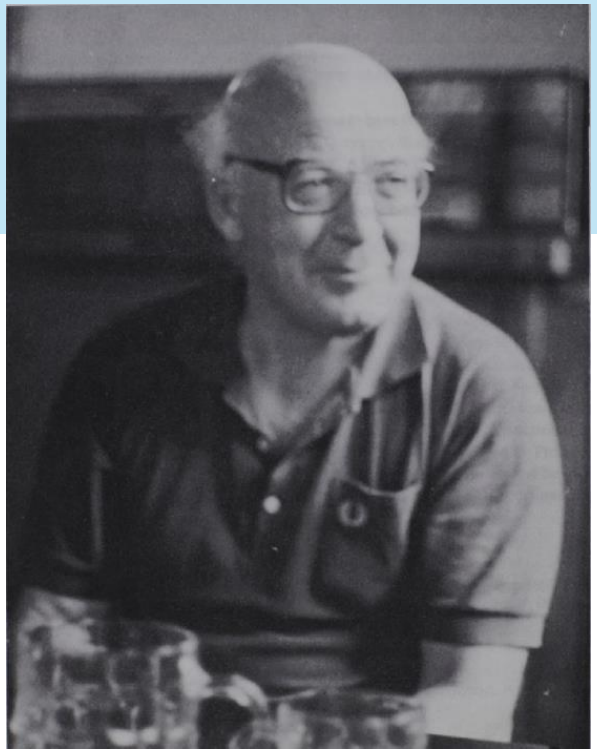
(in Belize and everywhere else!)

- Control the number of boats or fishers or trips to control fishing pressure
- Control the catch directly such as with a quota
- Implement closed seasons to limit fishing pressure or catch
- Gear restrictions to limit fishing, control harvest size, reduce waste or limit habitat impacts
- Implement MPAs to protect certain parts of the stock (mega spawners) or to protect key habitat
- Control the sizes or sex of animals that can be landed
- Limit the catch per trip (bag limits) to reduce fishing pressure

Warning Signs

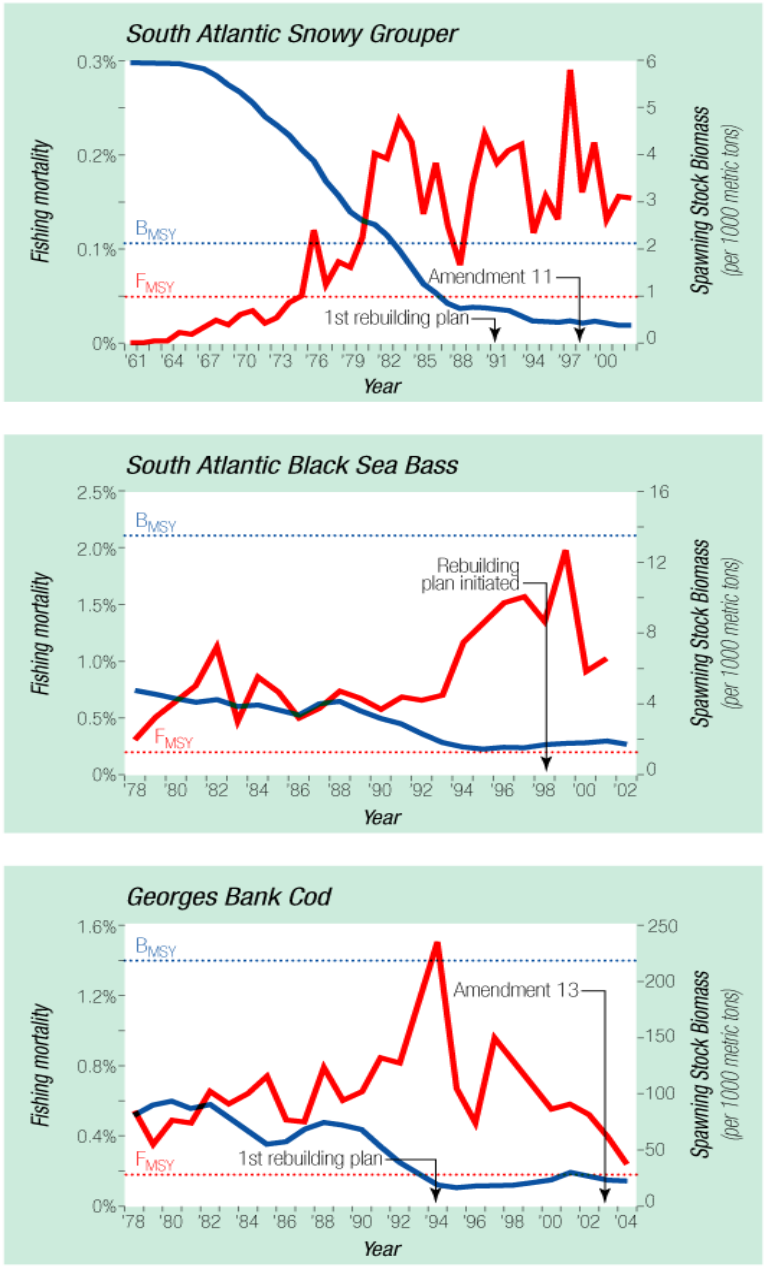
Warning signs of unsustainability are well known:

- Continuing declines in average size
- Continuing loss of range/fishing grounds
- Continuing loss of yield
- Continuing denial
- Demands for greater and greater scientific precision



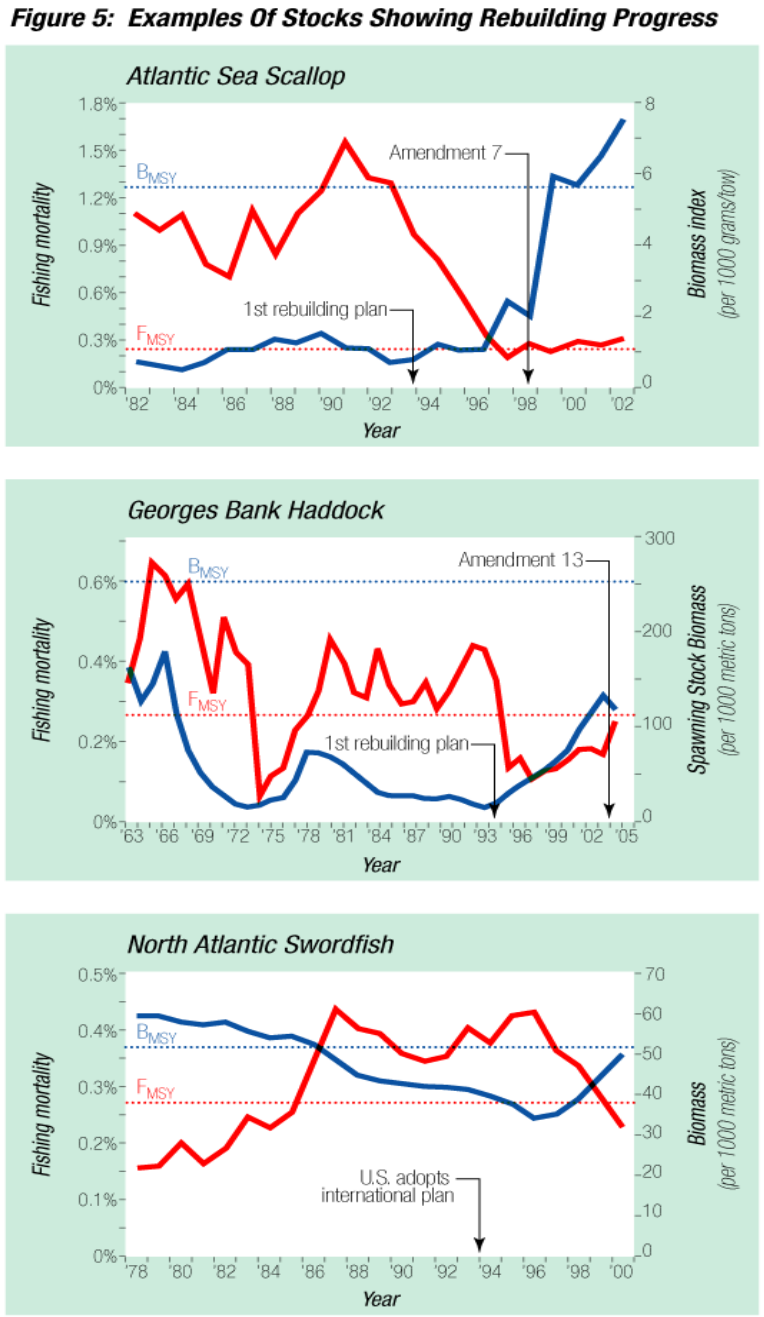
Fisheries management is an endless argument about how many fish there are in the sea until all doubt is removed and so are all the fish (John Gulland FRS 1926-1990).

Figure 4:
Examples Of Stocks Showing Little Or No Rebuilding Progress



LENFEST OCEAN PROGRAM

When fishing pressure remains high, stocks show little recovery

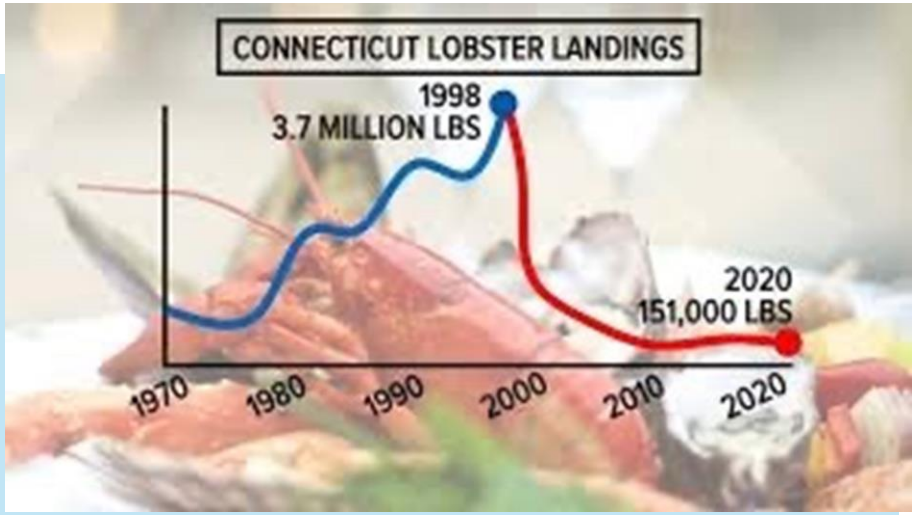


LENFEST OCEAN PROGRAM

When fishing pressure is reduced, stocks can recover

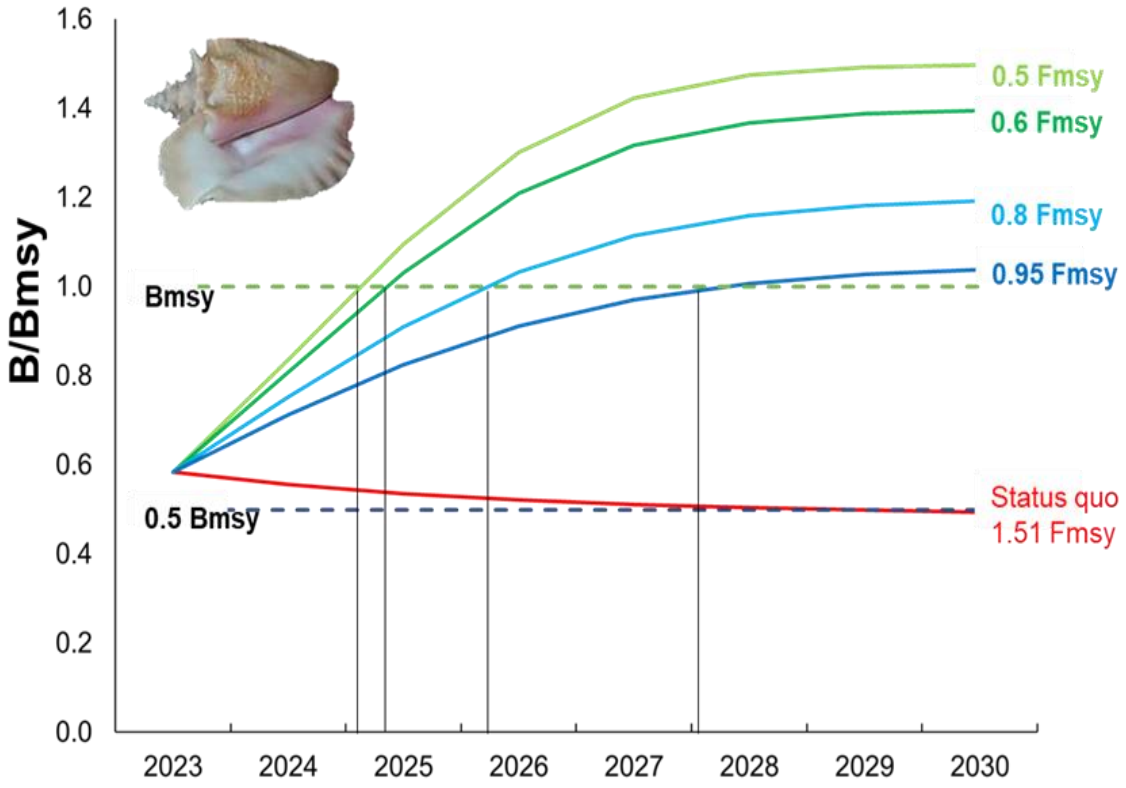
Key Considerations for Conch and Lobster

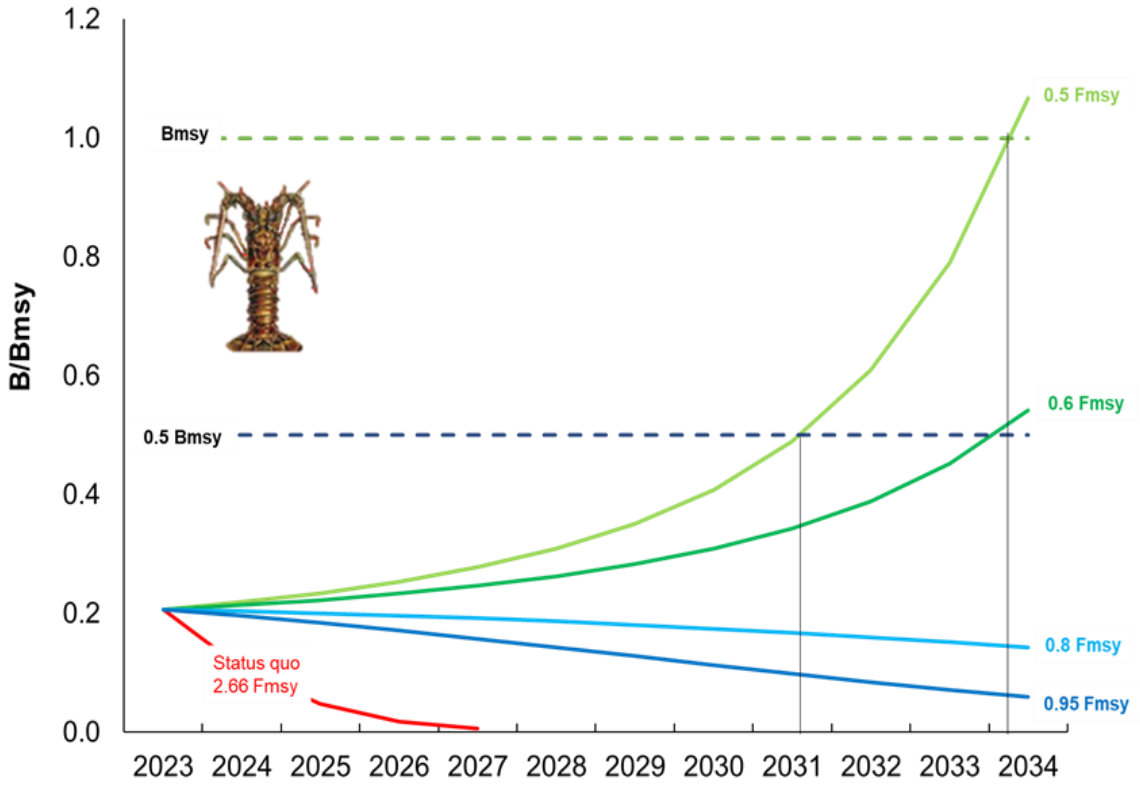
- Conch and lobster are highly vulnerable to very rapid decline, but also to rapid recovery:
  - Fast growth and reproduction
  - Resilient stocks with wide distributions



- Reducing catch of small animals and allowing more to reach spawning is critically important
- Management measures must be responsive to condition of the stock
- The management “tools” are well tested across a lot of similar fisheries

Stock Projections: Management Options





Pathways to Sustainability

- Community agreement on activities that should be avoided
- Adjustments to regulations (size limits, effort control, catch limits, seasons etc.)
- Area based actions (protected areas and associated special conditions of licensing)
  - Risks of deep-water fishing
  - Enhanced monitoring
- Development of Fishery Management Plans
  - Incorporate agreed actions
  - Procedures for review and revision
- Transition Plan