Belize Fisheries Project

Developing a Shared View of the Status of Belize's Fishery Resources

June 12, 2023

COBI Comunidad y Biodiversidad · Environmental Law Institute® · Healthy Reefs for healthy people · MRAG Americas · Sea Around Us

The Fisheries of Belize: Overview of Results

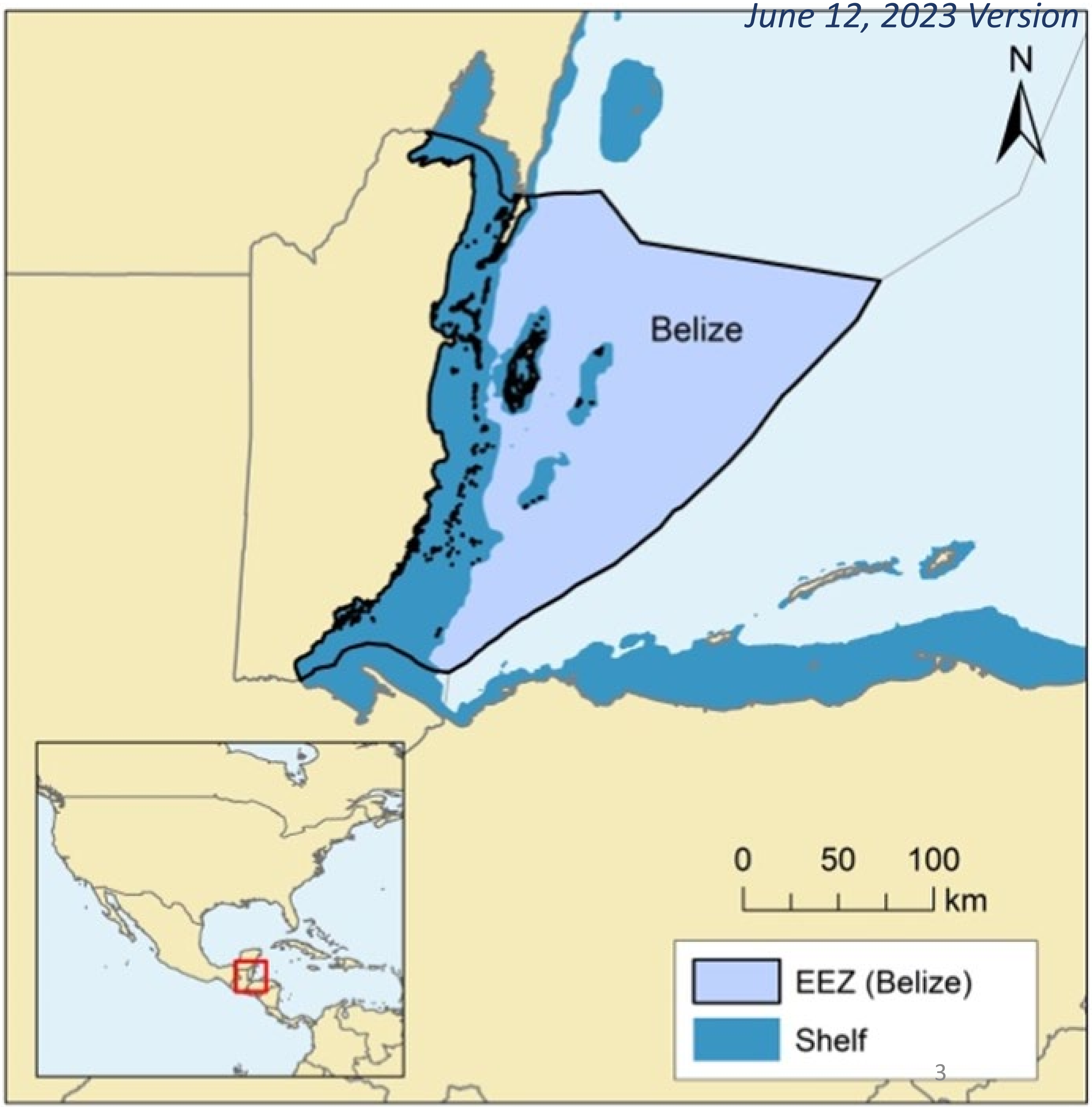
Daniel Pauly, M.L. 'Deng' Palomares, and Alexander Tewfik

Sea Around Us Research Initiative, IOF, UBC

Belize, 12 June 2023

- The Exclusive Economic Zone (EEZ) of Belize covers 36,182 km^2

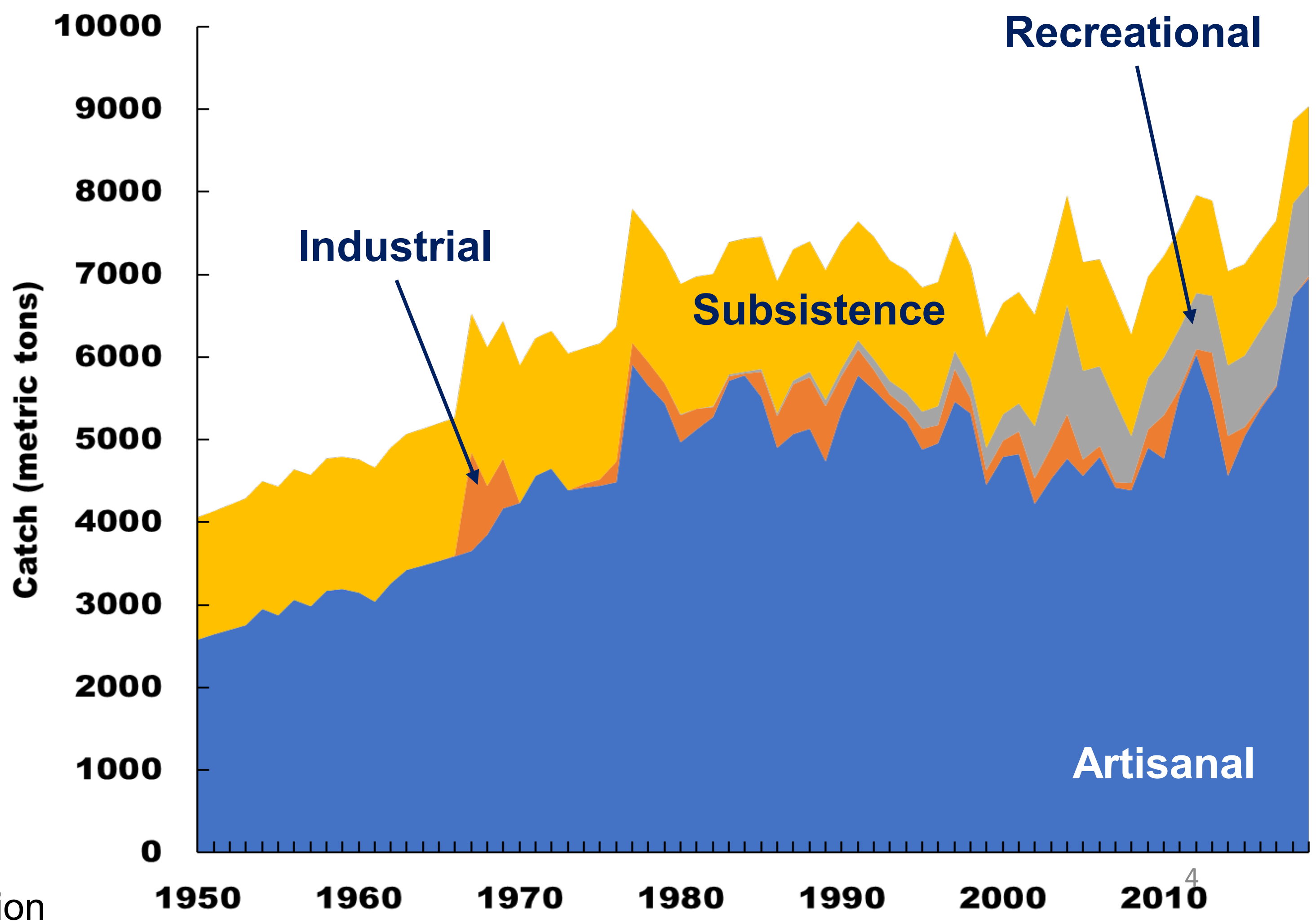
- The Territorial Sea includes three distinct atolls, Glover's Reef, Lighthouse Reef and Turneffe Atoll.



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 by species (I)

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

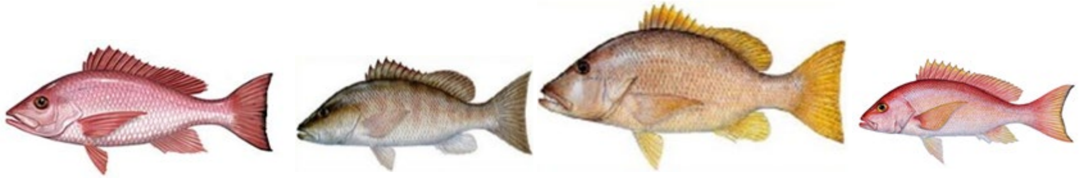
21% of the catch

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 by species (II)

- Other species included in these assessments:

Crevalle jack

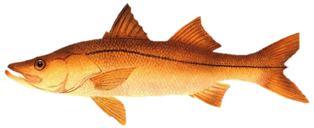
Horse-eye jack

King mackerel

8% of the catch

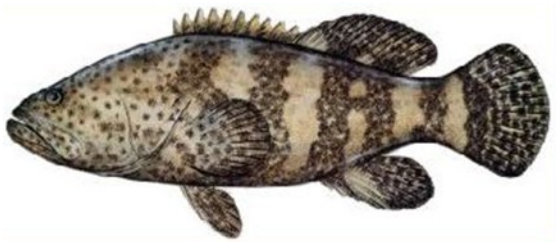
Great barracuda

2% of the catch



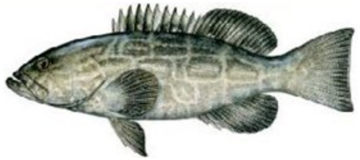
Snook

2% of the catch



Goliath grouper

Nassau Grouper



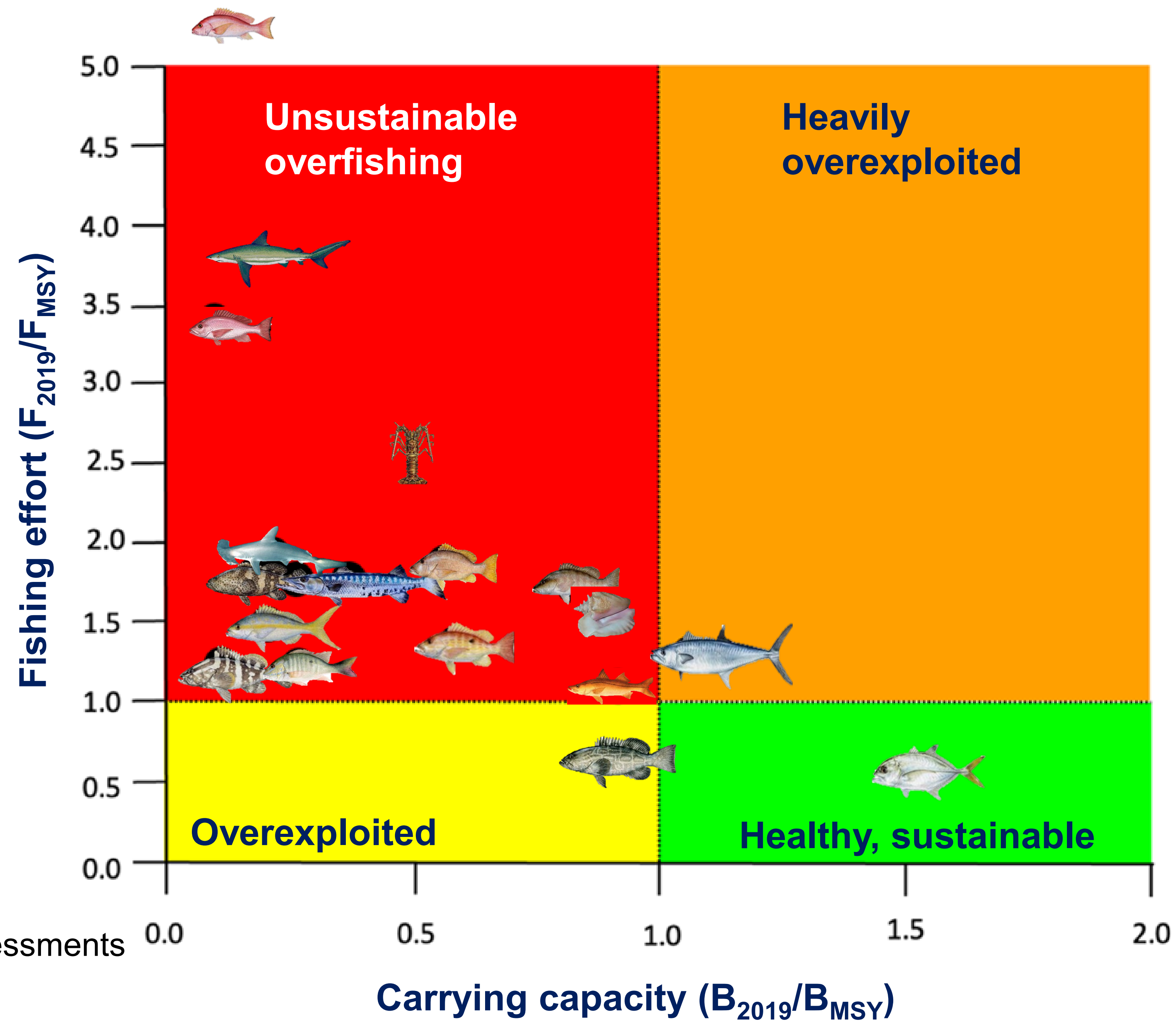
Black grouper

<1% of the catch

Sea Around Us stock analyses

In general, the most commercially important species are in the red:

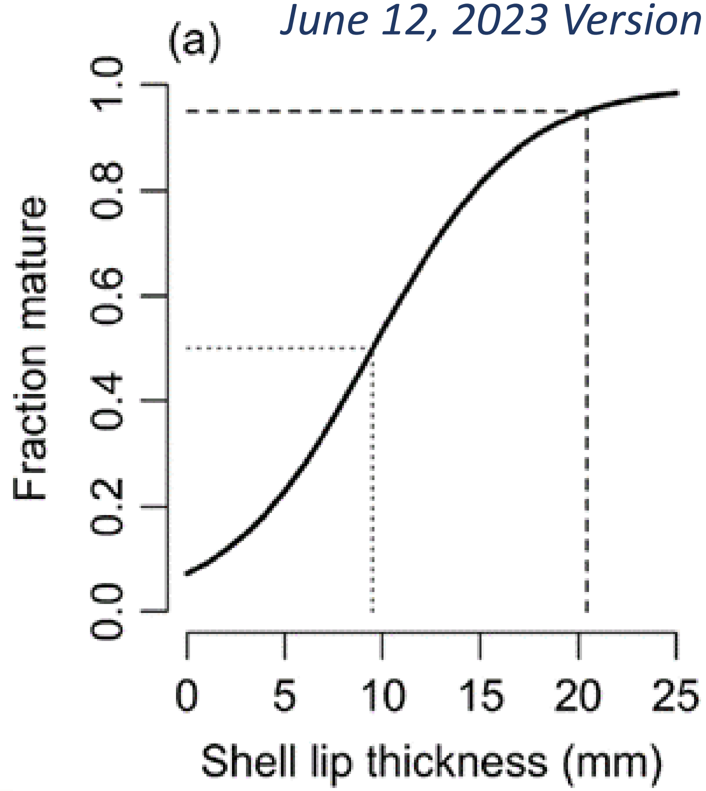
Low carrying capacity driven by high fishing effort.

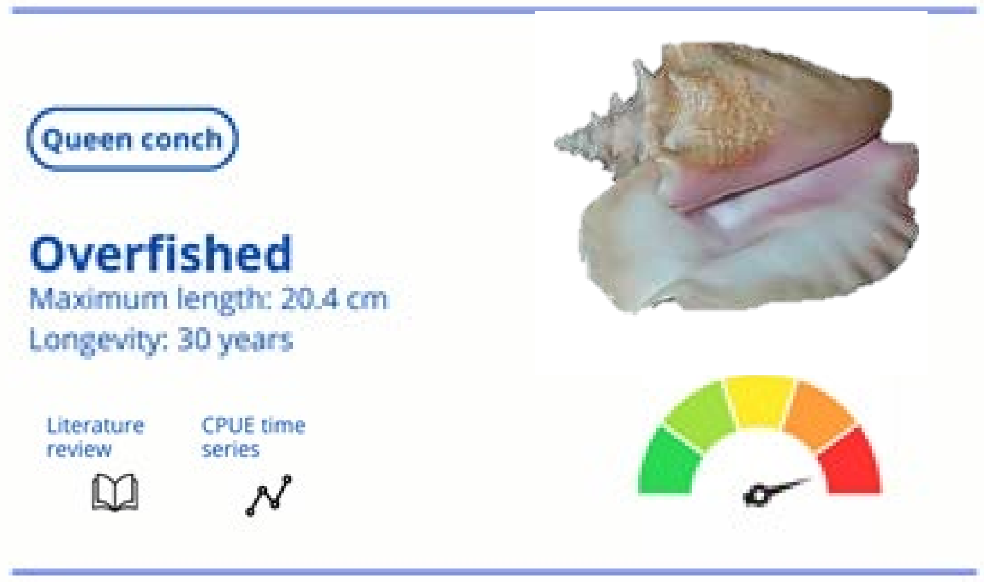


38 of 443 sources were used to inform these assessments

Review of existing knowledge: Queen conch

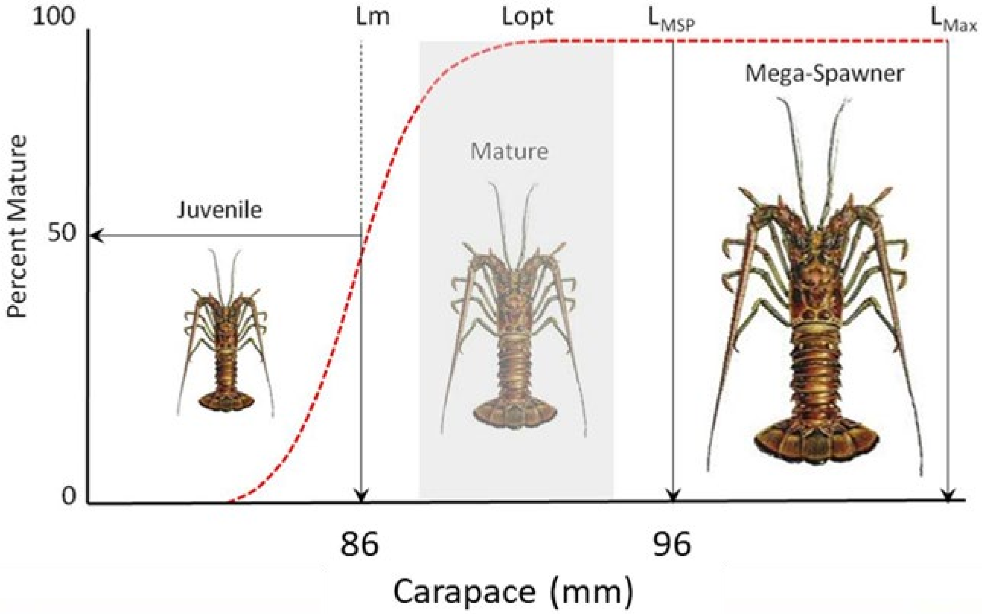
- Exploitation peaked in 2008-2013, which led to listing in Appendix II of CITES.
- Currently managed using size limits established in 1978 based on shell height and meat weight.
- Maturity is measured by thickness of shell lip (Tewfik et al. 2019).
- Bulk of catch is of immature individuals.





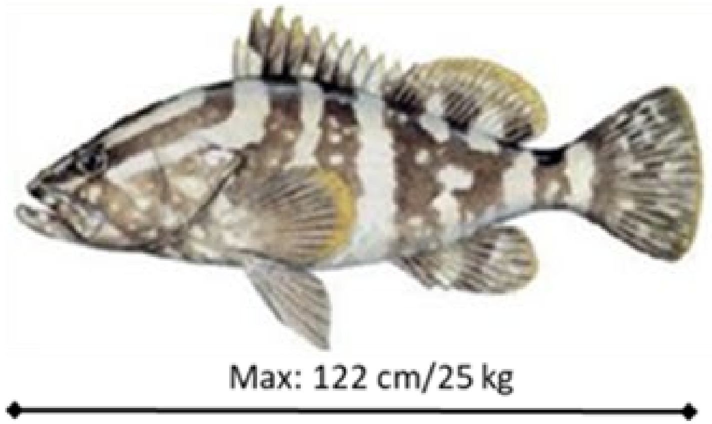
Review of existing knowledge: Spiny lobster

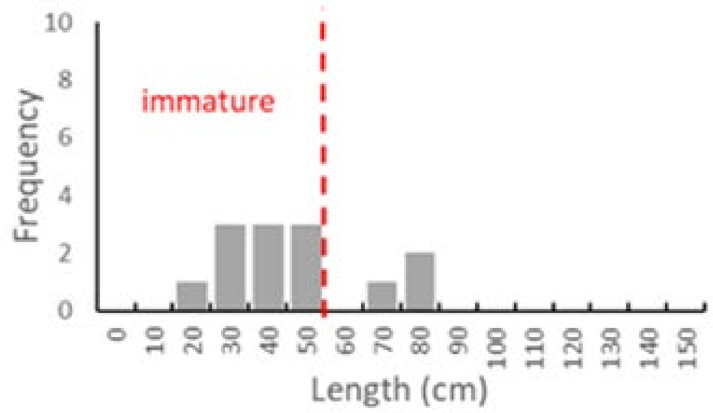
- 100 years of commercial fishery;
- Depletion of northern populations and expansion to the south and to atolls (Tewfik *et al*. 2020);
- Dramatic increases in catch in 21st century with all fishing grounds fully utilized for some time;
- Replenishment zones help but overfishing continues with landing of immature individuals;
- Belizean catches in the AVOID and NOT RECOMMENDED lists of Seafood Watch and Ocean Wise.



Review of existing knowledge: Nassau Grouper

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

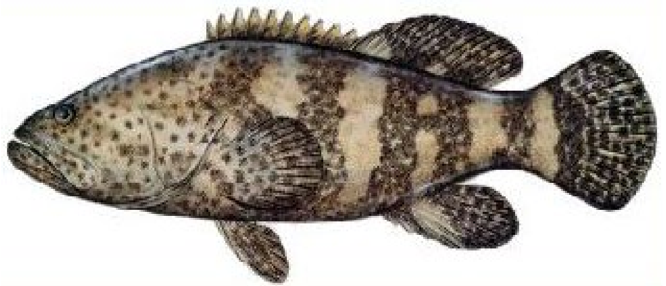




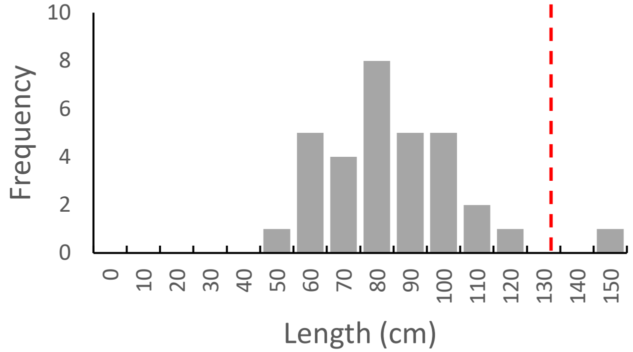
Review of existing knowledge: Goliath and Black Groupers

- In similar conditions as Nassau grouper

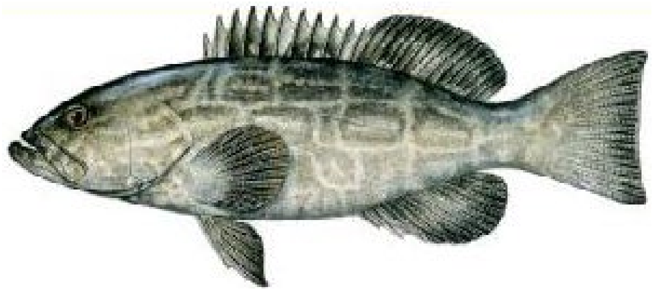
Goliath



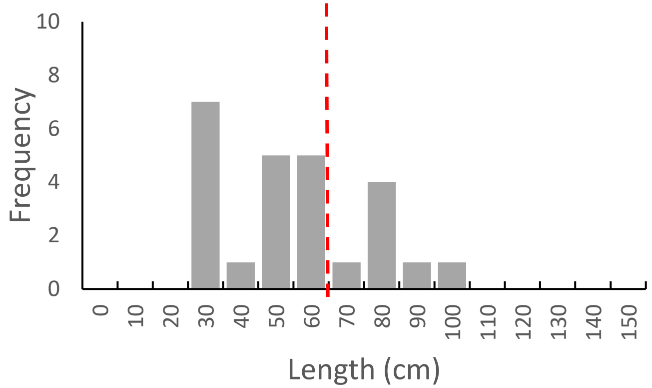
Max: 250 cm/360 kg



Black



Max: 150 cm/45 kg



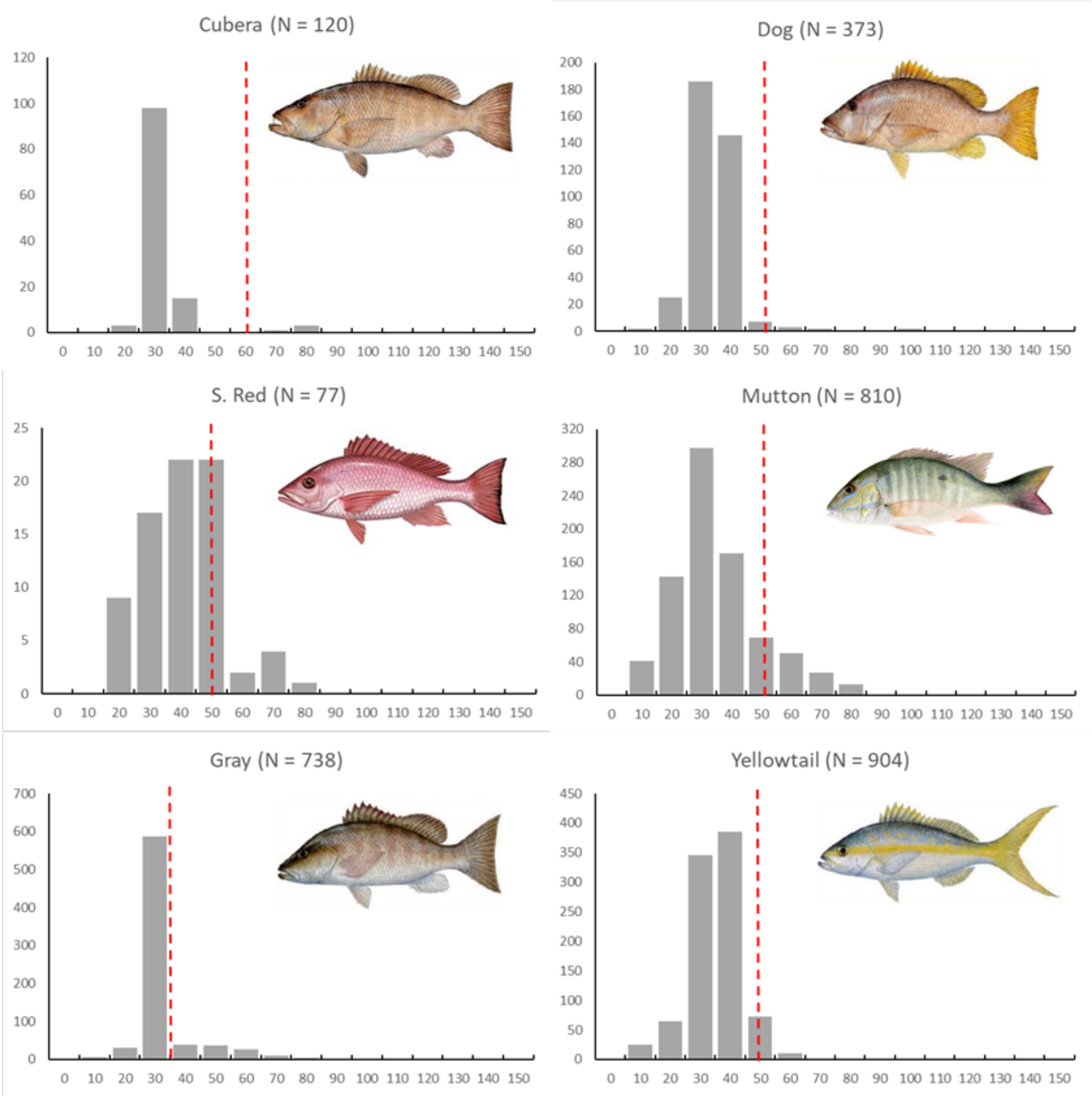
Review of existing knowledge: Snappers


Red


Cubera


Mutton


Lane



Crevalle jack

Overfished
Length at maturity: 56 cm
Maximum length: 124 cm
Optimal length: 70 cm
Longevity: 8 years

Common snook

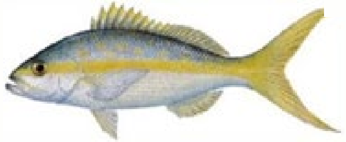
Overfished
Length at maturity: 61.2 cm
Maximum length: 140 cm
Optimal length: 77.6 cm
Longevity: 10 years

Great barracuda

Overfished
Length at maturity: 75.7 cm
Maximum length: 200 cm
Optimal length: 99.3 cm
Longevity: 17 years

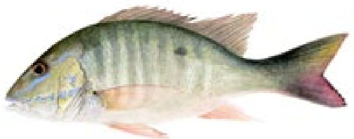
Yellowtail snapper

Overfished
Length at maturity: 29.3 cm
Maximum length: 86.3 cm
Optimal length: 33 cm
Longevity: 10 years

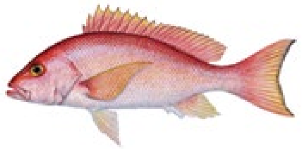


Mutton snapper

Overfished
Length at maturity: 46 cm
Maximum length: 94 cm
Optimal length: 55.8 cm
Longevity: 18 years



Silk snapper



Overfished
Length at maturity: 34 cm
Maximum length: 83 cm
Optimal length: 39.9 cm
Longevity: 9 years

Northern red snapper

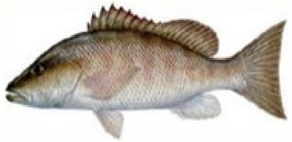
Overfished
Length at maturity: 49.5 cm
Maximum length: 100 cm
Optimal length: 60.6 cm
Longevity: 17 years

Official assessment | Literature review | CPUE time series | Expert testimony

Dog snapper

Overfished
Length at maturity: 47.6 cm
Maximum length: 128 cm
Optimal length: 58 cm
Longevity: 29 years

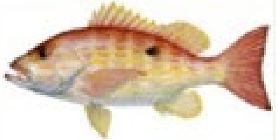
Grey snapper



Overfished
Length at maturity: 32.1 cm
Maximum length: 89 cm
Optimal length: 36.7 cm
Longevity: 12 years

Lane snapper

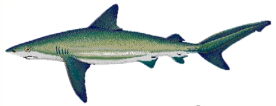
Overfished
Length at maturity: 26.4 cm
Maximum length: 60 cm
Optimal length: 29.3 cm
Longevity: 10 years



Scalloped hammerhead

Overfished
Length at maturity: 143.2 cr
Maximum length: 430 cm
Optimal length: 208.2 cm
Longevity: 32 years

Caribbean reef shark



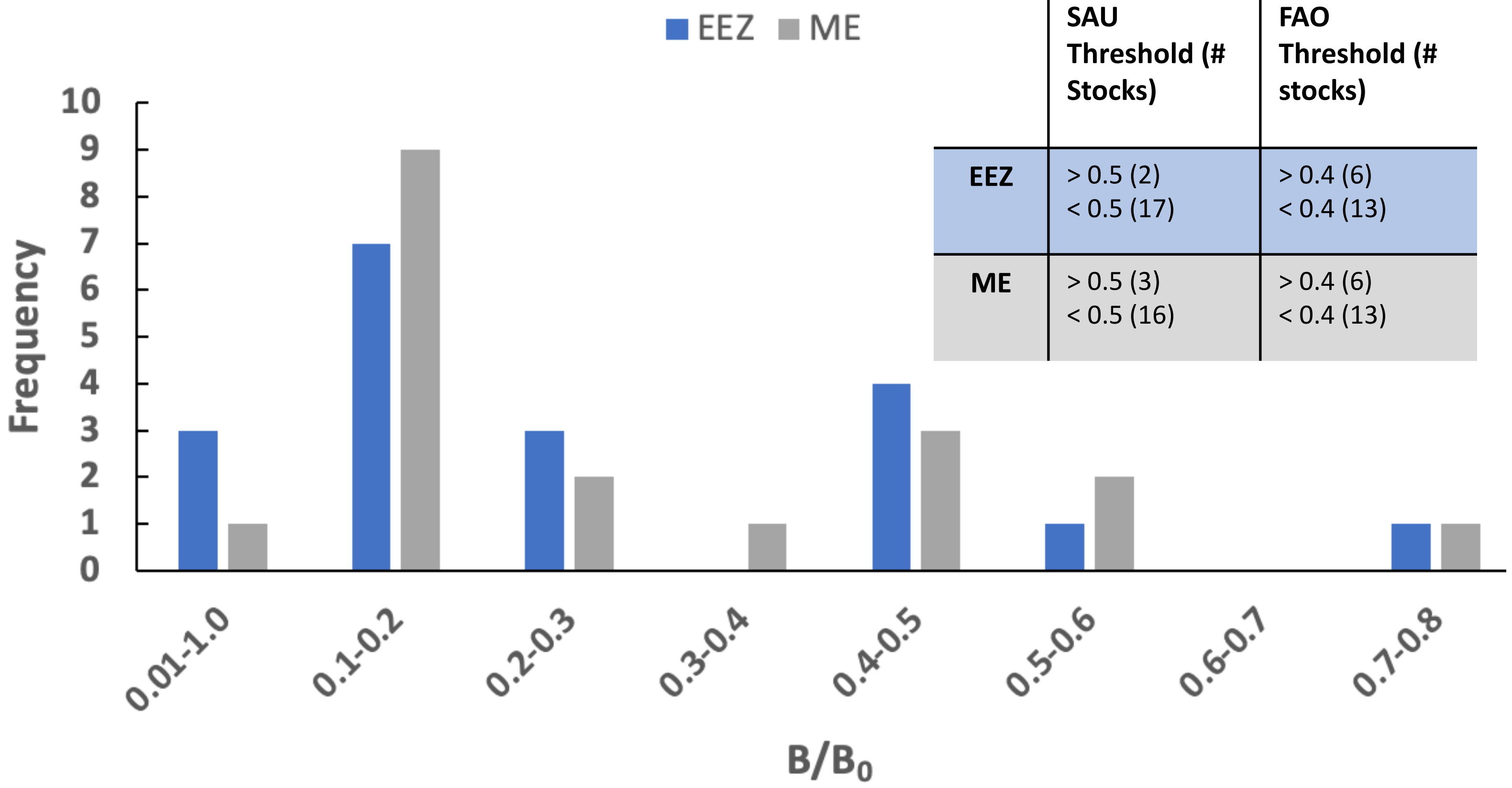
Overfished
Length at maturity: 141.1 cm
Maximum length: 300 cm
Optimal length: 205.1 cm
Longevity: 24 years

Status of stocks

- Review of existing knowledge conducted by Tewfik *et al*. (2020, 2022) suggest **growth overfishing**
  - Groupers, snappers, jacks and mackerels
  - Much of the catch consist of fish lengths < length at maturity, that is, the bulk of the catch are immature individuals.

- *Sea Around Us* stock analyses based on reconstructed catches point to the same conclusion: most of these species are **overexploited**.

Current biomass relative to carrying capacity (B/B_0)



	SAU Threshold (# Stocks)	FAO Threshold (# stocks)
EEZ	> 0.5 (2) < 0.5 (17)	> 0.4 (6) < 0.4 (13)
ME	> 0.5 (3) < 0.5 (16)	> 0.4 (6) < 0.4 (13)

Stock status of 19 stocks assessed for the Belize EEZ and Western Caribbean Marine Ecoregion. Final year B/B_0 = 2020 (EEZ) and 2019 (ME). This suggests that the biomass left of 89% (at EEZ-level) and 84% (at ME-level) of the 19 stocks assessed are below half of carrying capacity, .

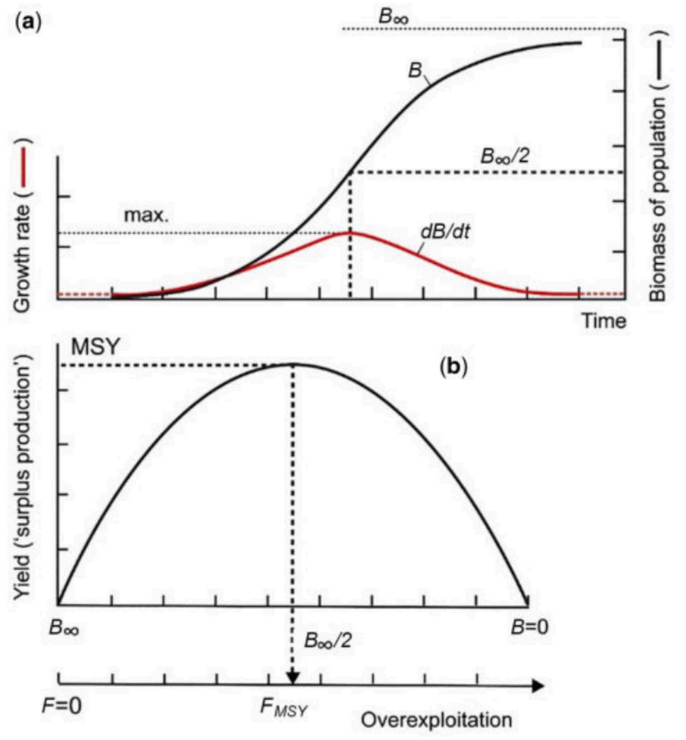


Figure 3. Basic elements of the Schaefer surplus production model. (a) A population invading an open space or recovering from a catastrophic decline will typically grow in sigmoid fashion, i.e. exponentially at first, then with at a declining rate as carrying capacity is approached. (b) The first derivative of the population growth curve [red line in (a)] plotted against the biomass from a parabola of surplus production vs. biomass, whose maximum occurs at $B_0/2$ (see text).

Pauly & Froese (2020)

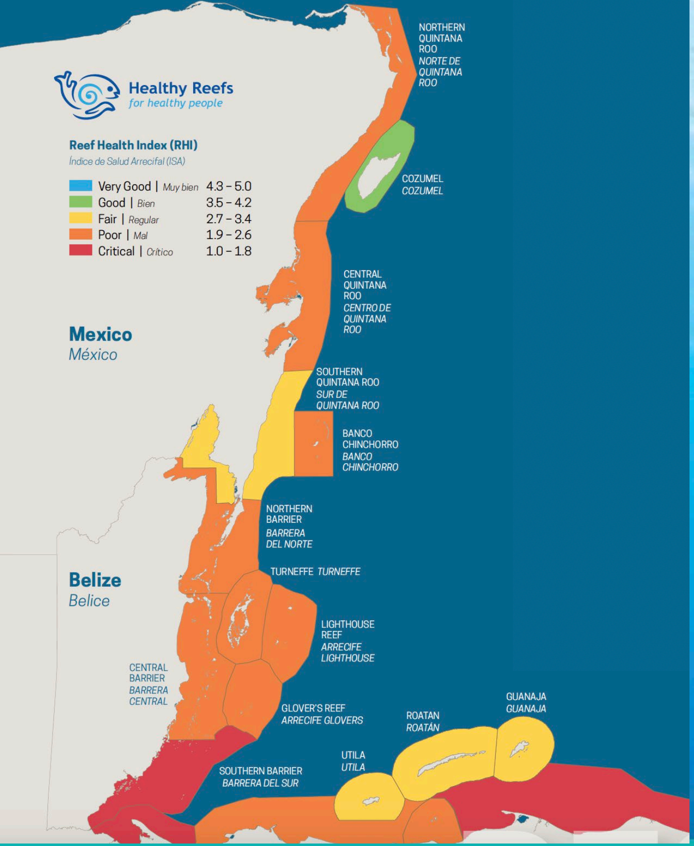
Reef Health Survey Results

Dr. Melanie McField

Healthy Reefs Initiative and Smithsonian Institution

June 12, 2023 Version

Mesoamerican Reef Health

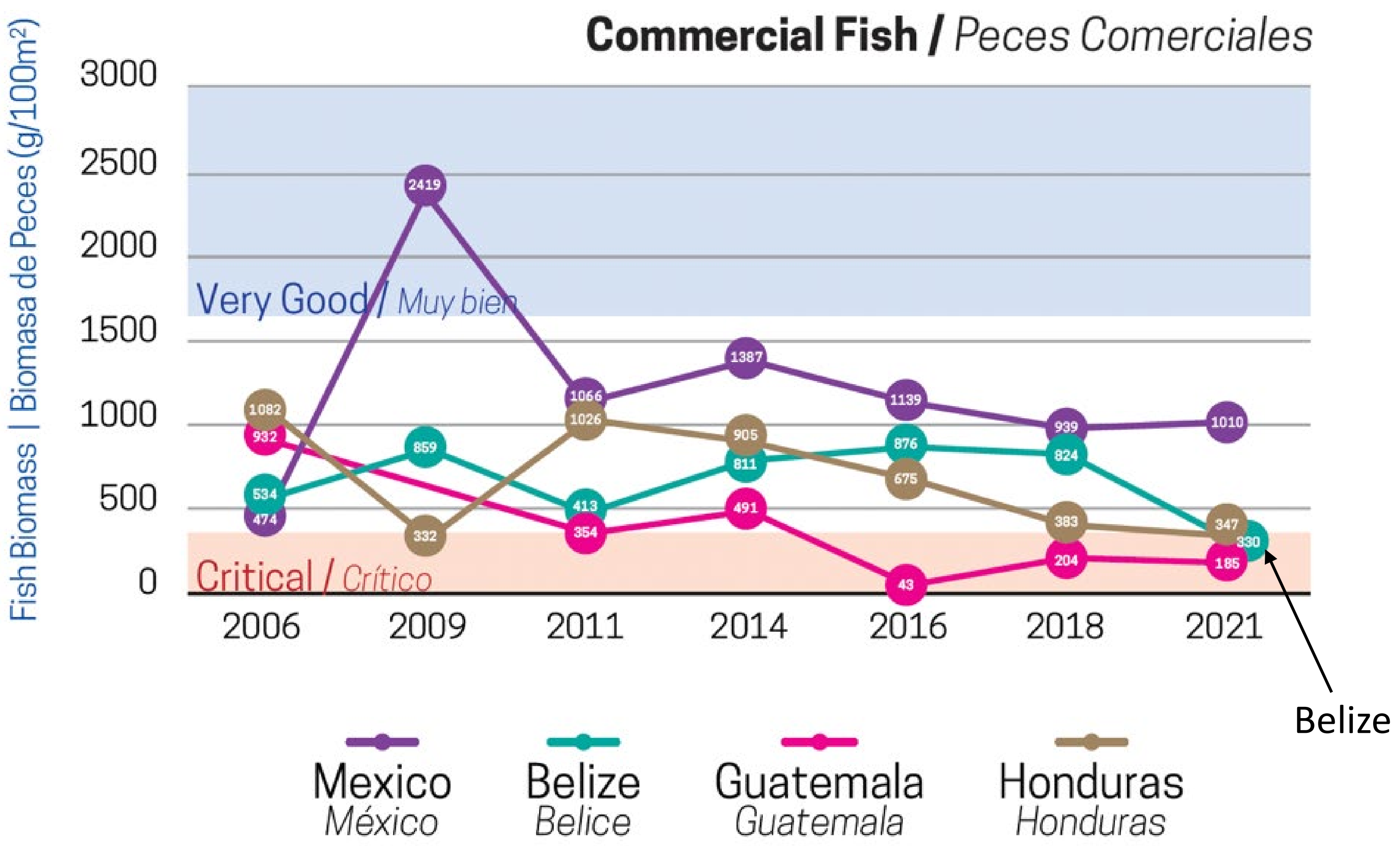


5 is top Score

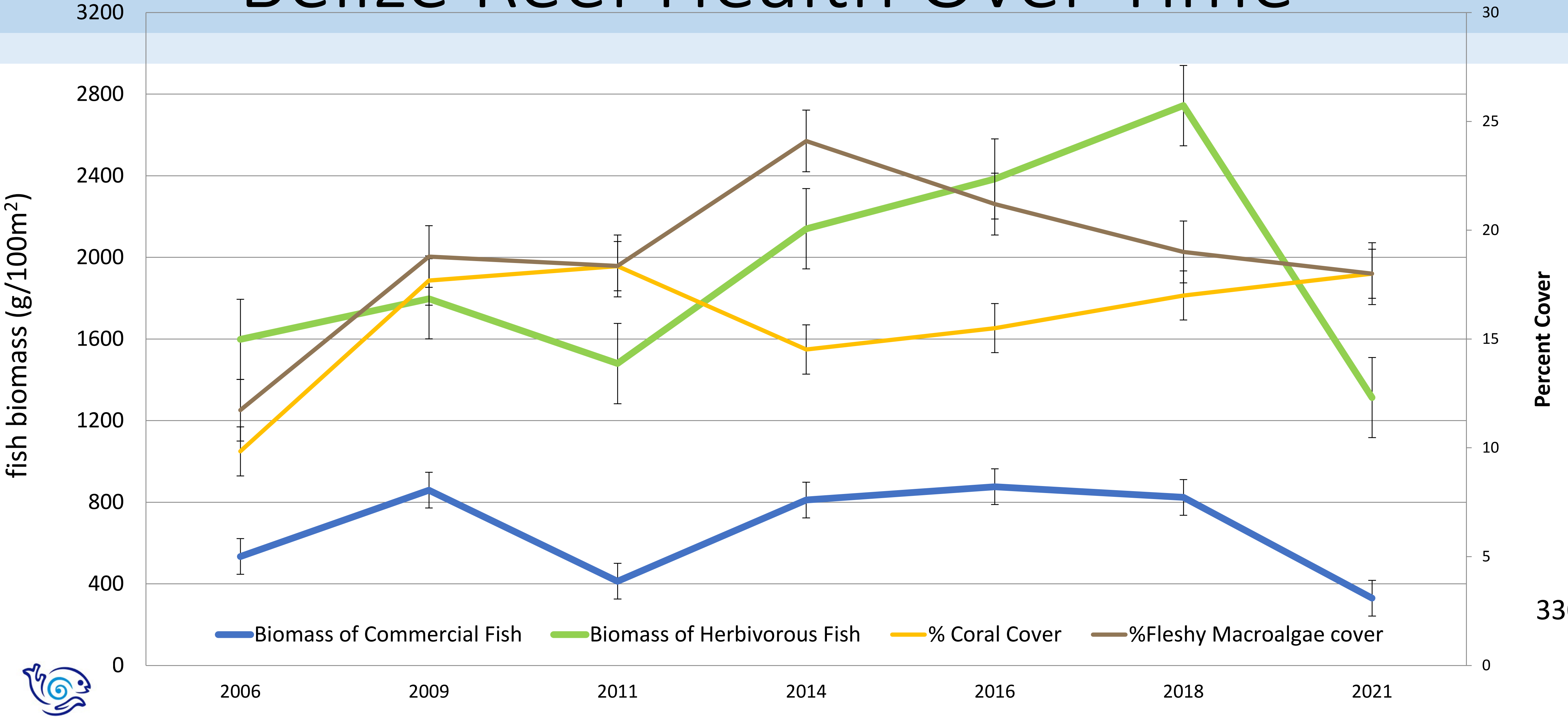
Years shown represent when data was collected not year report card was printed | *Los años que se muestran representan cuándo se colectaron los datos y no cuándo se imprimió el reporte.*

Living coral cover has slowly increased over the last 15 years, but diseases and bleaching are starting to have an impact. MAR average is 19%. A 5% increase is needed to attain a "Good" score.

Critical Commercial fish biomass (snappers & groupers) indicates the extent of overfishing, critical habitat loss, potential biodiversity loss, and dire ecological consequences. MAR average is 499 g/100m². A 142% increase is needed to attain a "Good" score.



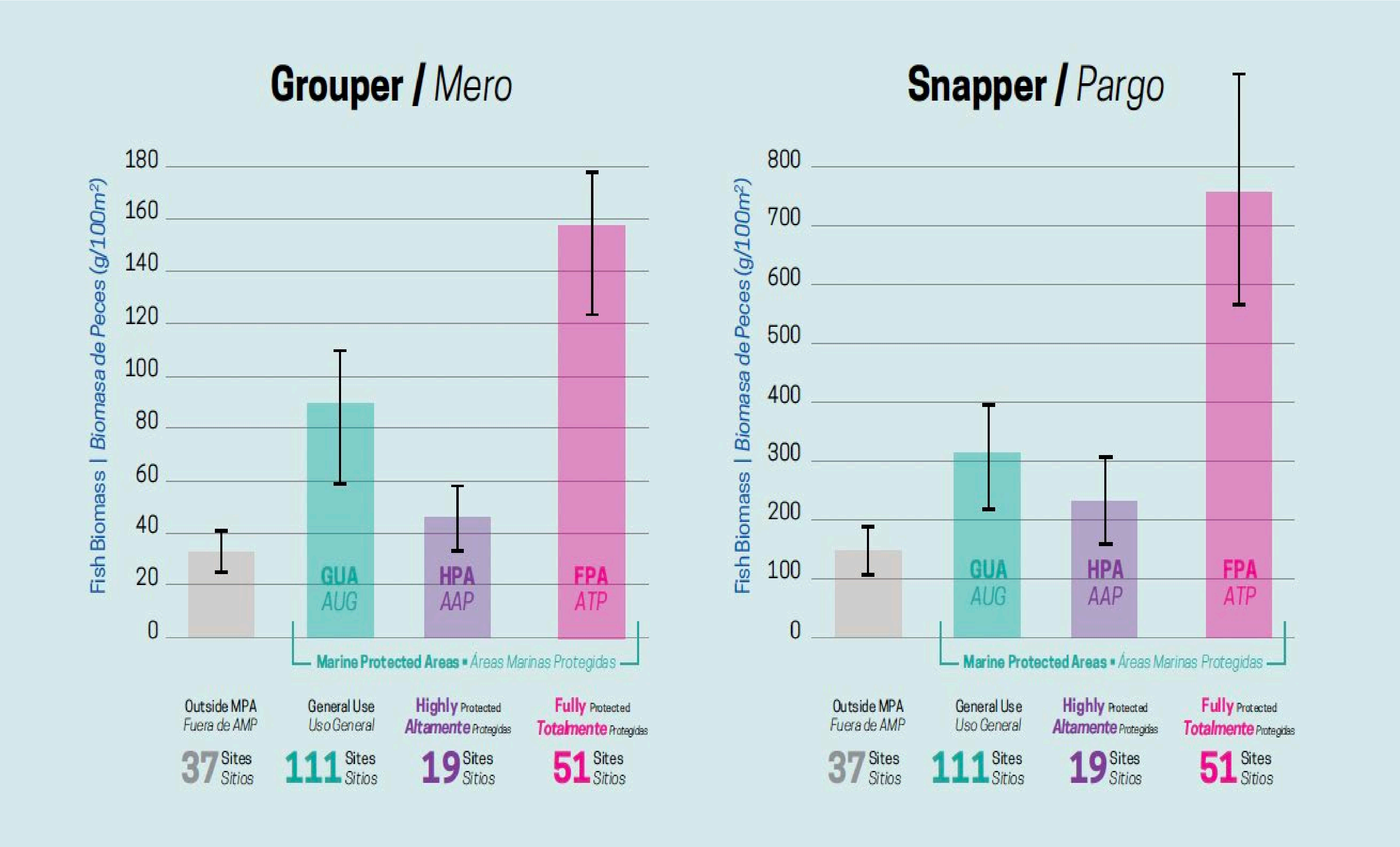
Belize Reef Health Over Time



330

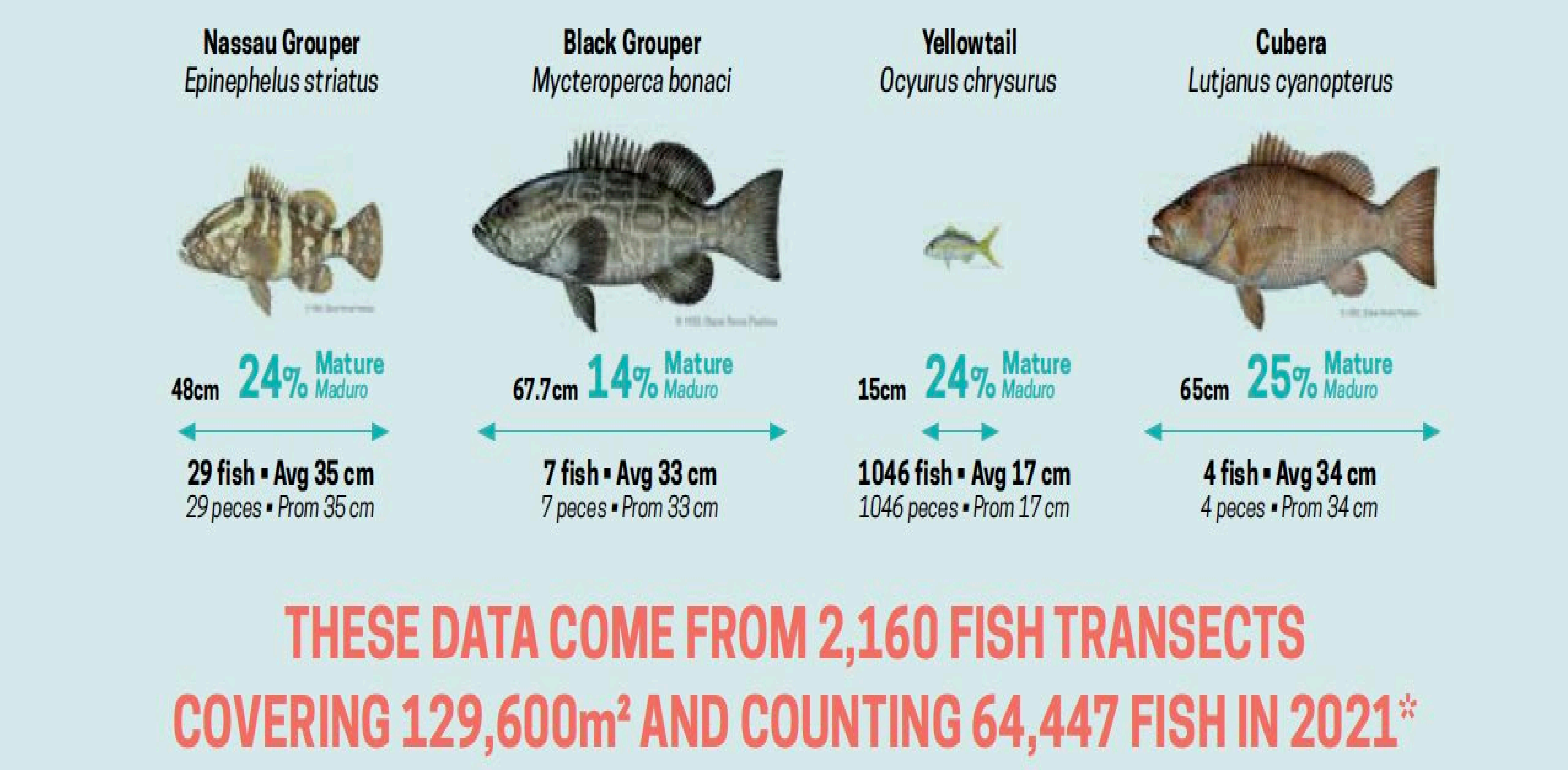
Healthy Reefs
for healthy people

Only Fully Protected Zones Have Higher Fish Biomass

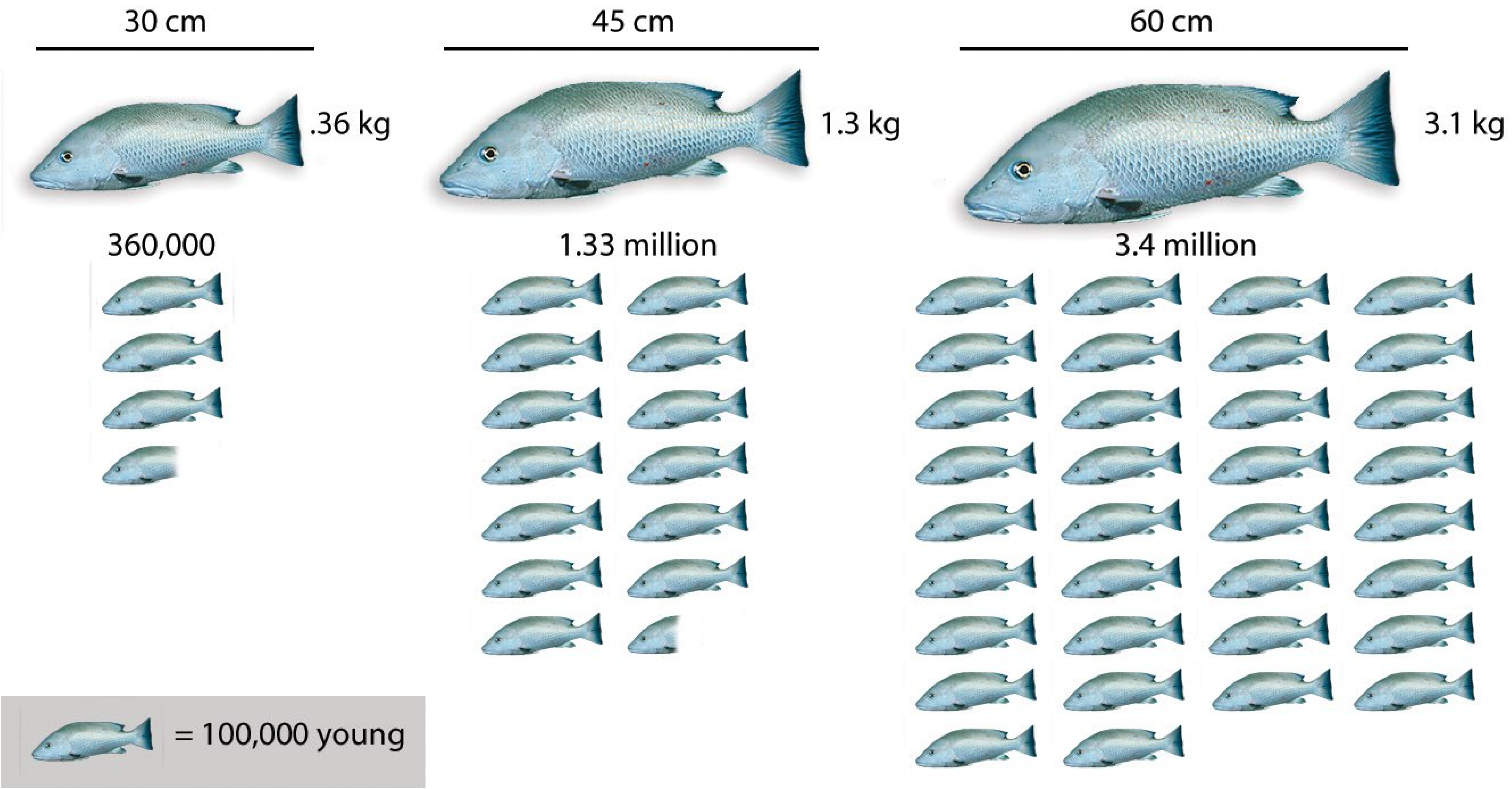


218 sites

Most fish that were counted were immature



Size Matters – Bigger fish make more young

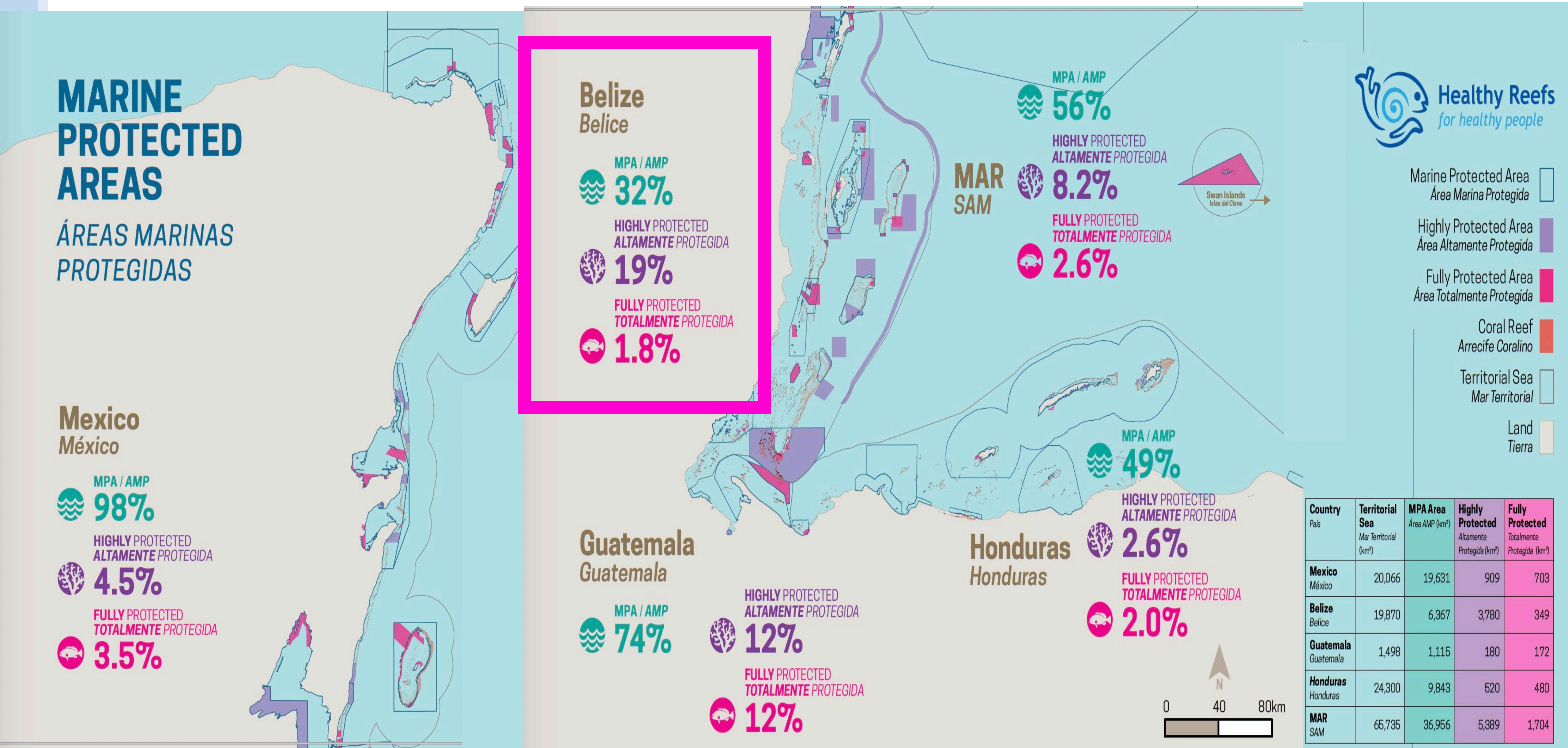


Average numbers of young produced by three different sizes of gray snapper.

Data: Bortone & Williams (1986) US Fish and Wildlife Service Biological Report

Big Fish are in the FULLY PROTECTED zones of MPAs

Now only <2% of Belize Sea; ~ 7% of the coral reef area



Country *País*	Territorial Sea *Mar Territorial (km²)*	MPA Area *Área AMP (km²)*	Highly Protected *Altamente Protegida (km²)*	Fully Protected *Totalmente Protegida (km²)*
Mexico *México*	20,066	19,631	909	703
Belize *Belice*	19,870	6,367	3,780	349
Guatemala *Guatemala*	1,498	1,115	180	172
Honduras *Honduras*	24,300	9,843	520	480
MAR *SAM*	65,735	36,956	5,389	1,704

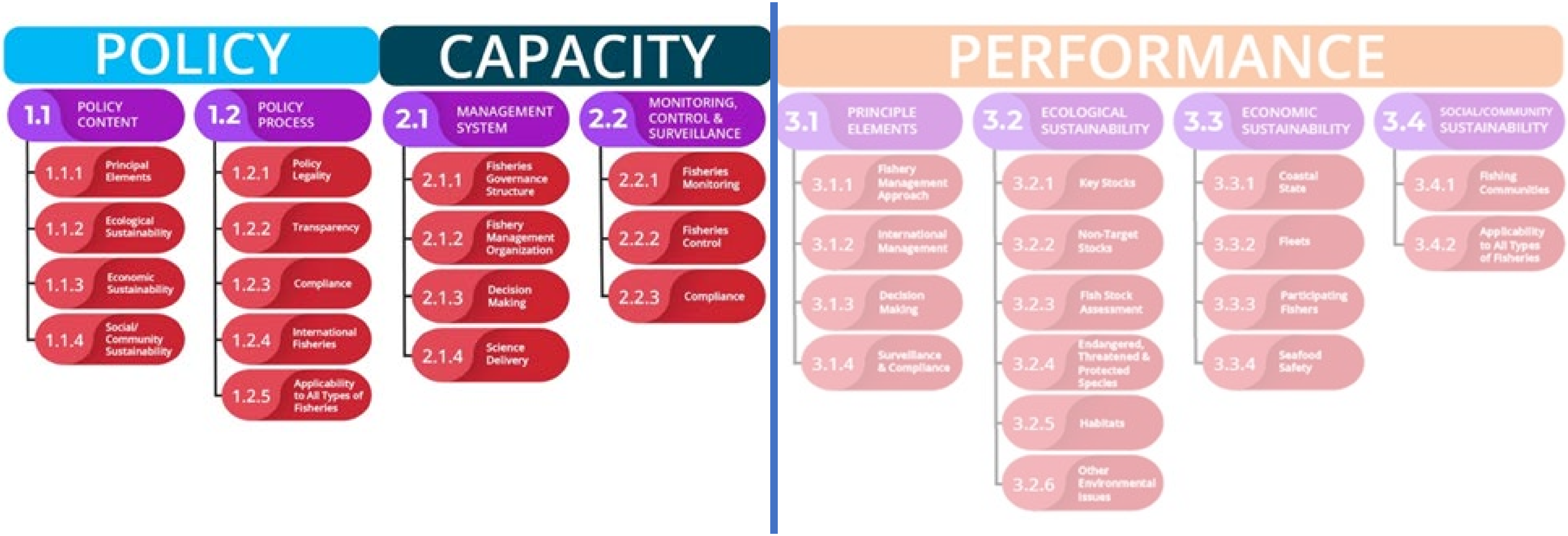
Fishery Management Opportunities

Dr. Graeme Parkes

MRAG Americas, Inc.

Governance Analysis

Structured analysis using the Fisheries Governance Tool



https://fishgovtool.com/

Swasey JH, Iudicello S, Parkes G, Trumble R, Stevens K, Silver M, et al. (2021) The fisheries governance tool: A practical and accessible approach to evaluating management systems. PLoS ONE 16(7): e0253775. https://doi.org/10.1371/journal.pone.0253775

Governance Analysis

Structured analysis using the Fisheries Governance Tool

Implemented in:

- Mexico
- Peru
- Chile
- Indonesia
- USA

https://fishgovtool.com/

Swasey JH, Iudicello S, Parkes G, Trumble R, Stevens K, Silver M, et al. (2021) The fisheries governance tool: A practical and accessible approach to evaluating management systems. PLoS ONE 16(7): e0253775. https://doi.org/10.1371/journal.pone.0253775

Governance Analysis

- Based on 40 source references, including 25 Belize Government documents
- Seeking feedback on our findings

Government Documents	Published and Public Literature
Constitution	Peer reviewed journal articles
Laws	Audits and assessments by NGOs
Regulations	Reviews by international and regional agencies
FMPs: draft, planned, in progress	Academic publications
Government Reports	NGO Reports
Ministry announcements and speeches	Papers produced by this project
Government News releases	Belizean news media
Agency Budgets	Workshop reports

Governance Analysis

POLICY

- **Policy Mandate**

No. 7] *Fisheries Resources* *83*

BELIZE:

FISHERIES RESOURCES ACT, 2020

- Coastal Zone Management Act, National Protected Areas System Act, Trade in Endangered Species (CITES) Act, High Seas Fishing Act, Environmental Protection Act

- **Policy Implementation**
  - laws, regulations, decrees, orders, and guidance.

Governance Analysis

POLICY

Fisheries Law follows international best practice:

- Precautionary Approach
- Best information available
- Stakeholder consultation
- Transparency

Governance Analysis

POLICY IMPLEMENTATION

Transparency is key

- Review Fishery Council meetings
- Review Fishery Management Plans
- Reviewed document "Towards a climate resilient multispecies finfish management plan for Belize"

Governance Analysis

POLICY IMPLEMENTATION

- Adaptive Management Framework
- Target and Limit Reference Points
- Risk tolerance and uncertainty
- Harvest Control Rule
- FMP Amendments
- Contains many ideas for an FMP, but requires implementation

Governance Analysis

CAPACITY

Policy Implementation requires a strong **capacity**, including:

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

Governance Analysis

CAPACITY

- Authority to manage fisheries is established
- Management organizations with regional focus exist
- Control and Compliance mechanisms exist

But

- Human resources needed, e.g. enforcement personnel and presence
- Sufficient and consistent budget allocation for management and science needed
- Vessel license limits raised (approximately 1000 additional fishing licenses in 2022);

Opportunities

- New Fisheries Act and other policy instruments provide sound basis for management
- Limit licenses/effort/access to match fishing capacity with fishing opportunities
- Develop FMPs to focus on fisheries sustainability in addition to MPAs
- Enhanced MCS capacity with clear presence and enforcement results
- Mandate use of science in management: Harvest Control Rules
- Regular review of management measures to support long-term resilience

Key Management Responses and Examples of Successes

Dr. Andrew Rosenberg

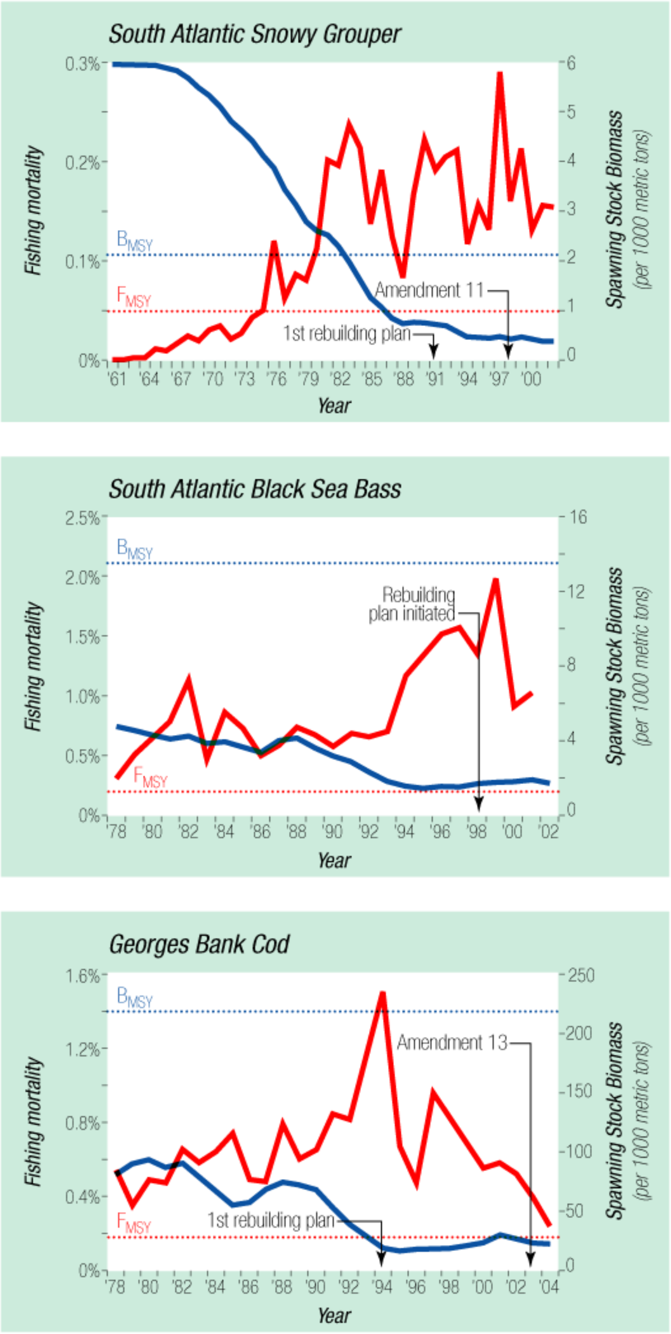
MRAG Americas, Inc.

Fishery Policy Key Lessons

- Policies must change as the fishery and environment changes
    - Holding regulations constant doesn’t work
    - Responding to new evidence is essential
    - Fishing businesses constantly adapt, so must management
- For key species and species assemblages exploitation rate and exploitation pattern (size, age, sex, maturity, etc) is fundamental
    - If exploitation is too high stock and yields will decline
    - If exploitation pattern doesn’t allow sufficient reproduction, stock and yields will decline

LENFEST OCEAN PROGRAM

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

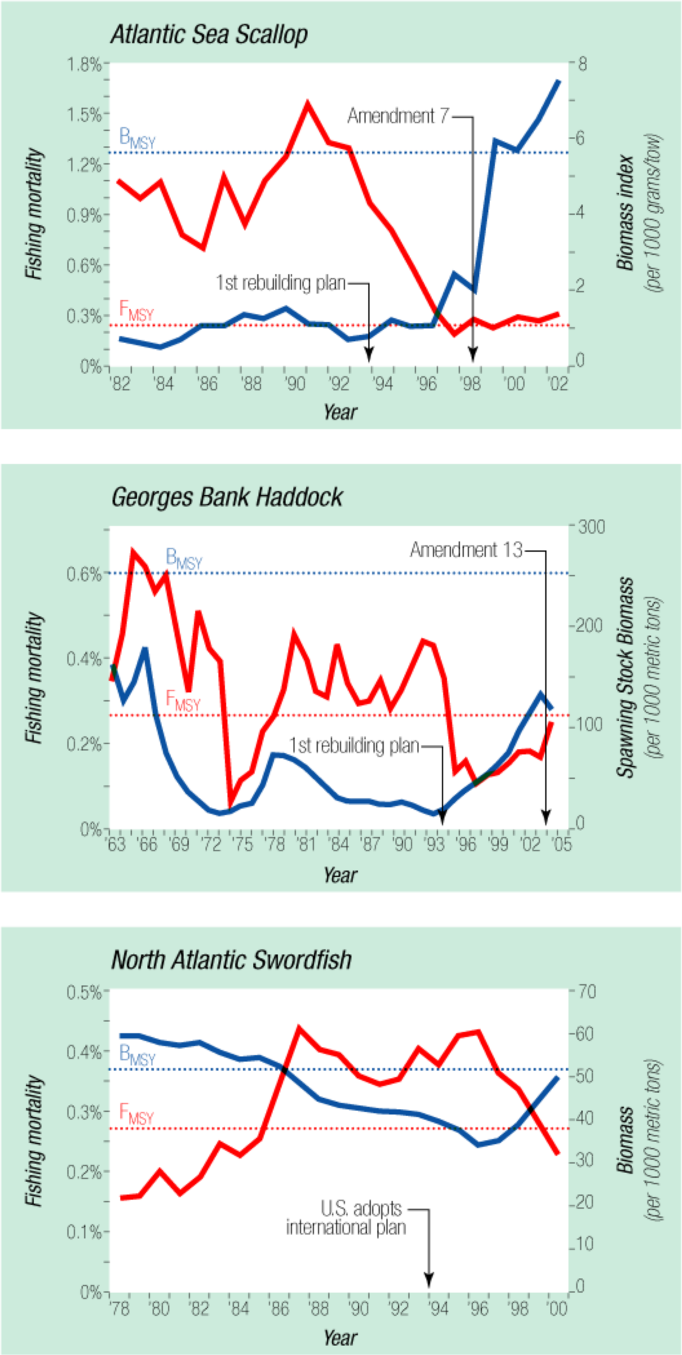


When fishing pressure remains high, stocks show little recovery

tps://www.eli.org/belize-fisheries-project

LENFEST OCEAN PROGRAM

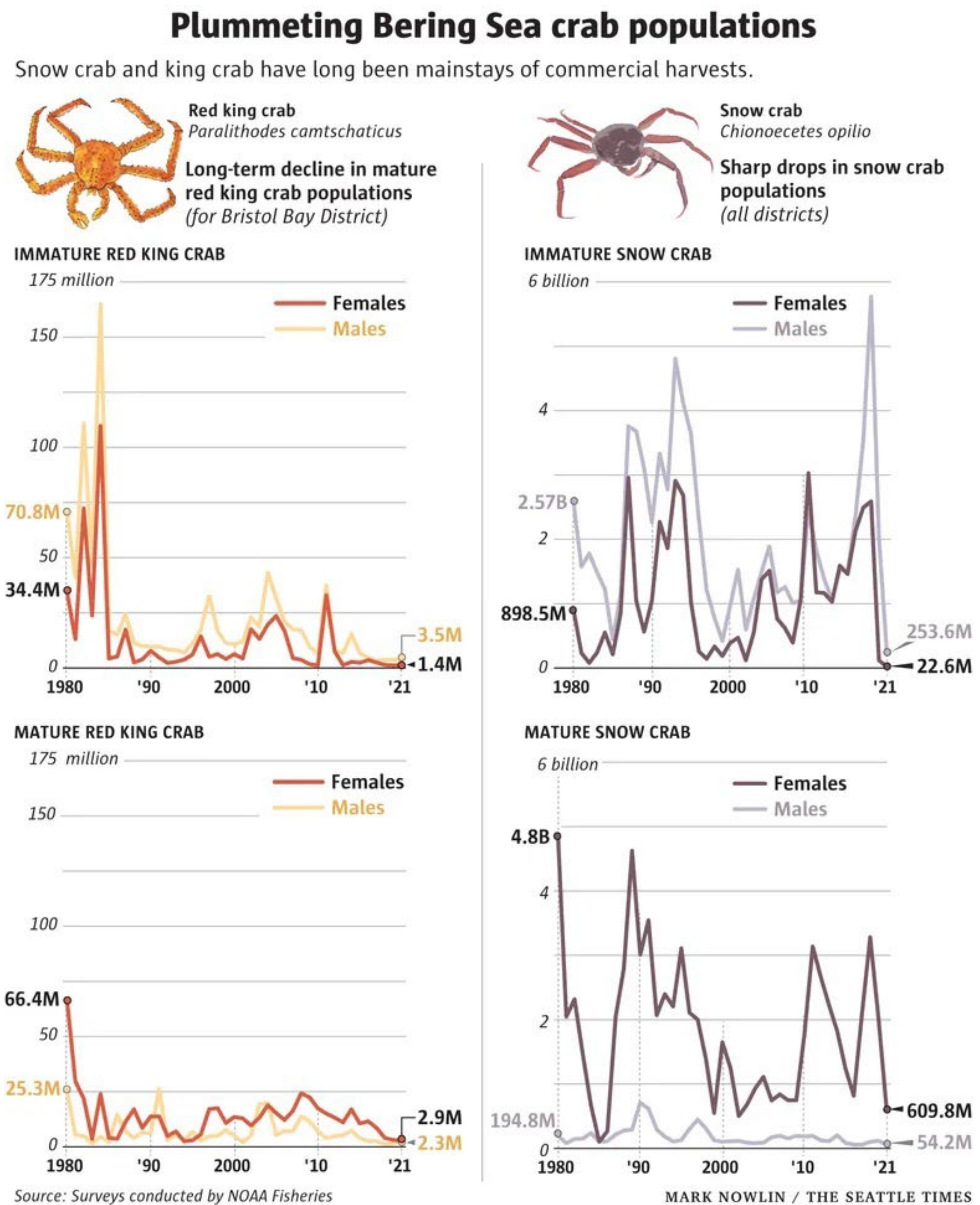
Figure 5: Examples Of Stocks Showing Rebuilding Progress

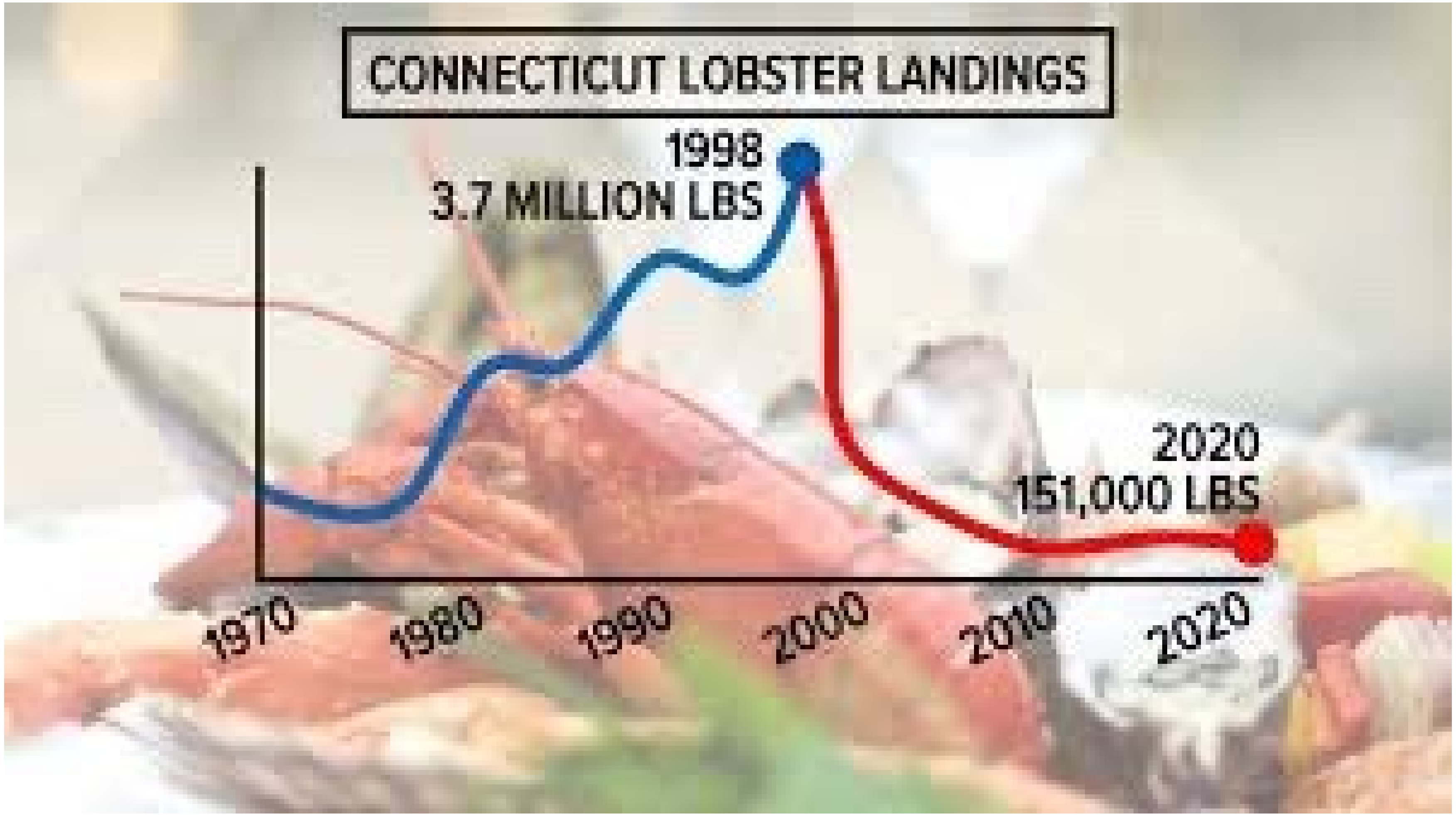


When fishing pressure is reduced, stocks can recover

:tps://www.eli.org/belize-fisheries-project

- 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
- A control/enforcement strategy that focuses on major violations is essential to give confidence to the community


Plummeting Bering Sea crab populations
Snow crab and king crab have long been mainstays of commercial harvests.
Red king crab
Paralithodes camtschaticus
Long-term decline in mature red king crab populations (for Bristol Bay District)
Snow crab
Chionoecetes opilio
Sharp drops in snow crab populations (all districts)
IMMATURE RED KING CRAB
175 million
150
100
50
0
Females
Males
70.8M
34.4M
3.5M
1.4M
1980
'90
2000
'10
'21
IMMATURE SNOW CRAB
6 billion
4
2
0
Females
Males
2.57B
898.5M
253.6M
22.6M
MATURE RED KING CRAB
175 million
150
100
50
0
Females
Males
66.4M
25.3M
2.9M
2.3M
MATURE SNOW CRAB
6 billion
4
2
0
Females
Males
4.8B
194.8M
609.8M
54.2M
Source: Surveys conducted by NOAA Fisheries
MARK NOWLIN / THE SEATTLE TIMES


CONNECTICUT LOBSTER LANDINGS
1998
3.7 MILLION LBS
2020
151,000 LBS
1970
1980
1990
2000
2010
2020

Fishing for certainty

Science advisers should have confidence in their data, or risk being drowned-out by more dogmatic stakeholders.

Andrew A. Rosenberg

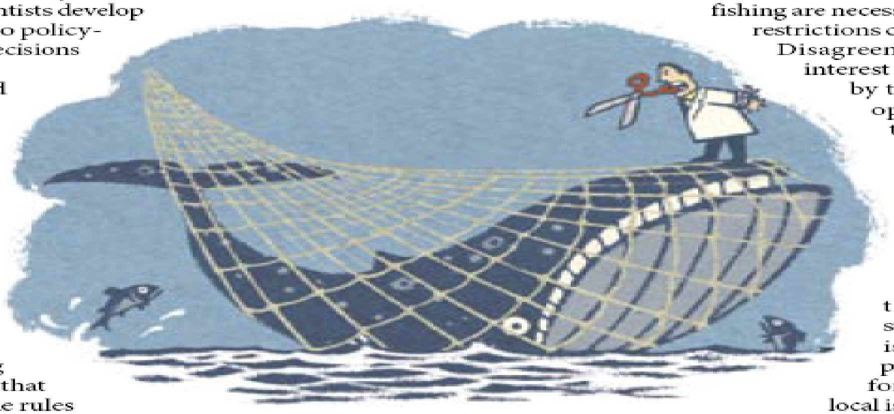
Policy-makers receive formal and informal advice from all quarters: scientific, legal, political and public. Each piece of advice is considered mandatory by the giver, and it often conflicts with other advisers' points of view. Uncertainty is a feature of all advice, but is usually only acknowledged by the scientific adviser.

I have worked as a scientist, policy-maker and adviser, mostly managing marine resources. As an ecologist specializing in fisheries population dynamics, I naively assumed that scientists develop advice that is passed on to policy-makers who then make decisions in the light of it.

When in 1995 I moved into the policy-making side of things, managing fisheries in the northeastern United States, I learned that advice comes from all directions. Scientists would present data with many caveats; others would give advice based mainly on opinion. Fishermen coming to the microphone in a public meeting might categorically state that the science was wrong, the rules wouldn't work and everyone would go out of business. Scientists tended to emphasize their uncertainty, and would be unwilling to speculate.

As scientists, we learn to analyse uncertainty and we explore decision-making in the light of that uncertainty. This is important, but we must also recognize that the precautionary approach will be adopted only slowly in policy-making. Uncertainty undermines political will in environmental decision-making. Officials are more likely to support a vociferous interest group that is apparently certain of the dire economic consequences of new restrictions, than scientists who advocate caution and prioritize the environment.

Over time, I learned that the solution for an adviser is not to hide careful analyses of uncertainty, but to distinguish the almost certain from the less certain. For example, it became clear in the 1980s that overfishing in New England, the North Sea and many other areas was critically depleting resources. Exploitation of species such as cod was removing 60–70% of the standing stock every year. Unfortunately, the debates were too often about whether the sustainable exploitation rate should be 20 or 25%. The conclusion drawn by many in industry and politics was that the science was uncertain. Hearing people say in debates, "fisheries science is not an exact science," made me wonder which other field they were comparing fisheries to, and indeed what an exact science is.



There is little uncertainty that overfishing was, and in many cases still is, occurring and that exploitation needed to be reduced by half or more. Emphasizing what we don't know often drowns out what we do know. In the event, strong action in New England reduced exploitation rates on some stocks, such as haddock, down to reasonable levels. As scientists predicted, the stocks began to recover. On other stocks such as cod, exploitation has remained relatively high, and they have not recovered. There is little mystery, and very slow progress is being made. Unfortunately, the fish may not wait for us to learn our lesson.

> "Emphasizing what we don't know often drowns out what we do know."

Statements of policy are still a far cry from implementing policy. It is easier to agree to the general principle of ending overfishing and rebuilding resources than it is to put the principle into effect. Few argue that overfishing and resource depletion is a good thing; many argue about whether their fishing activity, their business or their recreation really contributes to overfishing.

For example, the United States' Marine Mammal Protection Act of 1972 is a strong mandate to protect all marine mammals; its reauthorization in 1994 was passed unanimously by the US Senate. But in the northeastern United States, protection of whales from entanglement in fishing gear — one of the main causes of death in whales in coastal waters — means that restrictions on fishing are necessary. Implementing these restrictions caused huge controversy.

Disagreement between different interest groups was exemplified by the elected official who opposed the restriction, telling me to, "go save the whales somewhere else".

Political decision-making inevitably leans towards minimizing the impacts of policies on constituents who are most affected. The public cares about the general outcome, such as saving whales, but is unlikely to change its political view or support for an official because of local issues such as catch quotas or protected areas; fishermen will because the issue is immediate and vital to them.

In the 1990s, when I was a senior manager of the US National Marine Fisheries Service, I viewed my job as maximizing conservation without someone higher in the policy-making structure taking away my authority. Each decision was a judgement call about how far I could go, and without a doubt my judgment was imperfect. Science led my logic. I would start by asking: what do we know, and what does that mean we should do? In every case, I would then have to consider: what can be done, given the forces at play? As an adviser, I learned that adhering closely to the scientific advice is always the best course — as long as you can save some fish in the process. ■

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SCIENCE & POLITICS

Thank You

- Questions and discussion