OCEAN HEALTH INDEX™

Healthy Oceans. Healthy People.

Framework and Methods

Updated Dec 2015. For updated information visit ohi-science.org

“How inappropriate to call this planet Earth, when it is evident it should be called Ocean”

- Arthur C. Clarke

Recognizing Ocean Values
WORLDWIDE

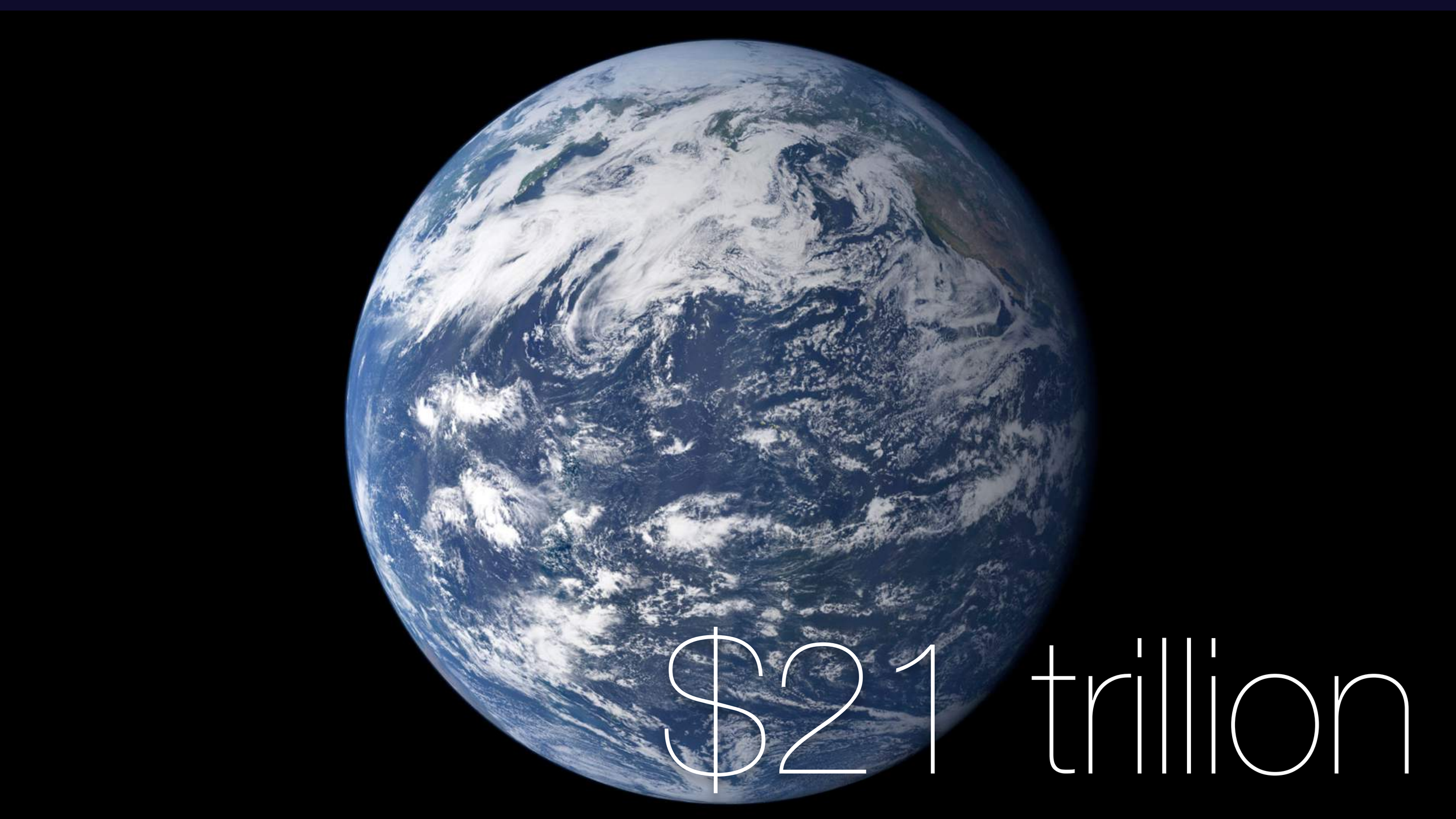

$21 trillion

photo: © art wolfe/ www.artwolfe.com

$190 billion/year

500 million

ocean related jobs

OUTLINE

1. Need
2. Goals and Methods
3. Scale of assessments
4. Uses and benefits
5. Results of global assessment
6. Overcoming limitations with independent assessments

WHY DO WE NEED AN OCEAN HEALTH INDEX?

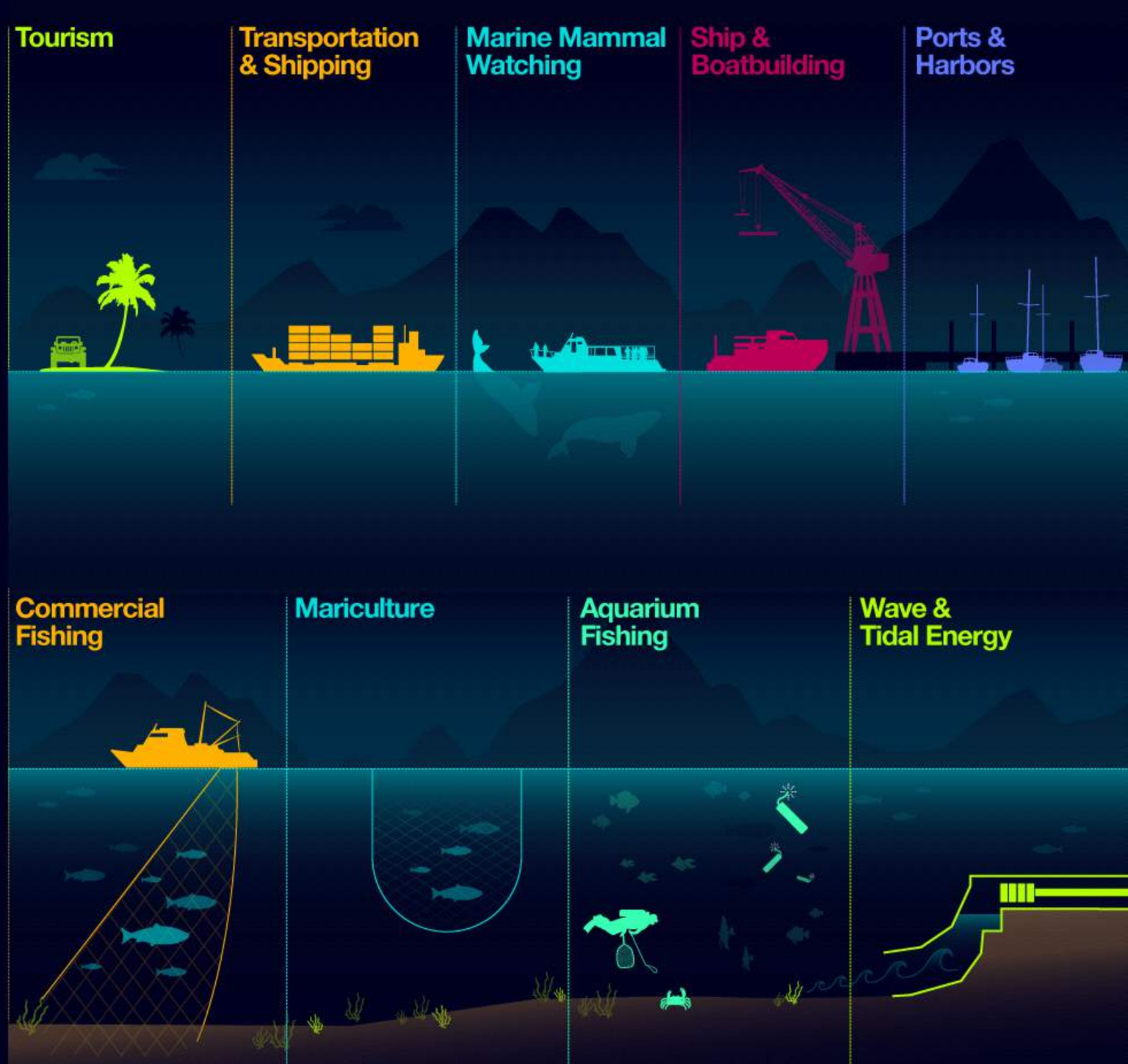
OCEAN & COASTAL GOODS AND SERVICES

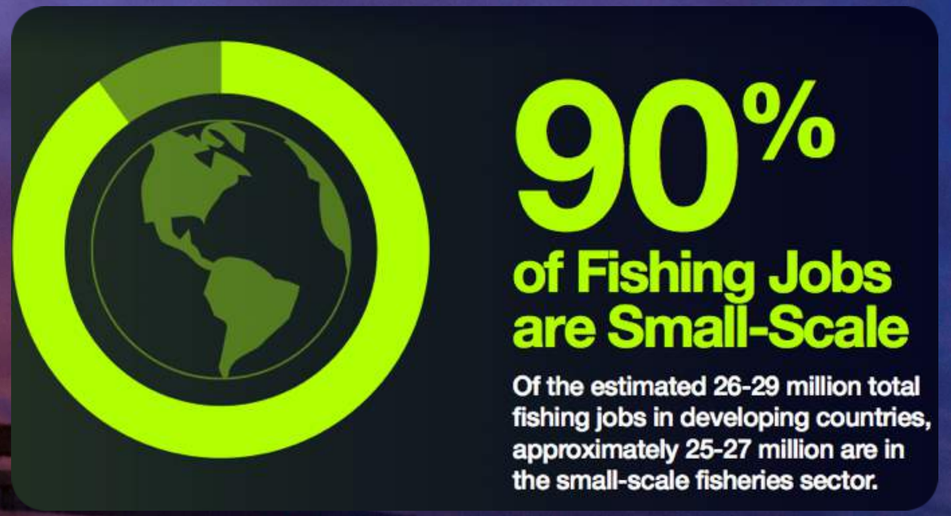
↓

potential conflicts

↓

need sustainable balance



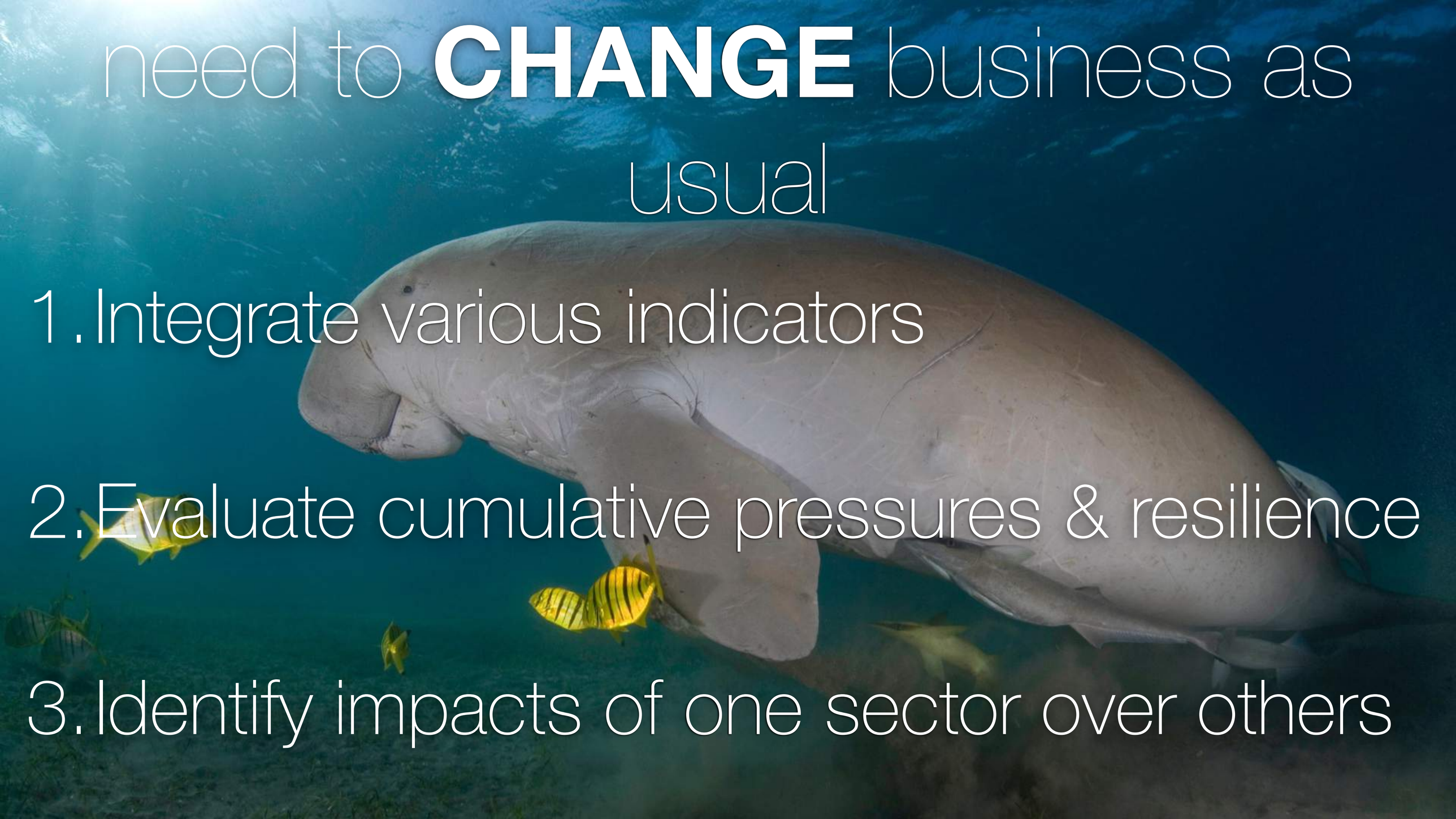


COASTS AND OCEANS ARE CHANGING IN **unprecedented ways**


HOW DO YOU MEASURE OCEAN HEALTH?
What is a healthy ocean?
One without human pressures?


HUMAN BEINGS ARE PART OF MARINE ECOSYSTEMS
Everywhere in the world


Policies aim to achieve healthy oceans
WITHOUT AN INTEGRATED TOOL TO MEASURE ITS HEALTH



need to **CHANGE** business as usual

1. Integrate various indicators

2. Evaluate cumulative pressures & resilience

3. Identify impacts of one sector over others

nature

An index to assess the health and benefits of the global ocean

published on 31.8.2012

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University of California, Santa Barbara
NCEAS
University of British Columbia
New England Aquarium
Union of Concerned Scientists
Conservation International
Center for Ocean Solutions


a HEALTHY OCEAN
sustainably delivers a range of
benefits to people both now and
in the future

What is the Ocean Health Index?

- a quantitative, repeatable, transparent and comprehensive tool

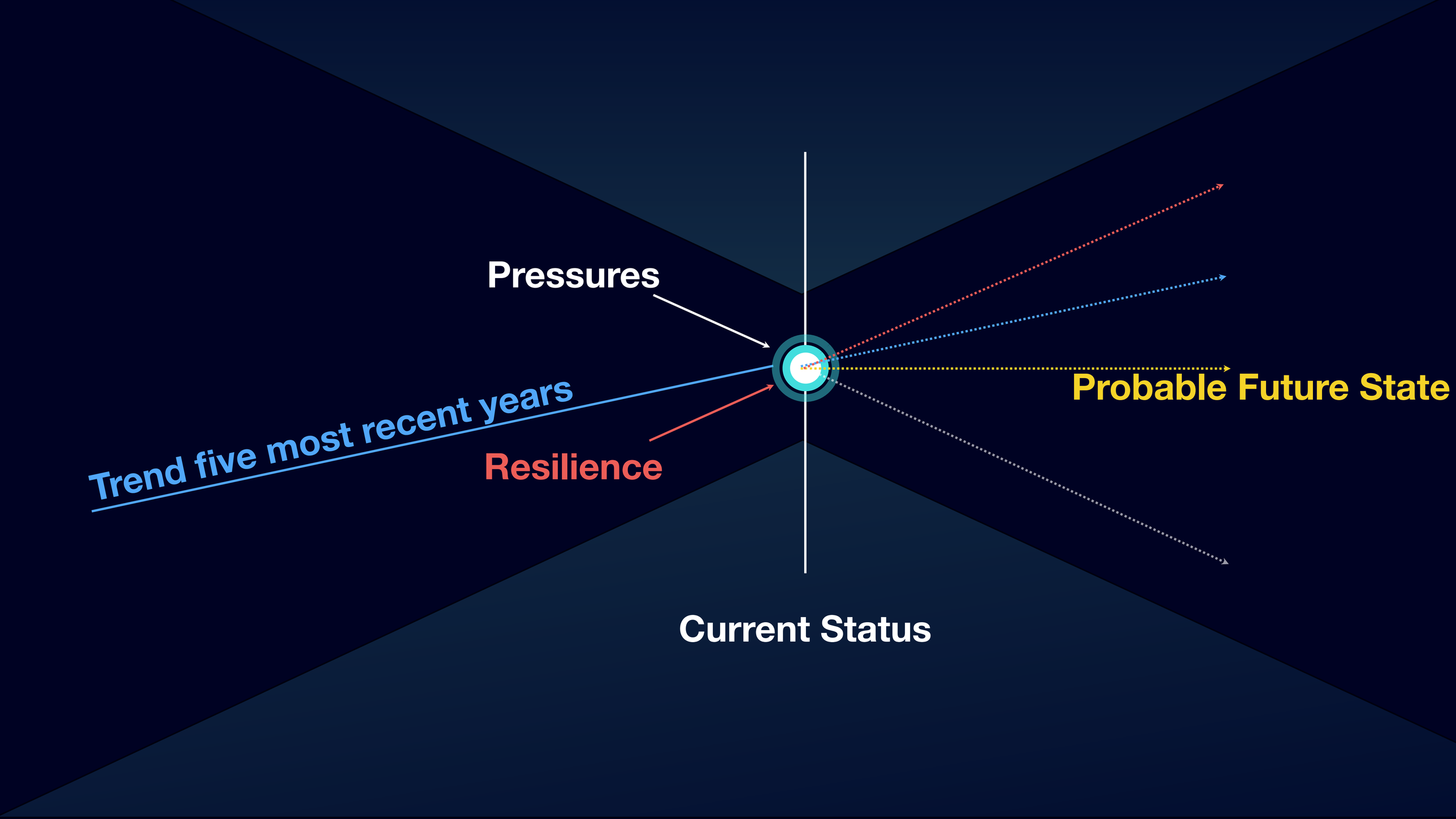
- that measures & tracks sustainable ocean use

- with a common language to inform decision making

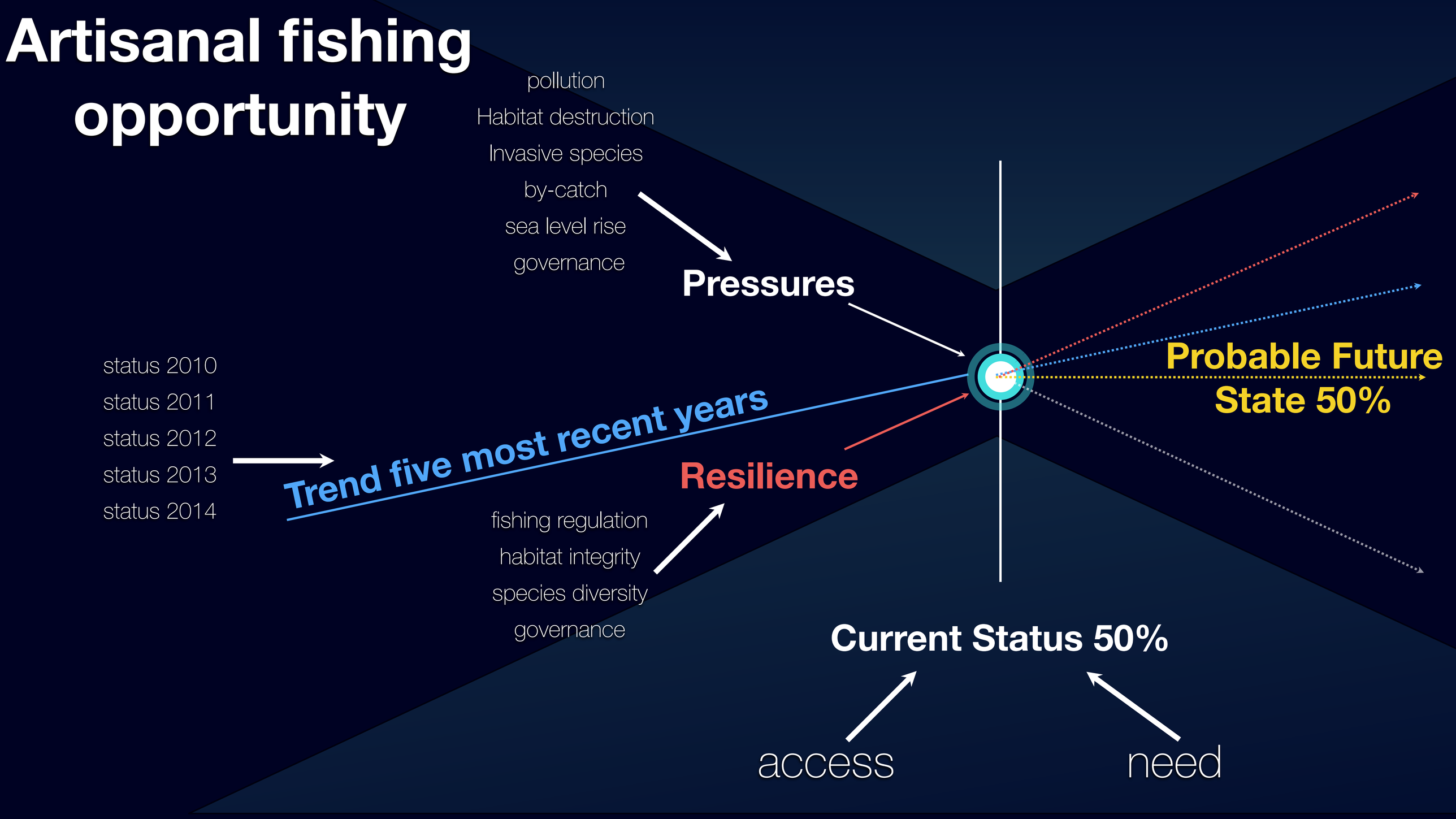
Ten Human Goals: an Ocean Dashboard

$$\sum_{i=1}^{N} \alpha_i I_i = I$$

The Ocean Health Index I is the weighted sum of individual goal indices I_i


Pressures
Trend five most recent years
Resilience
Probable Future State
Current Status

Artisanal fishing opportunity



Calculations for Each Goal

Present / Reference

$$\frac{X_i}{X_{i,\,R}} = x_i =$$

CURRENT STATUS 50

$$I_i = \frac{x_i + \hat{x}_{i,F}}{2}$$

+

PROBABLE FUTURE STATE 50

Trend T

Pressures p_i

Resilience r_i

$$(1+\delta)^{-1}\,[1 + \beta T_i + (1 - \beta)(r_i - p_i)]x_i = \hat{x}_{i,F}$$

Current Status

EXAMPLES OF INDICATORS USED TO CALCULATE GOAL STATUS				
Food Provision	**Artisanal Fishing**	**Natural Products**	**Carbon Storage**	**Coastal Protection**
Catch volume by species	Quality of artisanal fishing management	Tons harvest of non food products	Extent of coastal habitats	Extent of habitats 1km
Biomass/biomass of MSY	GDPpcPPP	Value of harvest by product	Relative weight of carbon storage by habitat	Condition of habitats 1km
Tons of Mariculture per species	Artisanal fishing need	Sustainability of the harvest		Ocean acidification
Mariculture sustainability				Ultra violet incidence
Coastal population				Sea level rise

Current Status

EXAMPLES OF INDICATORS USED TO CALCULATE GOAL STATUS				
Economies & Livelihoods	**Turism & Recreation**	**Cultural Identity**	**Clean Waters**	**Biodiversity**
Sector revenues	Proportional employment in tourism	Conservation status of iconic species	Chemical pollution	Conservation status of species
Employment and wages in the sectors	Tourism sustainability	Proportion of marine and coastal protected areas	Pathogens	Conservation status of habitats
Unemployment			Nutrient pollution	
Coastal GDP			Trash	
Marine sector evenness				

Pressures

EXAMPLES OF INDICATORS USED TO CALCULATE GOAL PRESSURES

Ecological Pressures					Social Pressures
Pollution	**Habitat destruction**	**Species Pollution**	**Fishing Pressures**	**Climate Change**	**Social factors**
Chemical	Subtidal hard and soft bottom habitats	Invasive species	Commercial bycatch (high & low)	Sea surface temperature	Governance indicators
Pathogens	Intertidal habitats	Genetic escapes	Artisanal bycatch (high & low)	Ocean acidification	
Nutrients			Selective harvesting	Ultraviolet incidence	
Trash				Sea level rise	

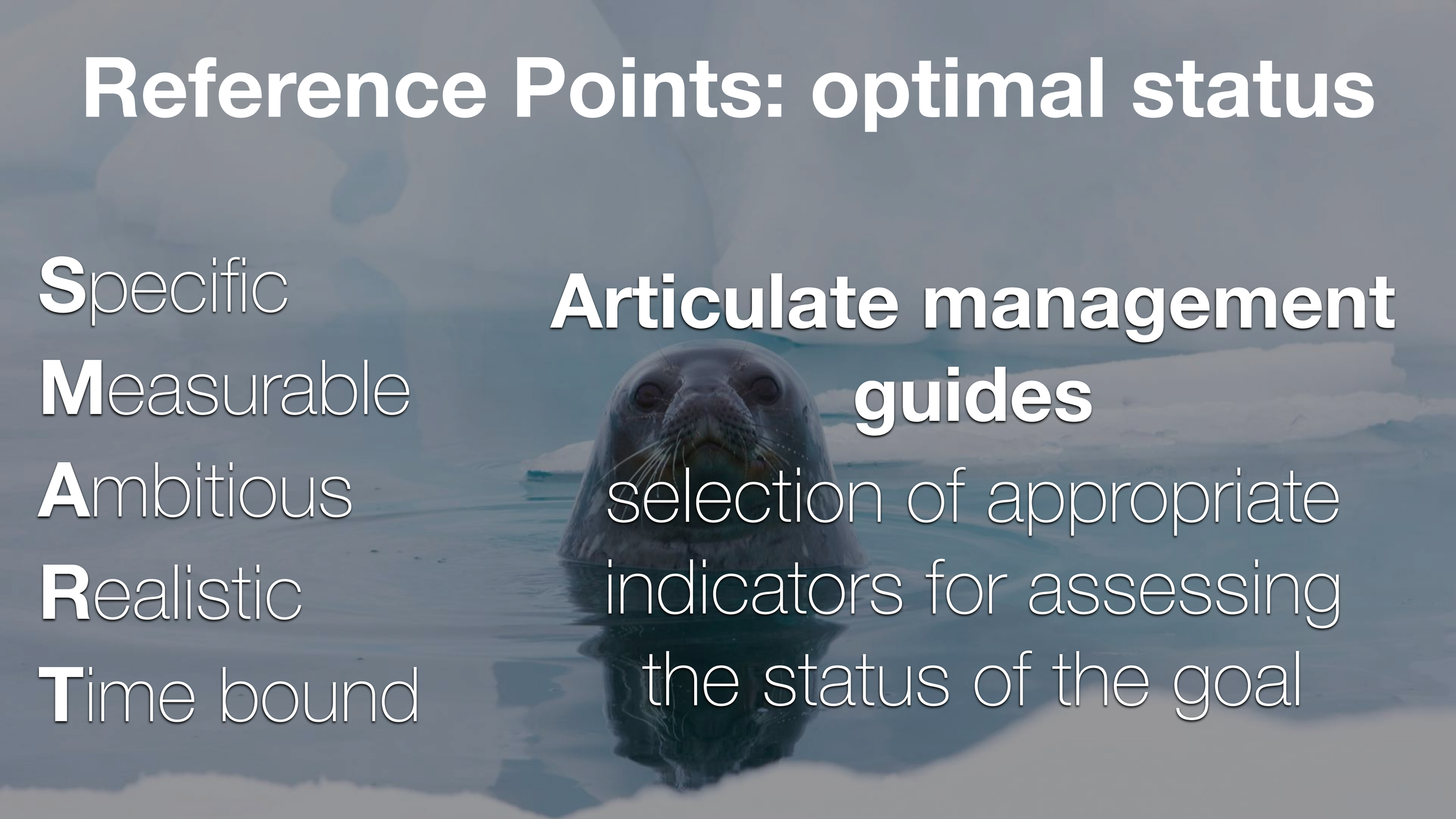
Resilience

EXAMPLES OF INDICATORS USED TO CALCULATE GOAL RESILIENCE

Ecological Resilience		Social Resilience
Regulatory	**Ecological Integrity**	**Social Integrity**
Invasive Species	Species Diversity	Global Competitiveness Index
CITES Signatories	Habitat Diversity	Sector Evenness
Fishing Regulations		Global Governance Indicators
Habitat Protection		
Biodiversity Protection		
Good Governance		
Sustainable Tourism Measures		
Clean Water Measures		

Reference Points: optimal status

Specific
Measurable
Ambitious
Realistic
Time bound

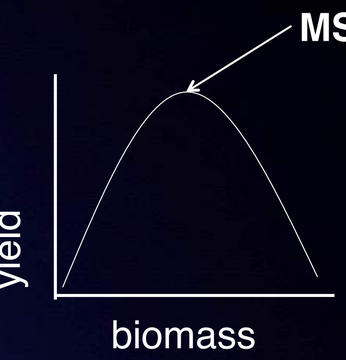


Articulate management guides

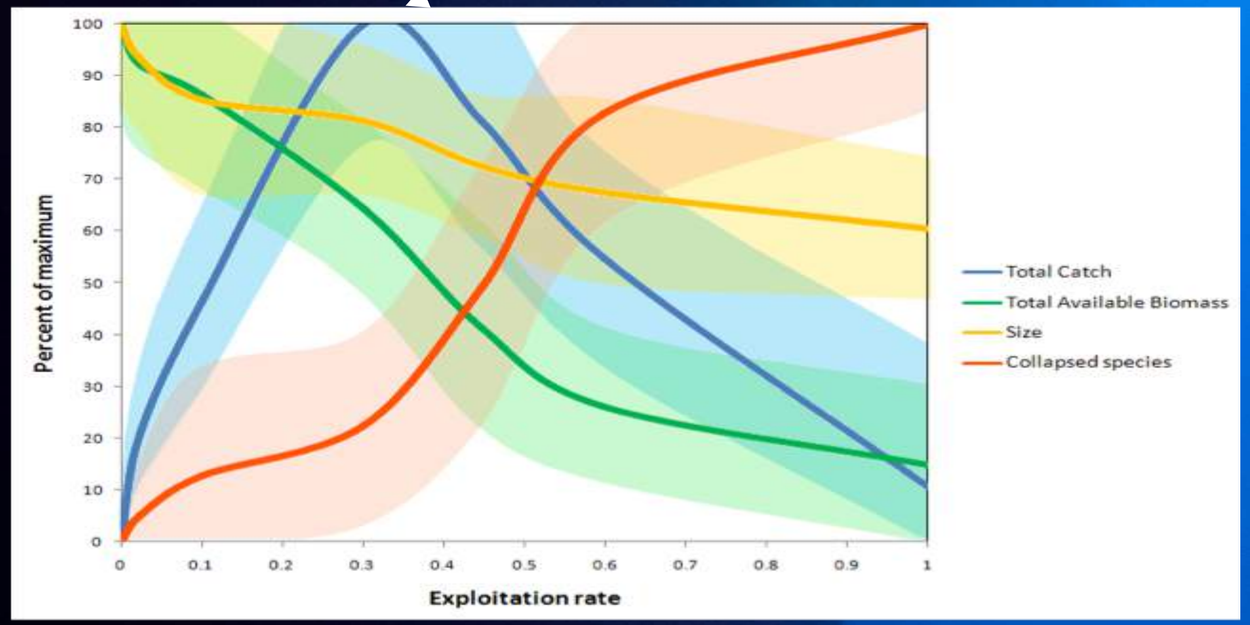
selection of appropriate indicators for assessing the status of the goal

Types of Reference Points

1.Functional Relationships (preferred method)



Multi species MSY



Wild Caught Fisheries

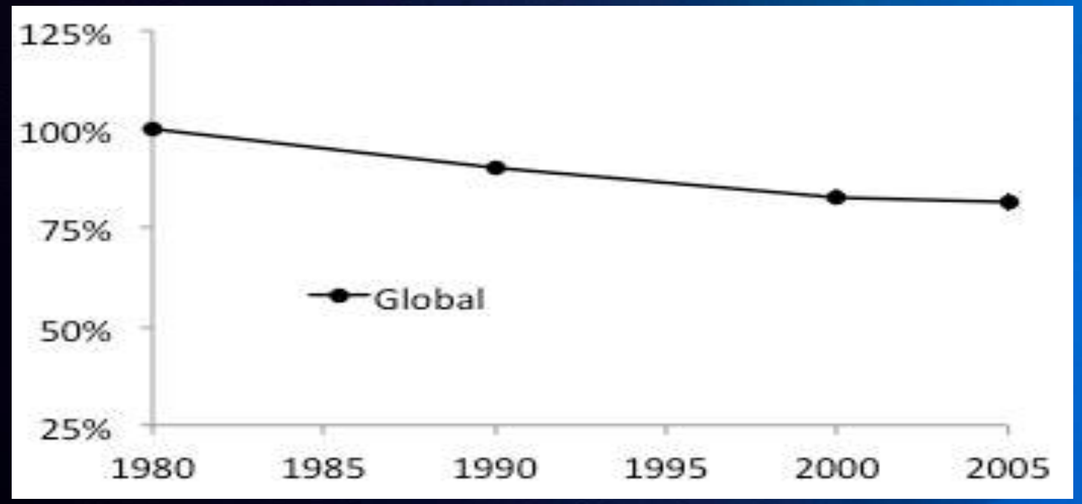
Artisanal Fishing

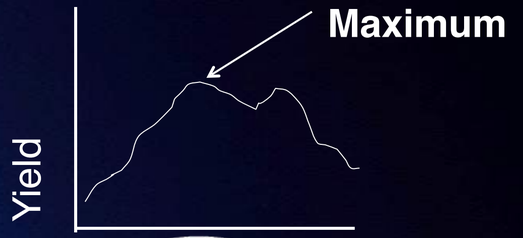
Natural Products

Samhouri et al. 2012 Ecosphere

Types of Reference Points

2. Temporal comparisons





Natural Products

Carbon Storage

Coastal Protection

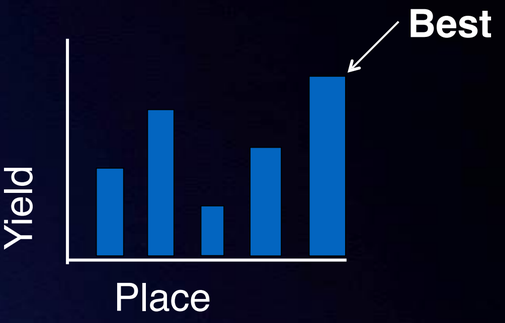
Livelihoods & Economies

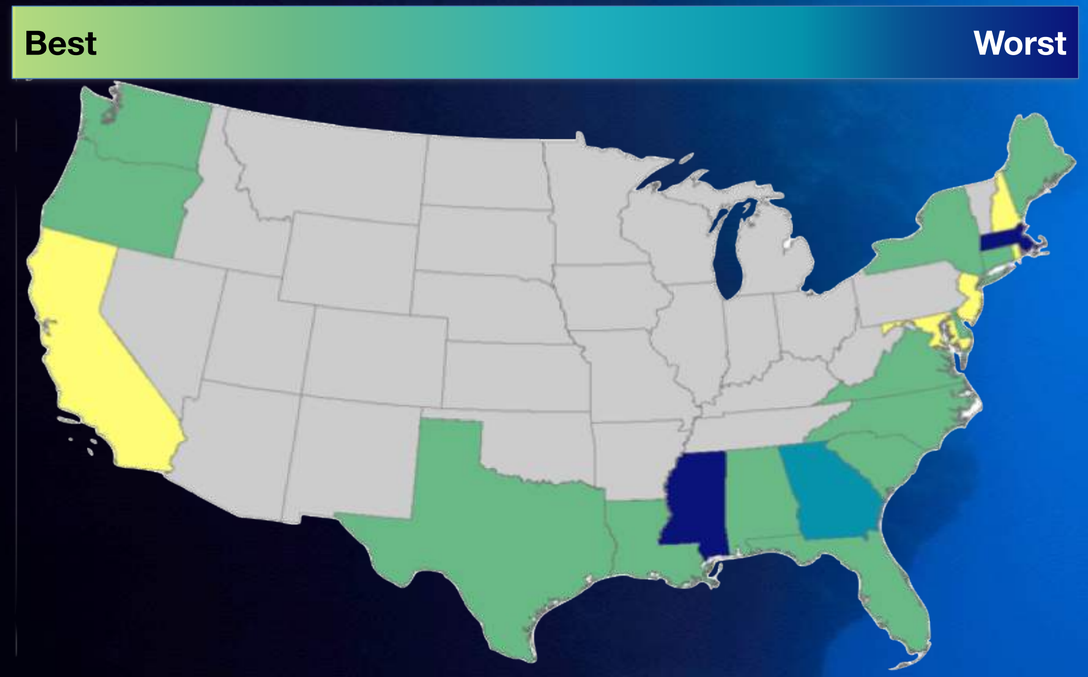
Biodiversity: Habitats

Samhouri et al. 2012 Ecosphere

Types of Reference Points

3.Spatial Comparison





Livelihoods

Turism & Recreation

Mariculture

Samhouri et al. 2012 Ecosphere

Types of Reference Points

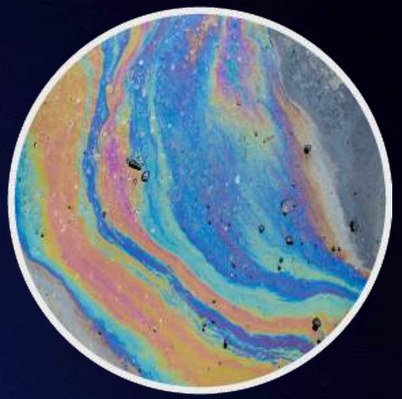
4.Known/established target

Convention on Biological Diversity

RED LIST

RIO+20

Sense of place: Lasting Special Places



Clean Waters

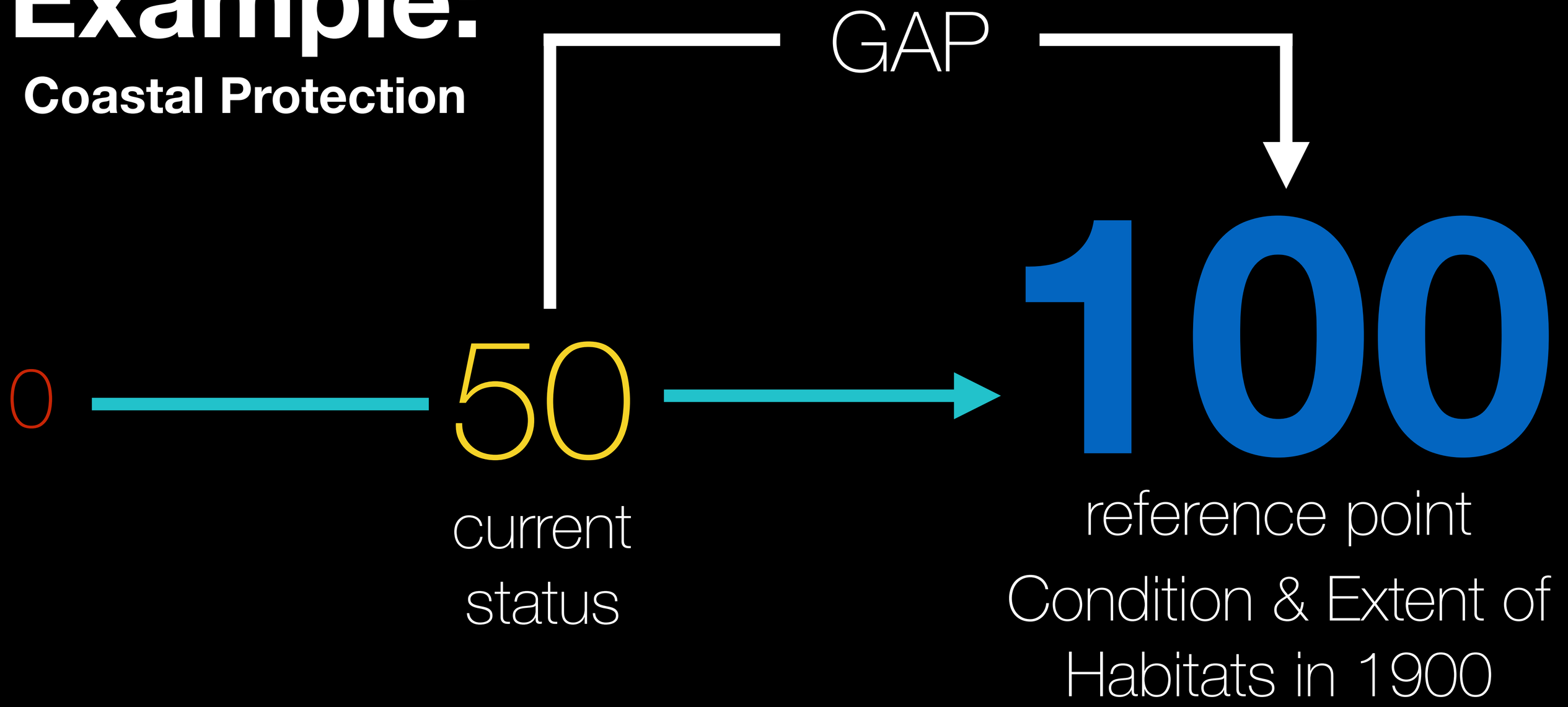
Sense of Place: Iconic Species

Biodiversity: Species

Samhouri et al. 2012 Ecosphere

Example:

Coastal Protection



Components of Goal Scores

Present Status 50%	Likely Future Status 50%	
	2/3	1/3
Goal's present value compared to a goal-specific reference point	**Trend** average percentage change in Status shown by the most recent five years of data	**Pressure** ecological and social factors that negatively affect status
		Resilience sum of ecological and social factors that positively affect status and reduce pressures

FLEXIBLE & SCALEABLE approach

global assessments

vs.

OHI+ independent assessments

Study area: Globe

Region: Countries

Study area: Country

Region: States

Global Goal Status Models and Reference Points

Food Provision

Measures the amount of seafood sustainably harvested & produced

WILD-CAUGHT FISHERIES

MARICULTURE

Fisheries

Amount of wild-caught seafood
that can be sustainably harvested

Biomass/$Biomass_{MSY}$ —> within 5% OSY

OSY = Optimal Sustainable Yield = 75% of MSY

Fisheries

$B/B_{MSY} => r \& K$

$$X_{FIS} = \prod_{i=1}^{n} SS_i^{\frac{c_i}{\sum c_i}}$$

values aggregated using geometric mean

Status Model Equation

r = rate of population increase

K = carrying capacity

B_{MSY} = mean time series B

Catch = FAO data report commercial fishing landings (proxy for catch) by fishing country —>0.5° resolution, distribution of taxa

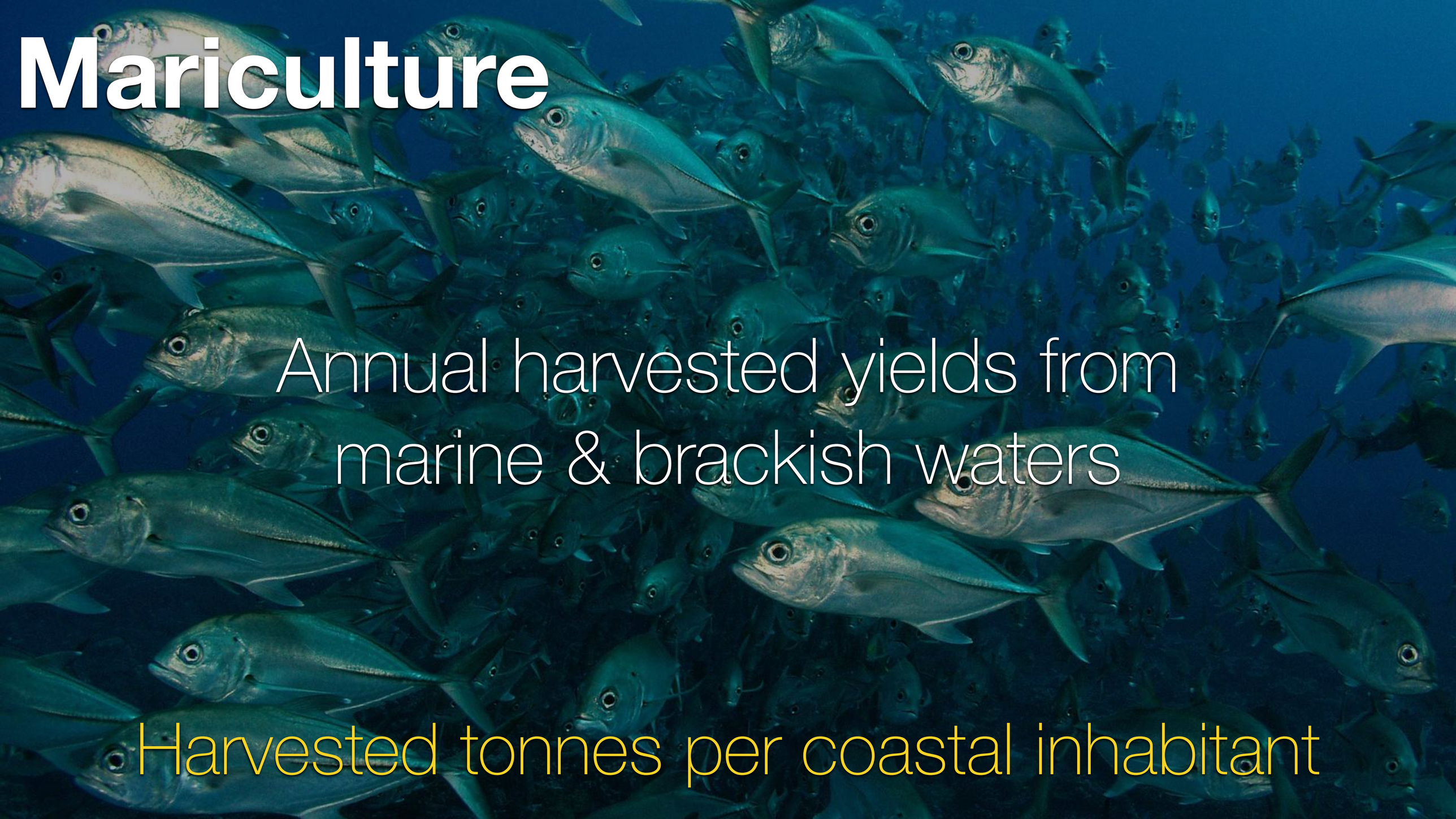
X_{FIS} = Status for each reporting region i

SS = stock status scores

i = individual taxon & n = total # of taxa

C = relative contribution to overall catch

Mariculture



Annual harvested yields from marine & brackish waters

Harvested tonnes per coastal inhabitant

Artisanal Fishing Opportunity

The ability to access fish for food - small & local scales

All demand for artisanal fishing is allowed and/or achieved and done in a sustainable manner

Natural Products

Harvest of non-food natural products

35% of the peak maximum value ever achieved

Carbon Storage

Extent and condition of coastal habitats store & sequester atmospheric CO2

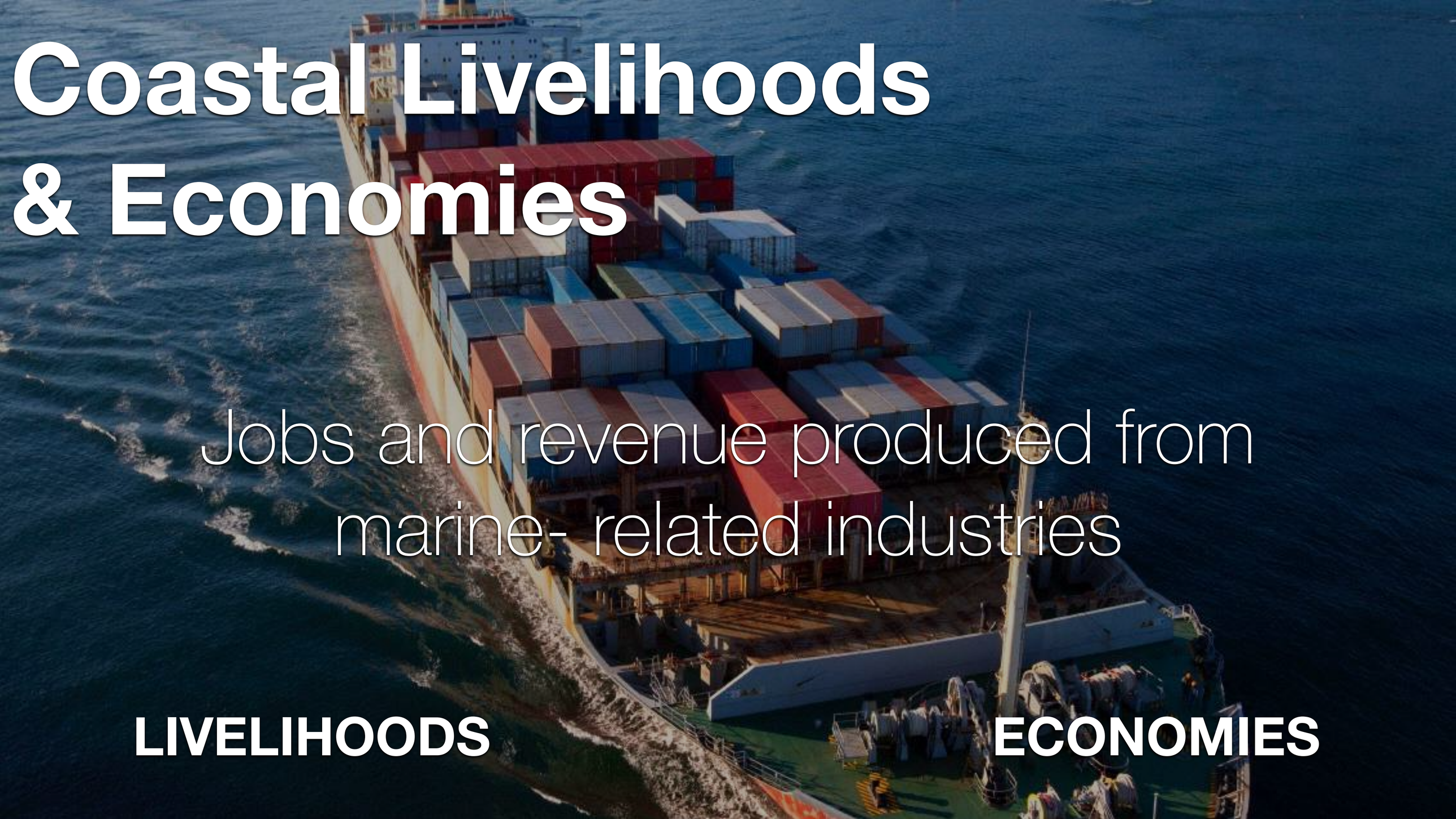
Condition in the early 1980s

Coastal Protection

Extent and condition of coastal habitats against flooding and erosion

Condition in the early 1980s

Coastal Livelihoods & Economies



Jobs and revenue produced from marine- related industries

LIVELIHOODS

ECONOMIES

Coastal Livelihoods

Jobs & wages

No-net-loss relative to trends in national employment

Coastal Economies

Eight Sectors

1. Commercial fishing
2. Mariculture
3. Tourism and recreation
4. Shipping and transportation
5. Whale watching
6. Ports and harbors
7. Ship and boat building
8. Renewable energy production (wind and wave)

Coastal Economies

Revenue produced from marine-related industries

No net loss marine-related revenue & keep pace with GPD growth

Tourism & Recreation

Capture experience in visiting coastal & marine areas and attractions

Proportion of the labor force engaged in the sector

90% percentile — 9.5% of total labor force

Sense of Place

Condition of iconic species &
protection of special places

ICONIC SPECIES

LASTING SPECIAL PLACES

Iconic Species

Unique importance is recognized through traditional activities

Relevant marine species categorized “least concern”

Lasting Special Places

Geographic locations that
are valuable to people

Protecting 30% of coastal waters to 3 nautical miles & 30% 1km inland of shoreline

Clean Waters

Measures the degree to which waters are polluted

Zero pollution

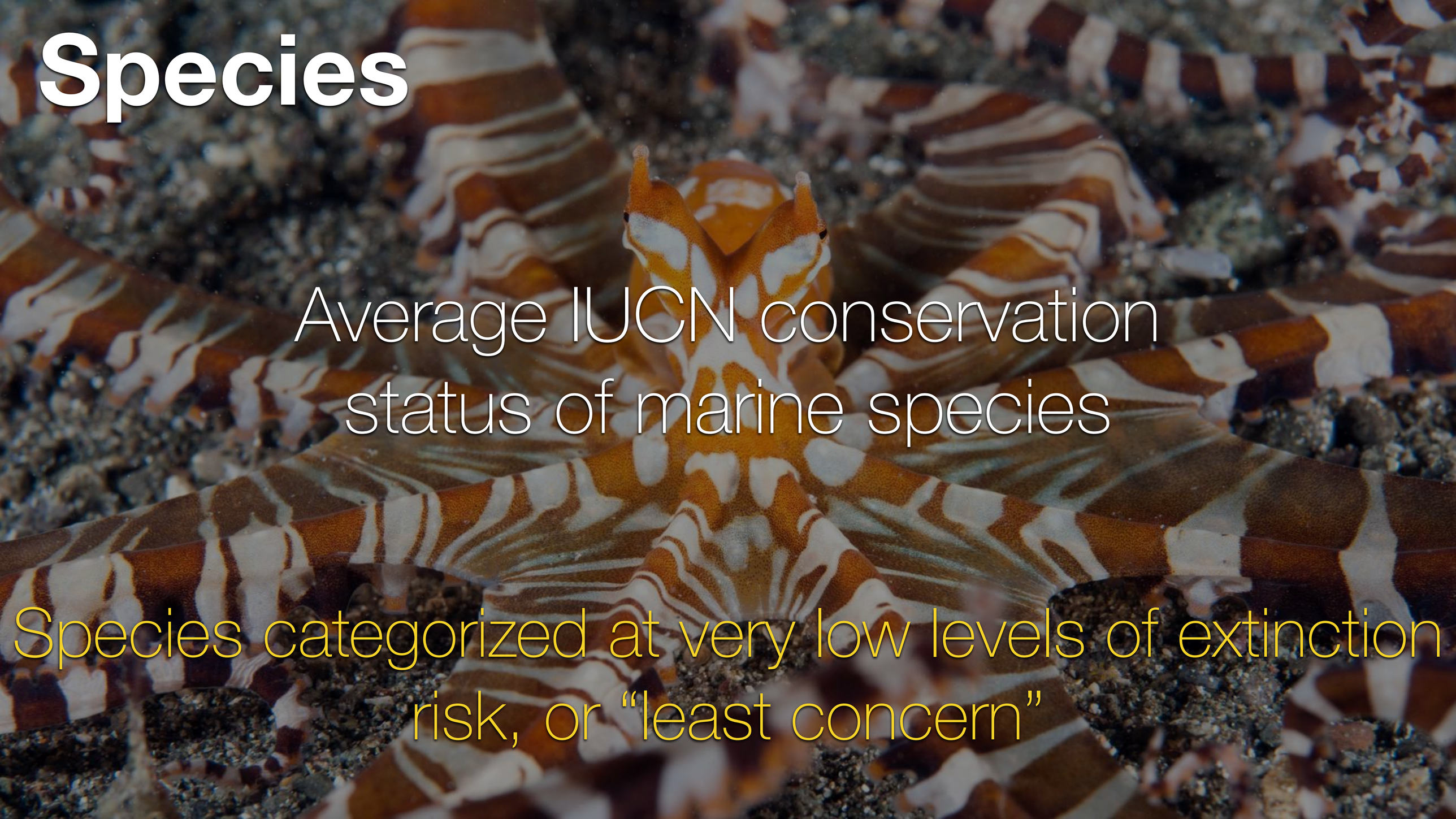
Biodiversity

Success in maintaining the
richness and variety of marine life

SPECIES

HABITATS

Species



Average IUCN conservation status of marine species

Species categorized at very low levels of extinction risk, or “least concern”

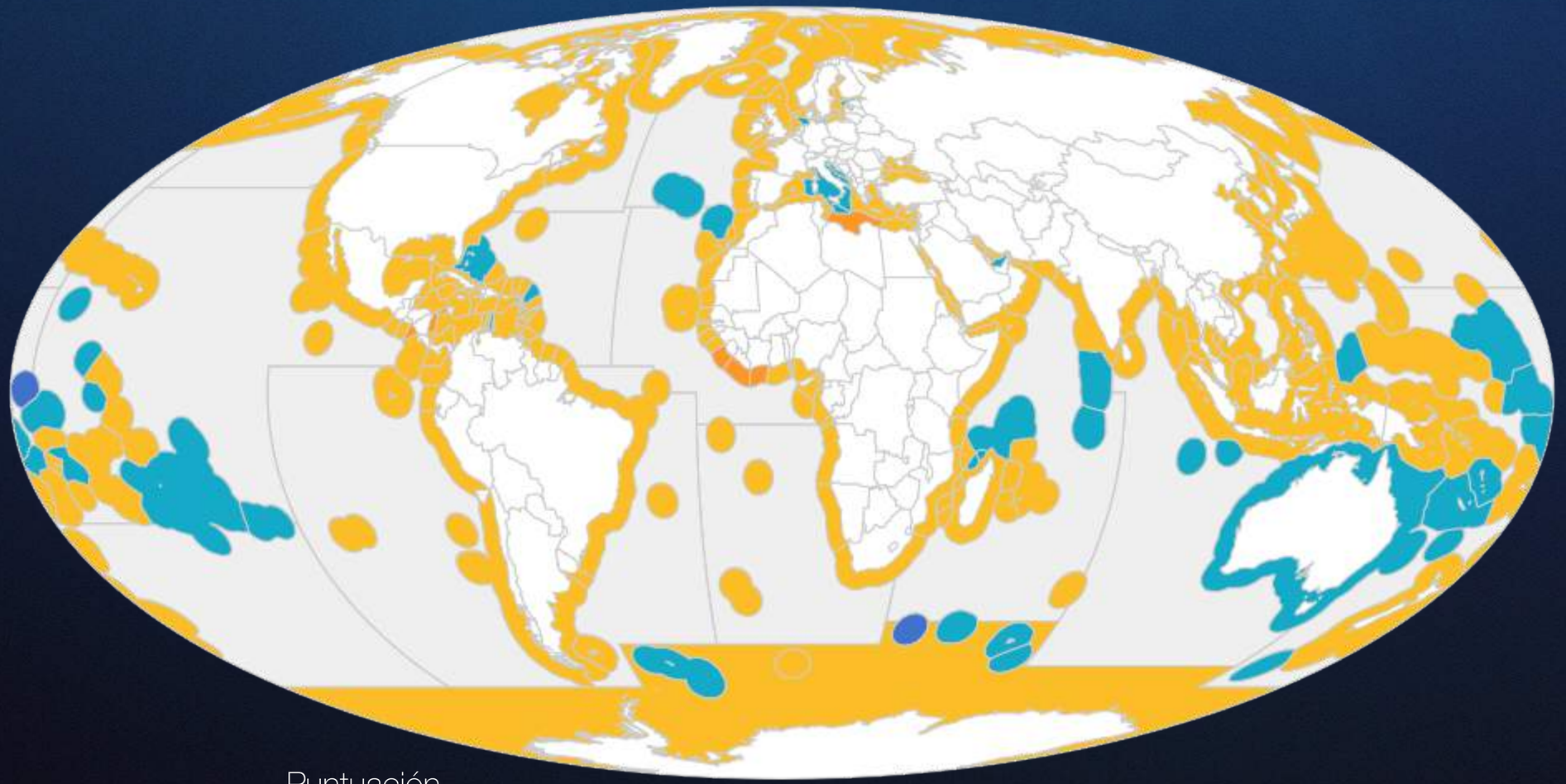
Habitats

mangroves, coral reefs, seagrass beds, salt marshes, sea ice, and subtidal soft-bottom habitats

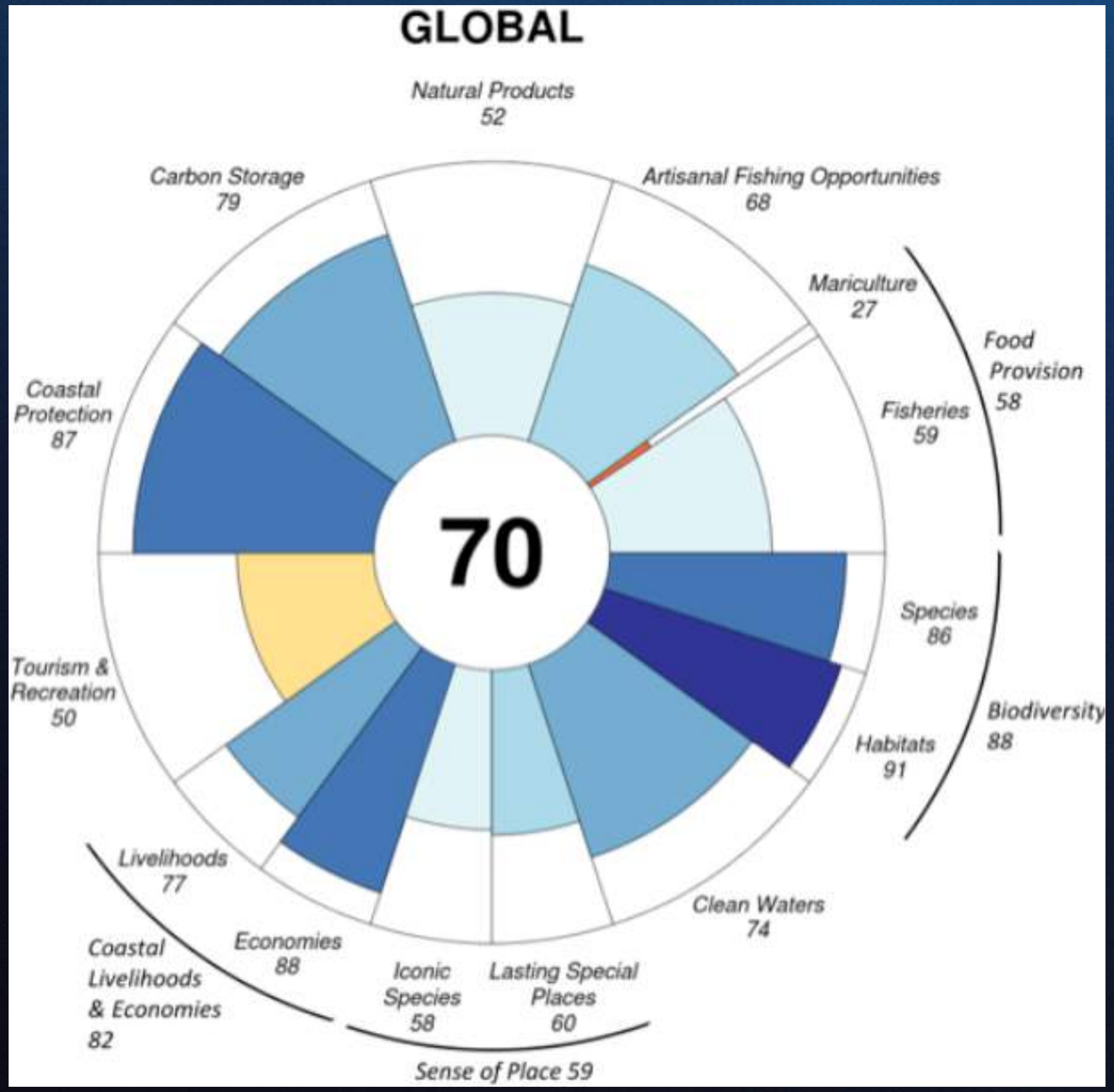
Areas or conditions equal or exceed what they were in the early 1980s

110 Global Data Sets

221 EEZ — Countries & Territories



2015 Global Assessments



Highest scoring areas:

Prince Edward Islands **92**
Howland Island and Baker Island **90**
Macquarie Island, Heard and McDonald Islands **87**
Phoenix Group, Northern Saint-Martin **86**
New Caledonia (pop. 269,000) **85**

Lowest scoring areas:

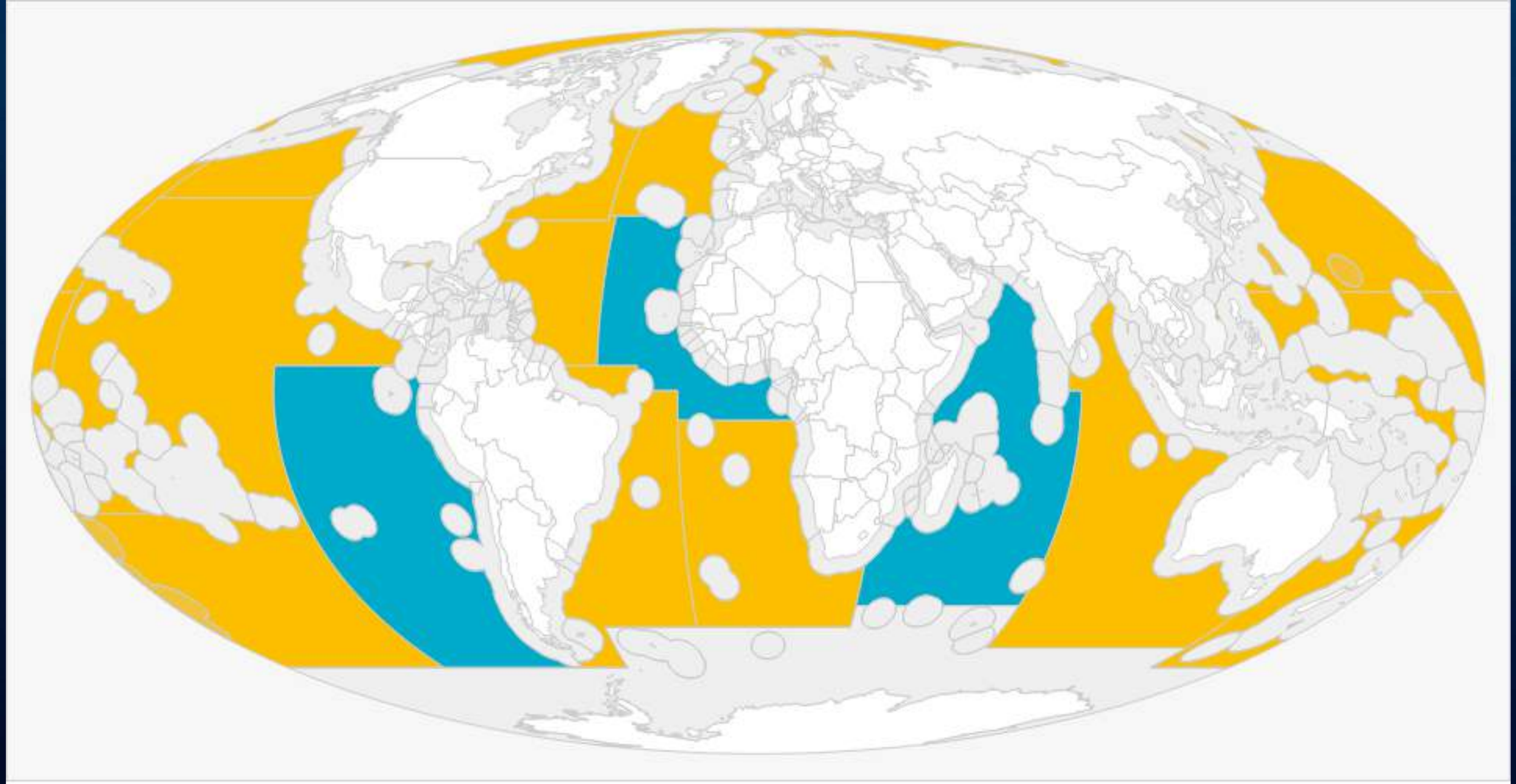
North Korea, Lebanon **50**
Liberia, Nicaragua **48**
Sierra Leone, Ivory Coast, DRC **47**
Dominica **46**
Libya **43**

High Seas Assessment

Based on 15 FAO subdivisions

Only three components assessed:

1. Food provision: fisheries
2. Sense of place: iconic species
3. Biodiversity: species



Lowest: 53 Pacific Northwest
Highest: 79 Western Indian Ocean

LIMITATIONS & CHALLENGES OF GLOBAL STUDY

- Data must be uniformly available from all countries
- Better data from individual countries can’t be used
- Results are coarser than country-level data might provide
- Can’t see local-scale phenomena

Strengths

Uniform methods & common language

Comparisons

Synergy with Multilateral Environmental Agreements

Limitations

Global data quality

Low local precision

Low policy relevance at local scales

Endorsements & Adoptions

Member login

United Nations World Ocean Assessment

Regular Process for Global Reporting and Assessment of the State of the Marine Environment Including Socioeconomic Aspects

WORLD ECONOMIC FORUM

COMMITTED TO IMPROVING THE STATE OF THE WORLD

TWAP

TRANSBOUNDARY WATERS ASSESSMENT PROGRAMME

Convention on Biological Diversity


Thank You!
Questions?