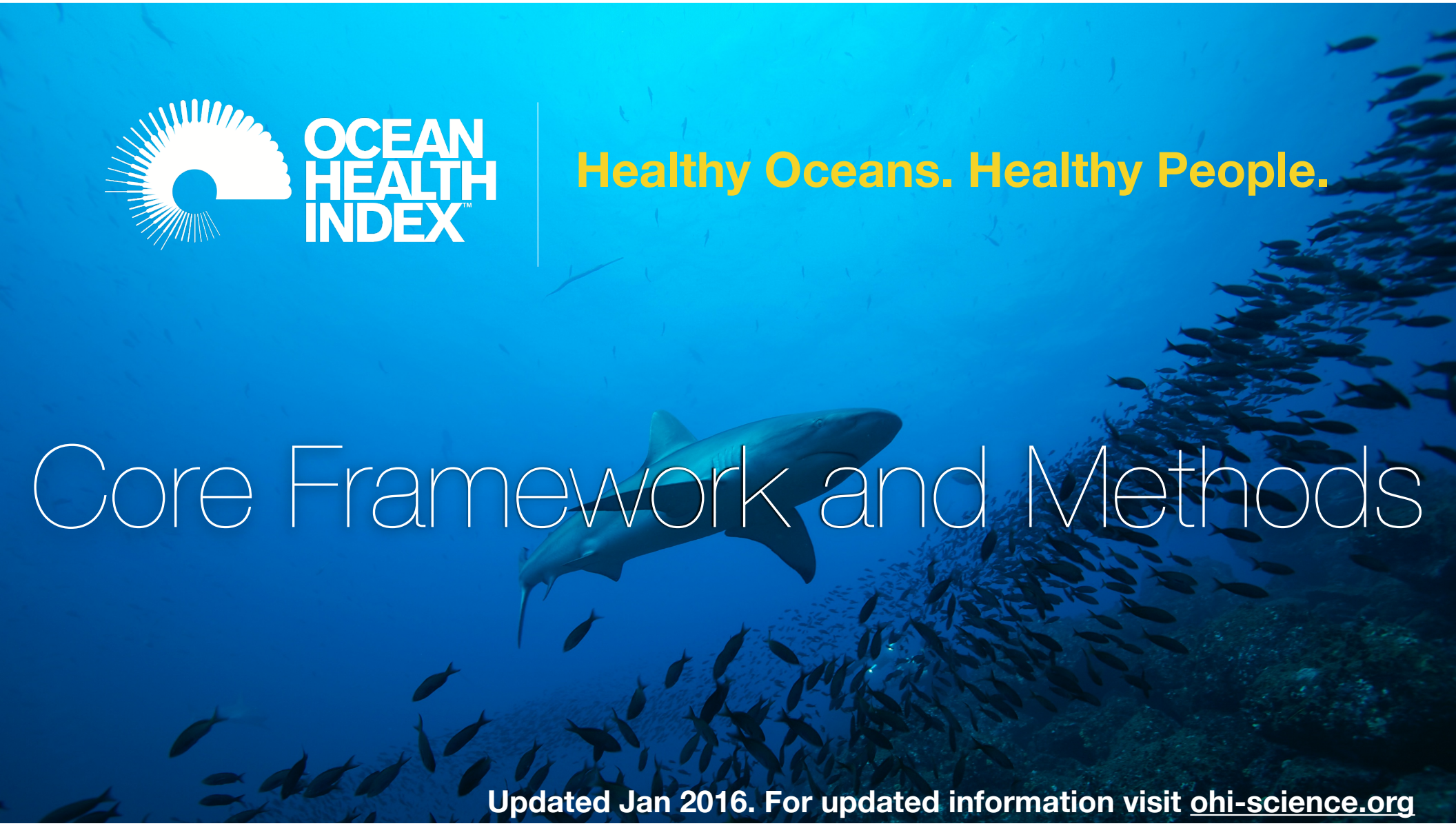
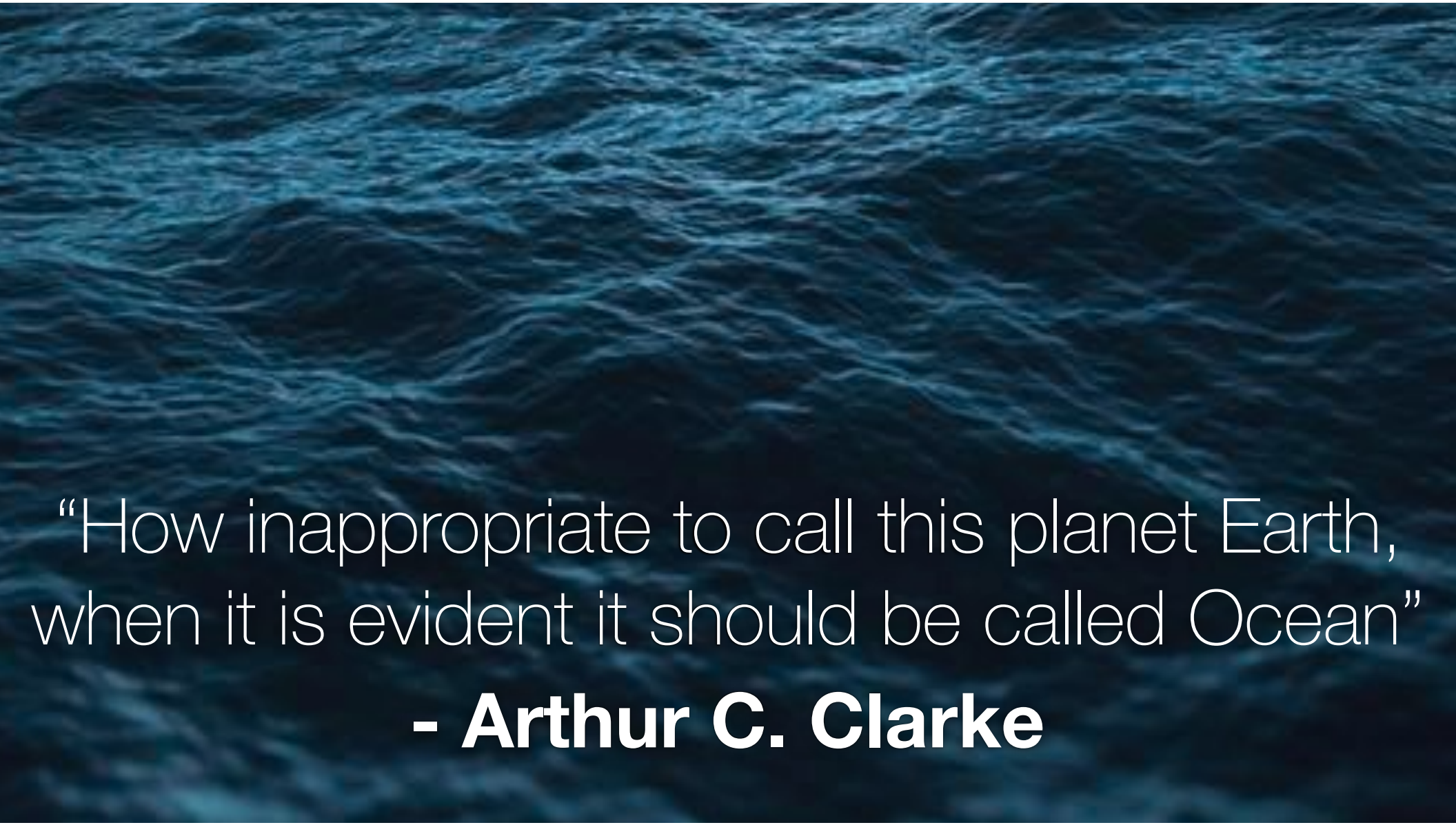

OCEAN HEALTH INDEX™
Healthy Oceans. Healthy People.
Core Framework and Methods
Updated Jan 2016. For updated information visit ohi-science.org


“How inappropriate to call this planet Earth,
when it is evident it should be called Ocean”
- Arthur C. Clarke


Recognizing Ocean Values
WORLDWIDE
© Olivier Langrand


$21 trillion
services provided by the ocean


1 billion people
essential nutrition
photo: © art wolfe/ www.artwolfe.com


$190 billion/year
seafood industry


500 million
ocean related jobs

OUTLINE

1. Need
2. Goals & Methods
3. Scale of Assessments
4. Uses & Benefits
5. Results of Global Assessment
6. Overcoming Limitations with Independent Assessments

WHY DO WE NEED AN OCEAN HEALTH INDEX?

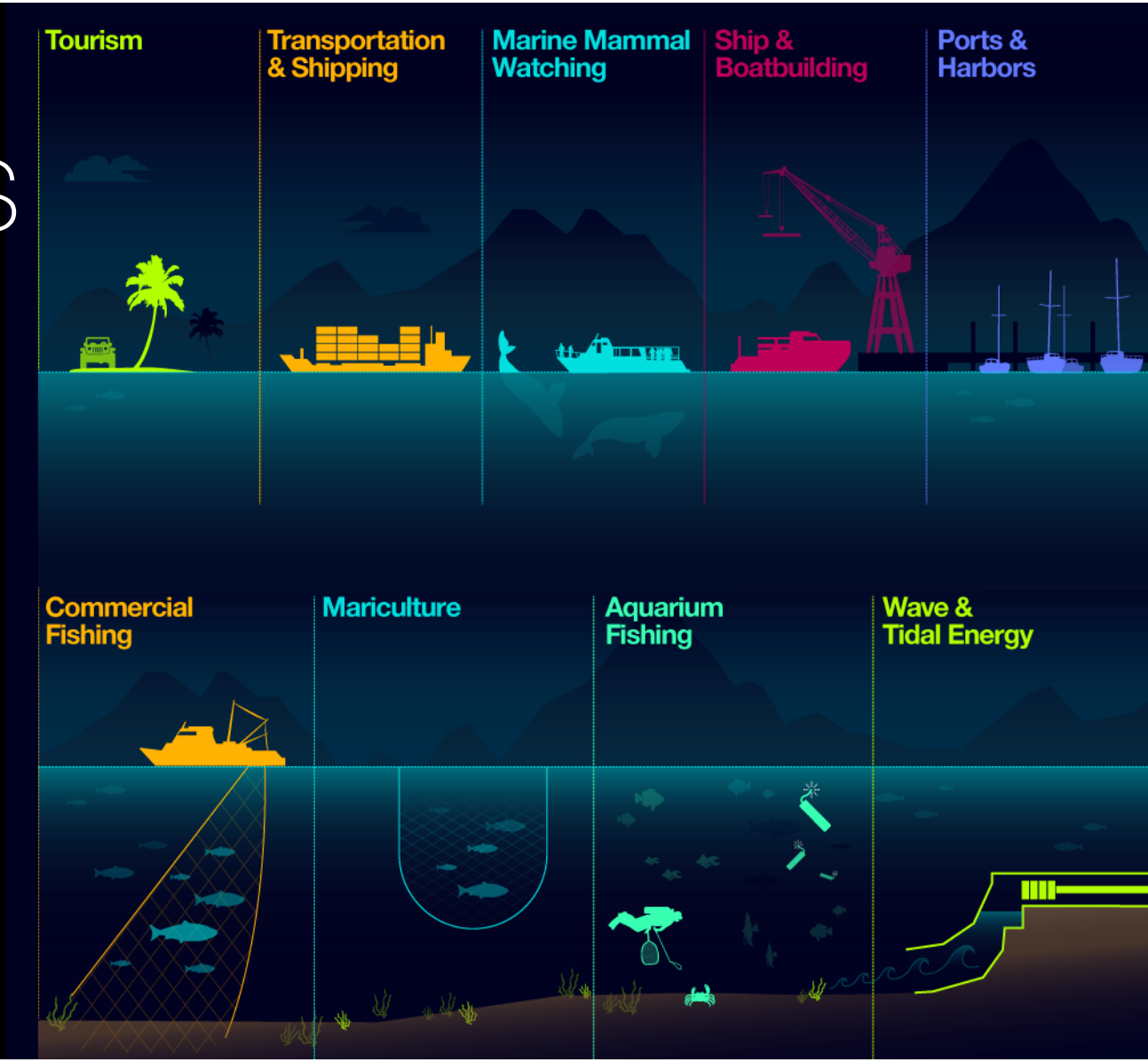
OCEAN & COASTAL GOODS AND SERVICES

↓

potential conflicts

↓

need sustainable balance

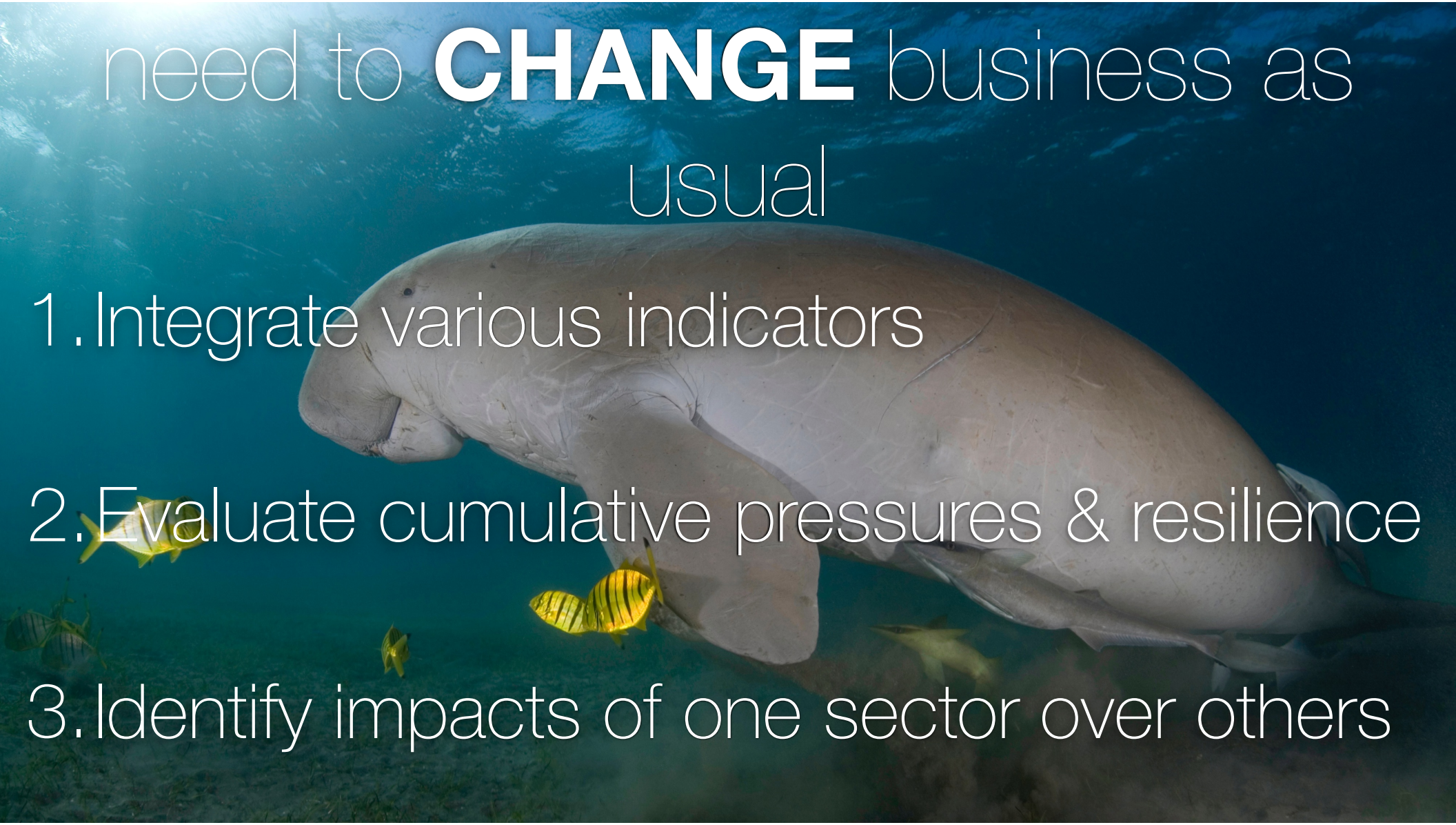



Growing population
Mangrove Populations Are Declining Worldwide
Between 1980 and 2005 there has been a total loss of 3.6 million hectares of mangroves worldwide.
1980
18.8
Million Hectares
20%
Loss of Total Mangroves Worldwide
2005
15.2
Million Hectares
90%
of Fishing Jobs are Small-Scale
Of the estimated 26-29 million total fishing jobs in developing countries, approximately 25-27 million are in the small-scale fisheries sector.
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

doi:10.1038/nature11397

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

Benjamin S. Halpern[1,2], Catherine Longo[1], Darren Hardy[1], Karen L. McLeod[3], Jameal F. Samhouri[4], Steven K. Katona[5], Kristin Kleisner[6], Sarah E. Lester[7,8], Jennifer O'Leary[1], Marla Ranelletti[1], Andrew A. Rosenberg[5], Courtney Scarborough[1], Elizabeth R. Selig[5], Benjamin D. Best[9], Daniel R. Brumbaugh[10], F. Stuart Chapin[11], Larry B. Crowder[12], Kendra L. Daly[13], Scott C. Doney[14], Cristiane Elfes[15,16], Michael J. Fogarty[17], Steven D. Gaines[8], Kelsey I. Jacobsen[8], Leah Bunce Karrer[5], Heather M. Leslie[18], Elizabeth Neeley[19], Daniel Pauly[6], Stephen Polasky[20], Bud Ris[21], Kevin St Martin[22], Gregory S. Stone[5], U. Rashid Sumaila[6] & Dirk Zeller[6]


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

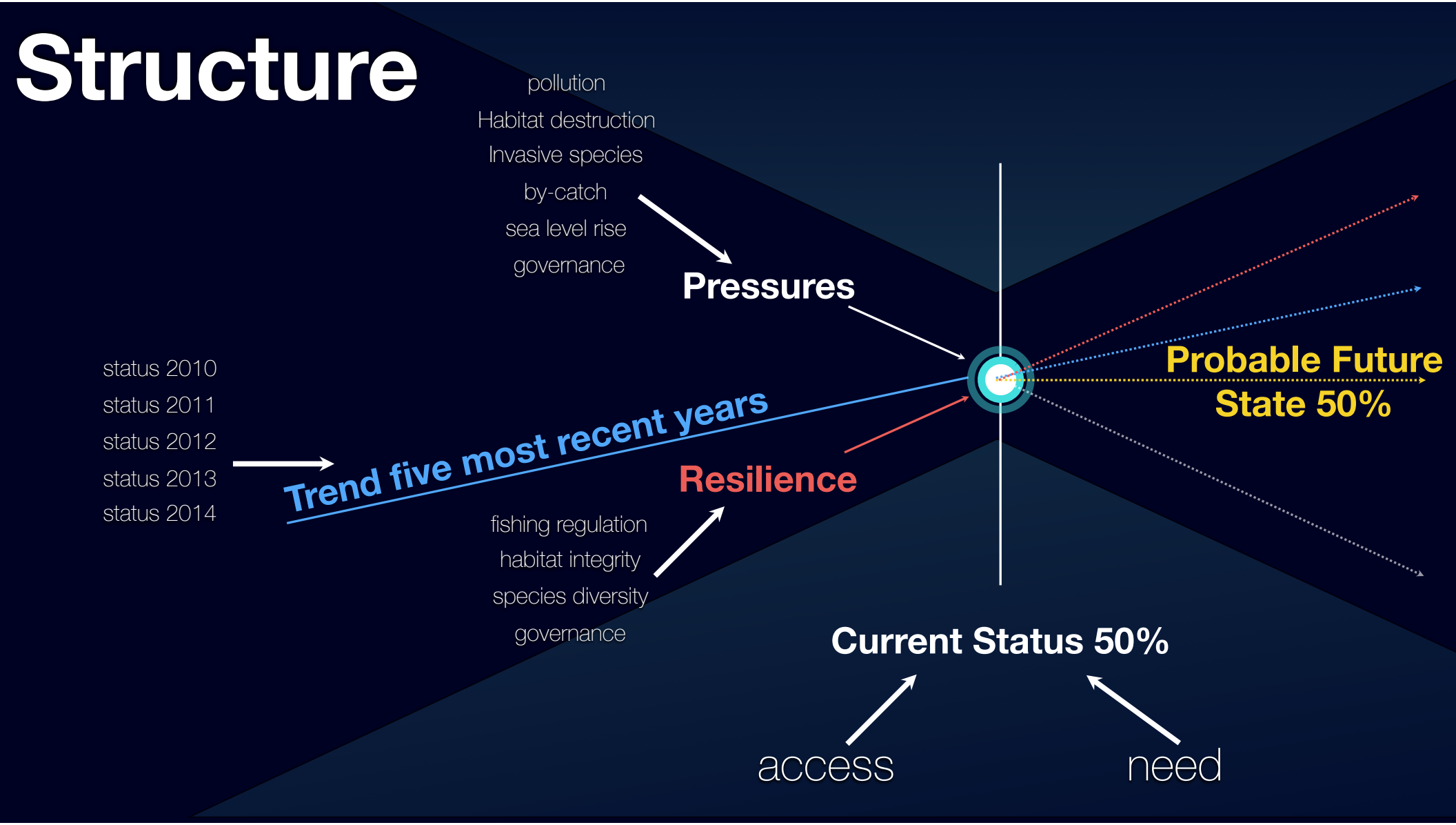
What is the Ocean Health Index?

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

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


Structure
pollution
Habitat destruction
Invasive species
by-catch
sea level rise
governance
Pressures
status 2010
status 2011
status 2012
status 2013
status 2014
Trend five most recent years
Resilience
fishing regulation
habitat integrity
species diversity
governance
Probable Future State 50%
Current Status 50%
access
need

Understand Pressures

Stressor on the **social** or **ecological** system

Change how goals interact with each other

Five ecological categories: pollution, habitat destruction, species pollution, fishing pressure, and climate change

One social category: governance effectiveness

Understand 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	

Understand Resilience

Beneficial measures on the **social** or **ecological** system

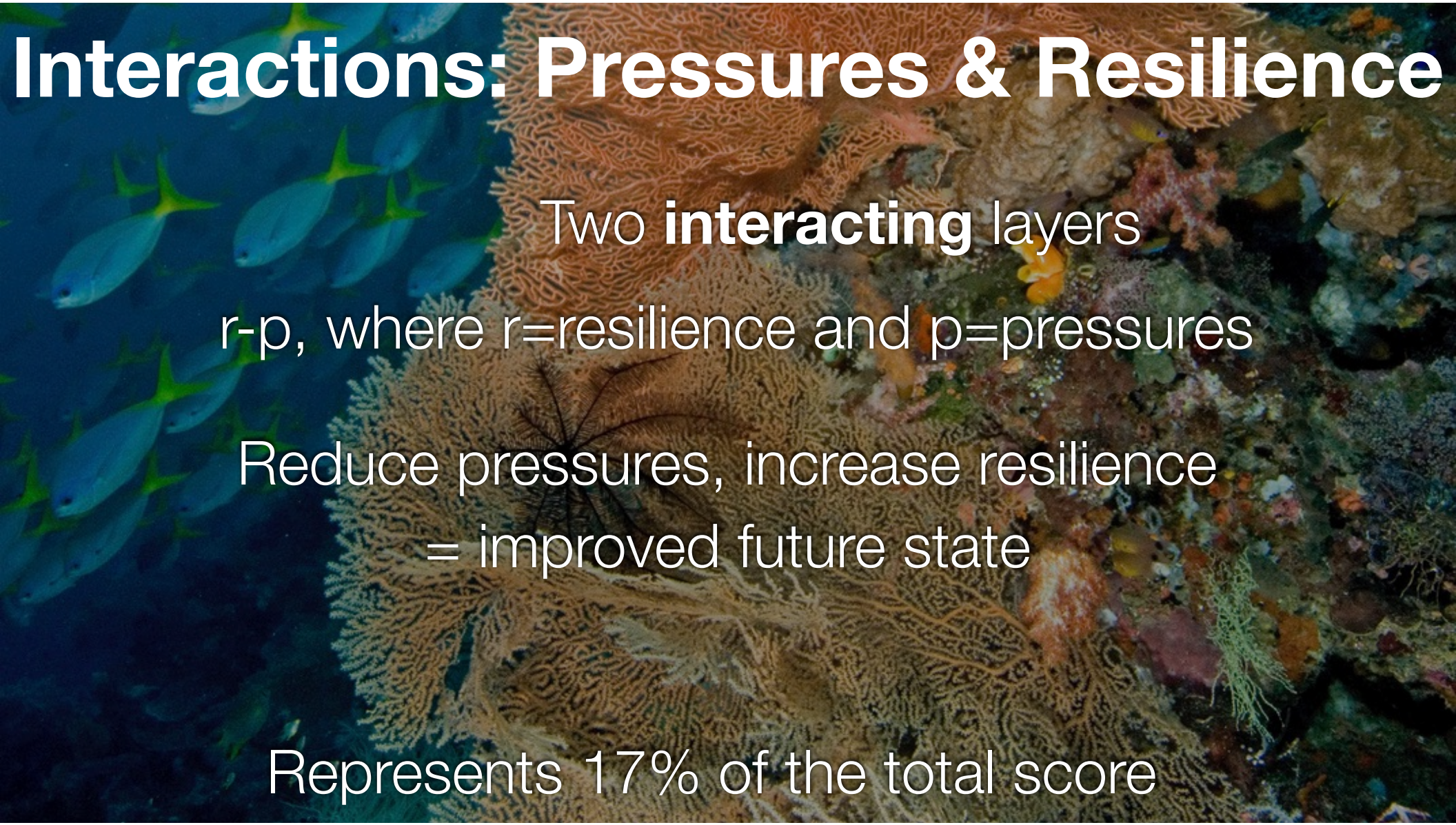
Resilience helps shape the future of ocean health

Two ecological categories: regulatory (laws, policies, treaties, conventions, management actions) and ecological integrity

Social category: social integrity

Understand 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		



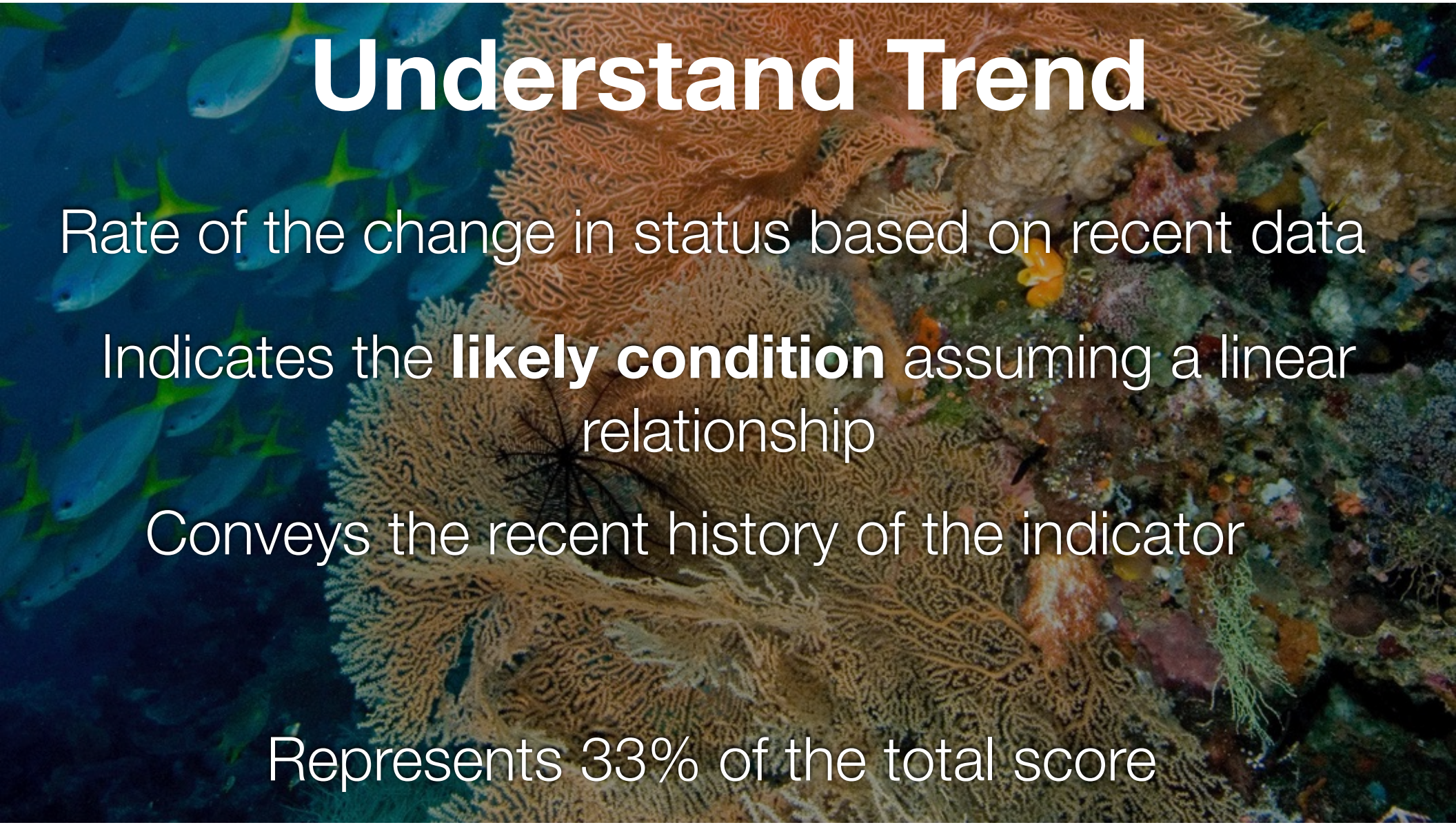
Interactions: Pressures & Resilience

Two **interacting** layers

r-p, where r=resilience and p=pressures

Reduce pressures, increase resilience
= improved future state

Represents 17% of the total score



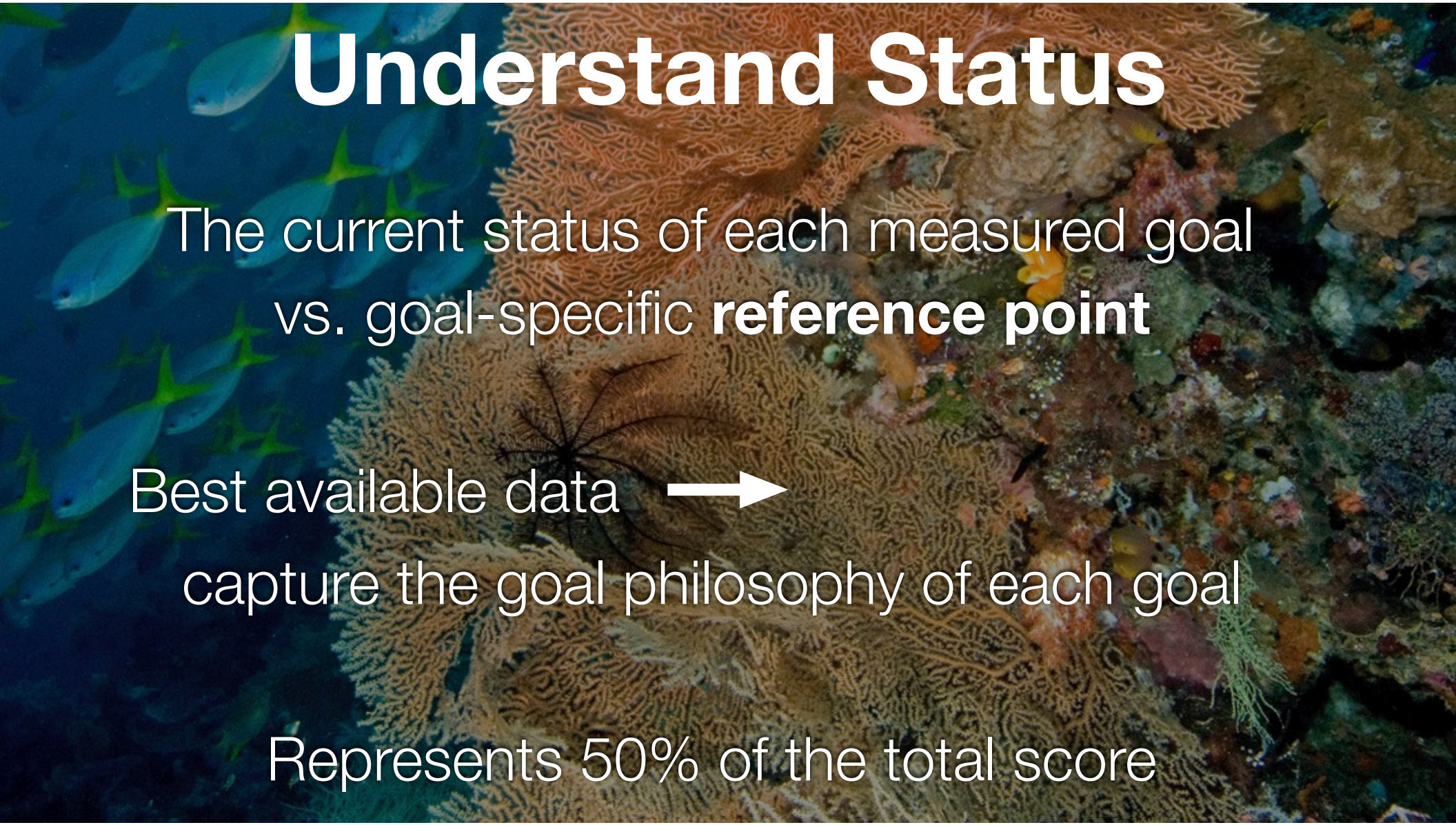
Understand Trend

Rate of the change in status based on recent data

Indicates the **likely condition** assuming a linear relationship

Conveys the recent history of the indicator

Represents 33% of the total score



Understand Status

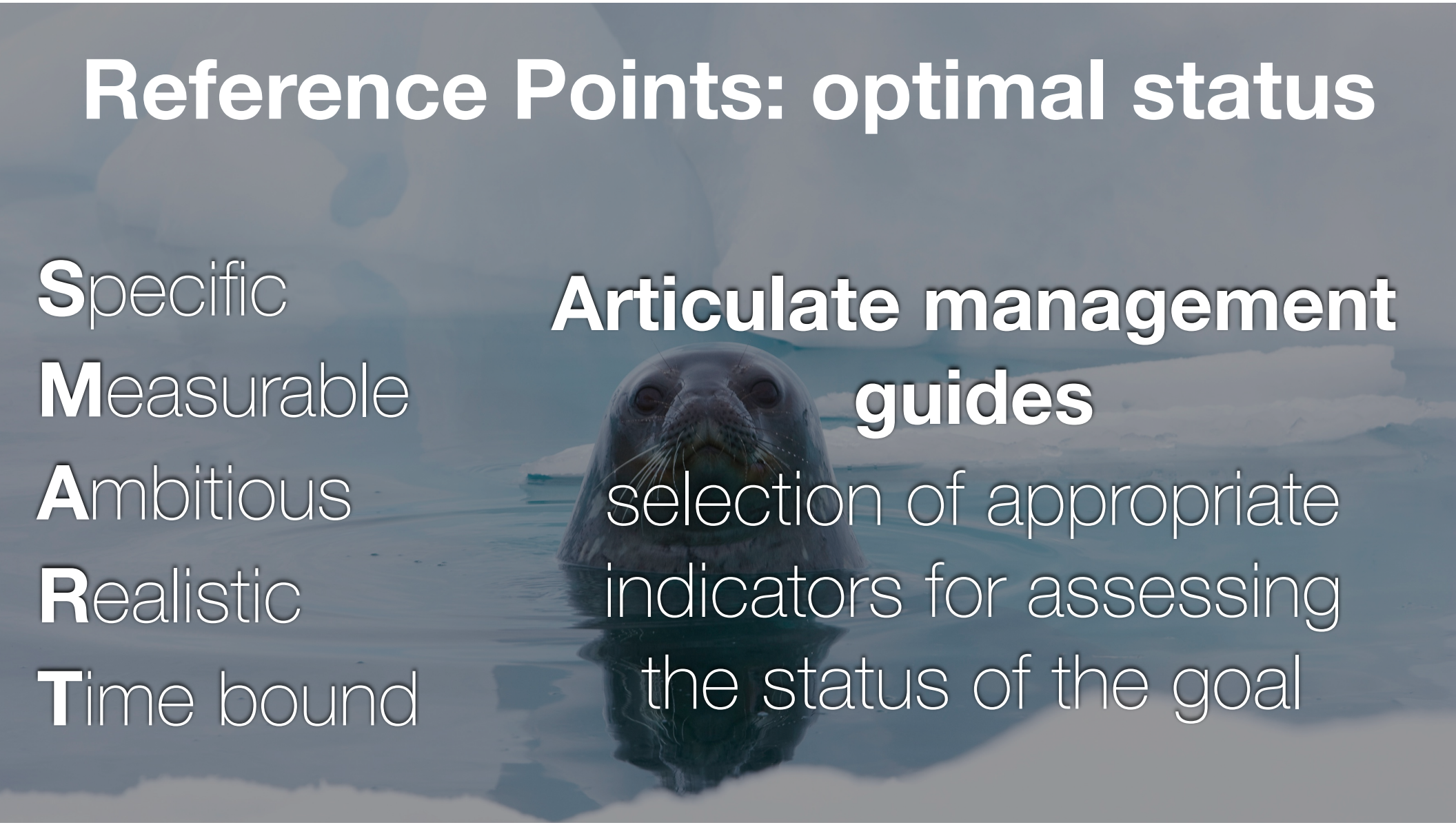
The current status of each measured goal
vs. goal-specific **reference point**

Best available data →
capture the goal philosophy of each goal

Represents 50% of the total score

Reference Points: optimal status

Specific
Measurable
Ambitious
Realistic
Time bound

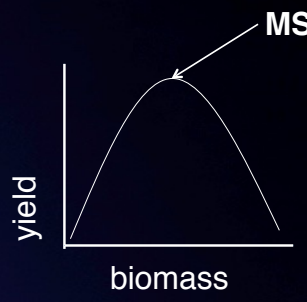


Articulate management guides

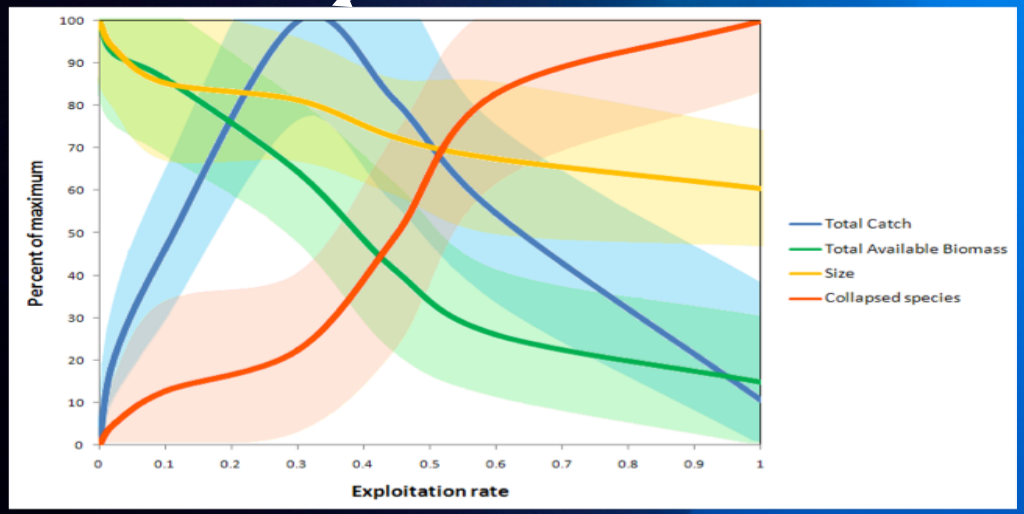
selection of appropriate indicators for assessing the status of the goal

Types of Reference Points

1. Functional Relationships (preferred method)



Multi species MSY



Wild Caught Fisheries

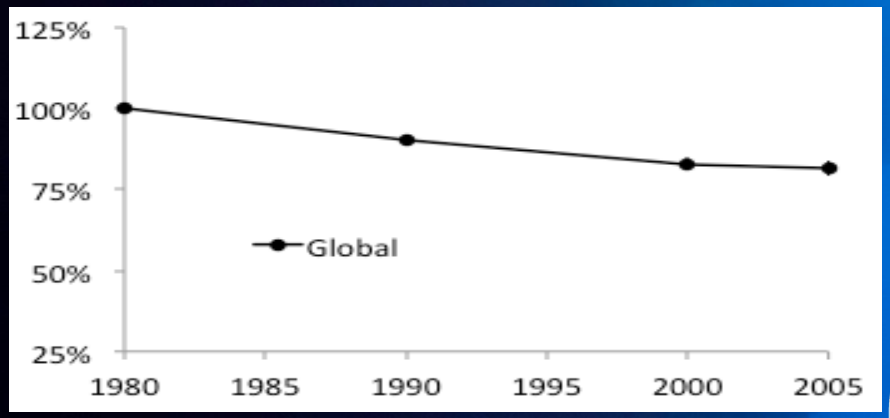
Artisanal Fishing

Natural Products

Samhouri et al. 2012 Ecosphere

Types of Reference Points

2. Temporal comparisons



Natural Products

Carbon Storage

Coastal Protection

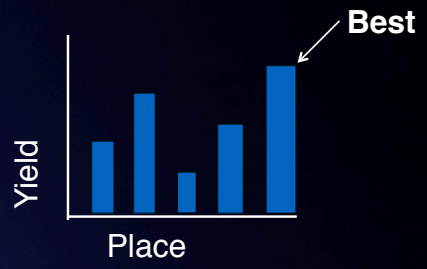
Livelihoods & Economies

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

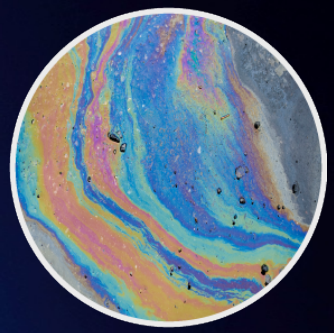
4.Known/established target

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

Calculations for Each Goal

Present / Reference $\dfrac{X_i}{X_{i,R}} = x_i =$ **CURRENT STATUS** 50

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

+

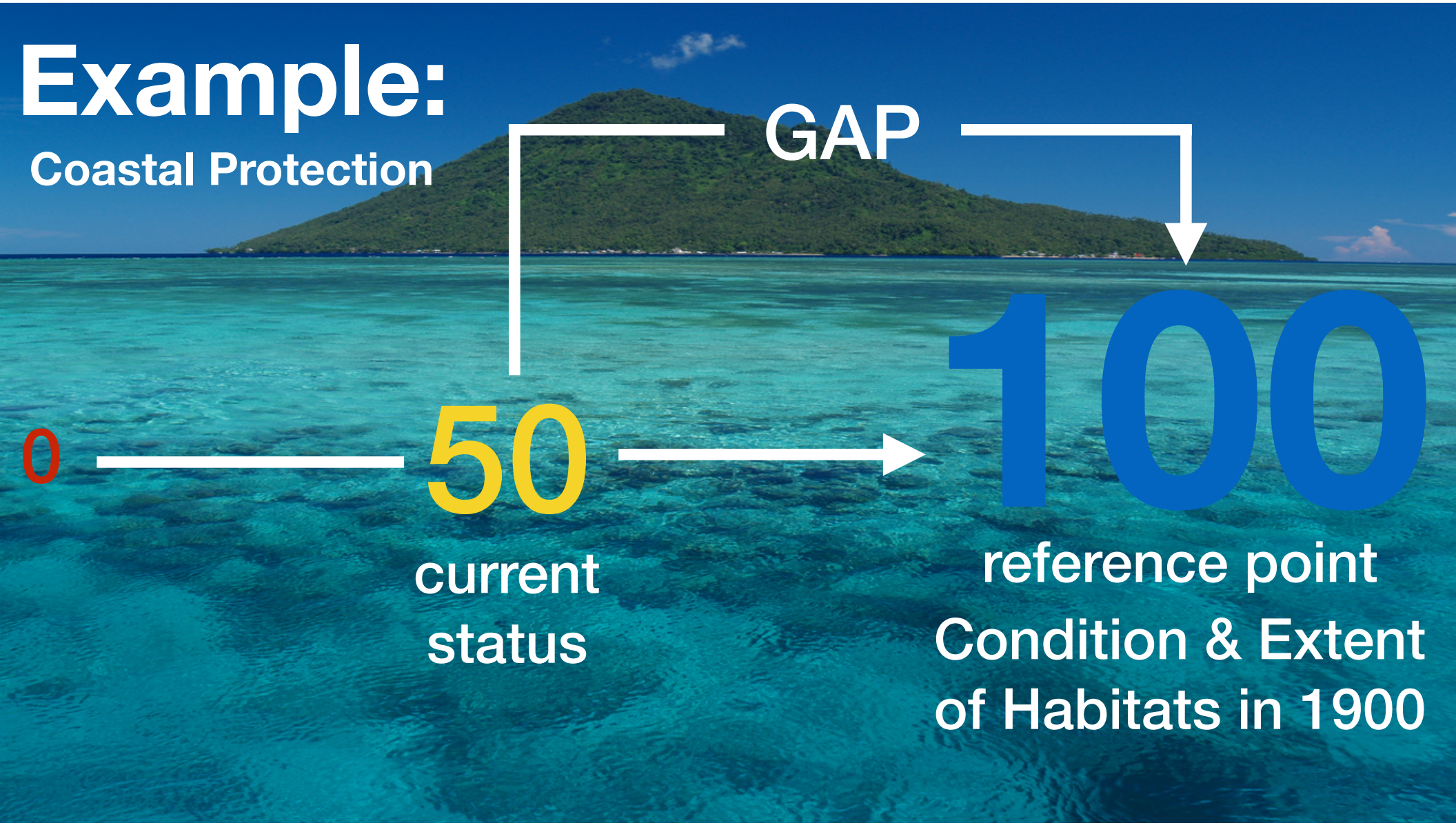
PROBABLE FUTURE STATE 50

Trend T

Pressures p_i

Resilience r_i

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


Example:
Coastal Protection
GAP
0
50
current
status
100
reference point
Condition & Extent
of Habitats in 1900


Goal Philosophies

1. Food Provision

Measures the amount of seafood sustainably harvested & produced

WILD-CAUGHT FISHERIES

Amount of wild-caught seafood that can be sustainably harvested

MARICULTURE

Annual harvested yields from marine & brackish waters


2. Artisanal Fishing Opportunity
The ability to access fish for food - small & local scales

3. Natural Products

Harvest of non-food natural products

4. Carbon Storage

Extent and condition of coastal habitats store & sequester atmospheric CO_2

5. Coastal Protection

Extent and condition of coastal habitats against flooding and erosion

6. Coastal Livelihoods & Economies

Jobs and revenue produced from marine-related industries

LIVELIHOODS

Jobs & wages

ECONOMIES

Revenue produced from marine-related industries

7. Tourism & Recreation

Capture experience in visiting coastal & marine areas and attractions

8. Sense of Place

Condition of iconic species & protection of special places

ICONIC SPECIES

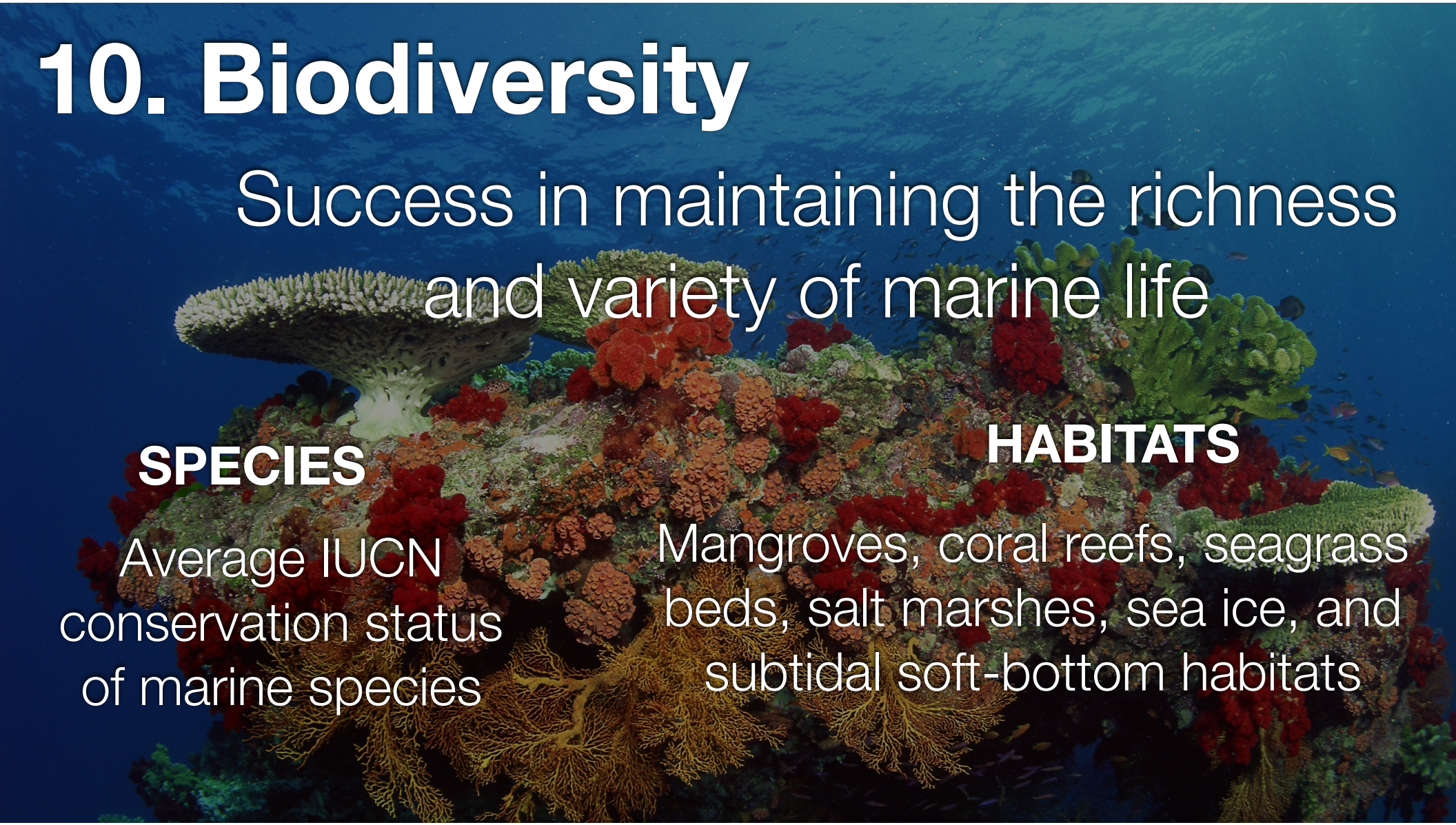
Unique importance is recognized through traditional activities

LASTING SPECIAL PLACES

Geographic locations that are valuable to people

9. Clean Waters

Measures the degree to which waters are polluted



10. Biodiversity

Success in maintaining the richness and variety of marine life

SPECIES

Average IUCN conservation status of marine species

HABITATS

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

Goal 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

Goal 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				

Data Normalizing

$$X' = \frac{X - X_{min}}{X_{max} - X_{min}}$$

All status, pressures, and resilience data are **normalized from 0-100**

DATA LAYERS

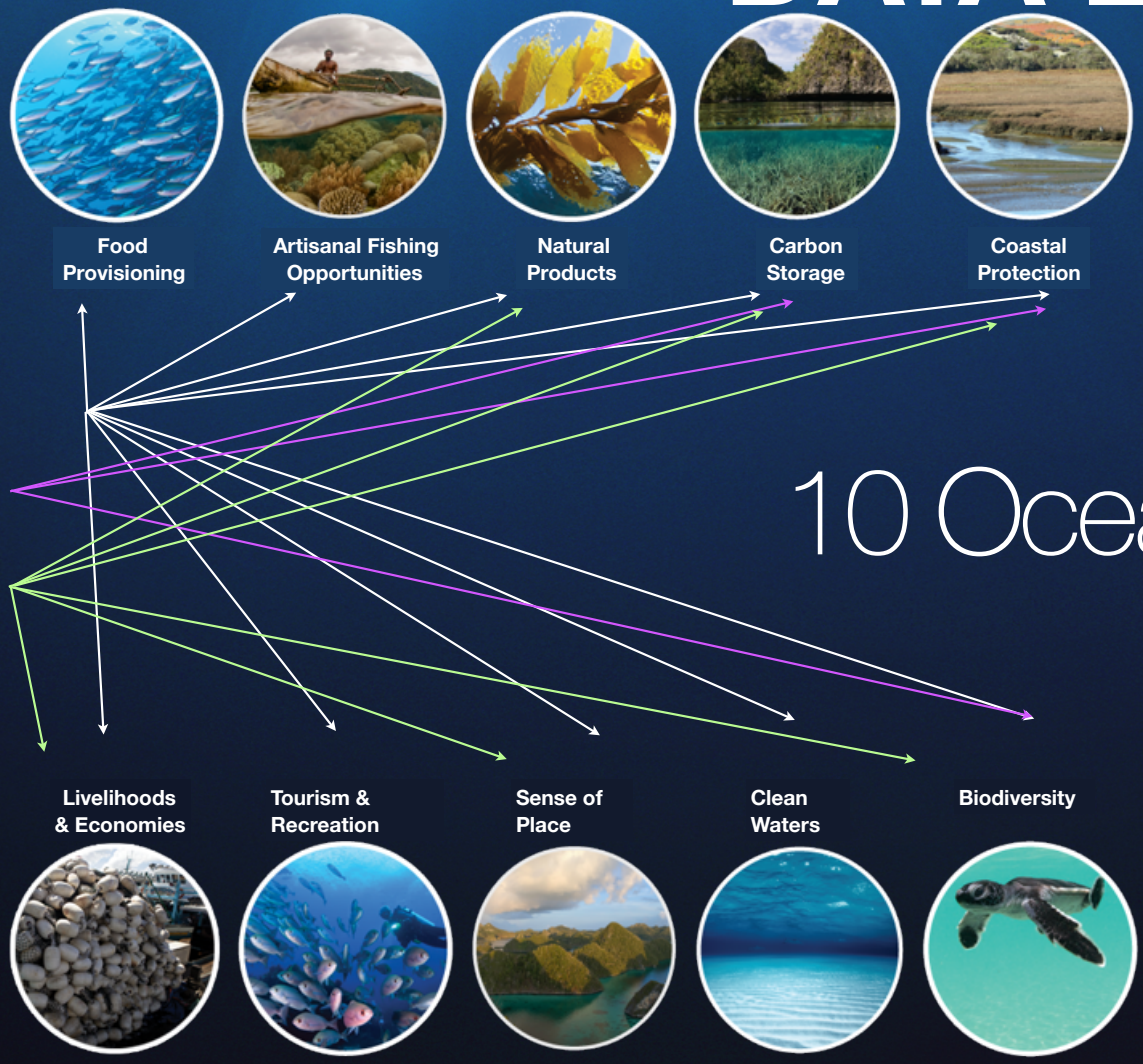
Alien species
Destroyed habitats
MPA
Salaries
Fish oil
Marine revenues
IUCN Risks

Nutrient Pollution

Mangroves

Acidification

Mariculture yields
Trash
Salt marshes
Tourism
World Governance Indicators
CITES
Marine revenues
Ornamental fish



10 Ocean Goals

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

OCEAN HEALTH INDEX™

Global Assessments

- Annual global studies led by OHI team
- Apply uniform data & methods
- 221 EEZ + High Seas

OCEAN HEALTH INDEX+

+ = independent Assessments

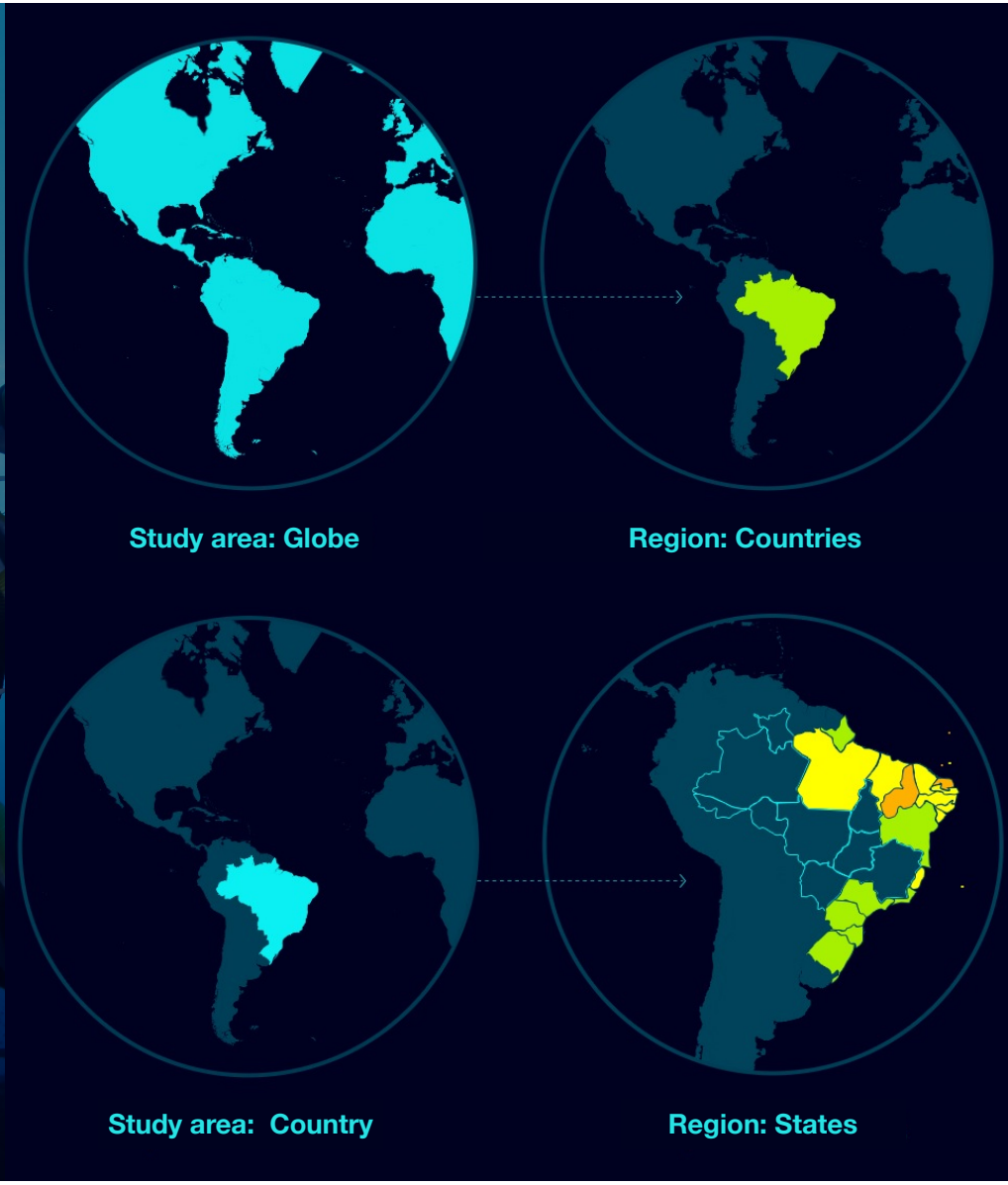
- Led by independent groups
- Customized scales
- Local data & methods
- Stakeholder participation
- Inform local decision-making

Study area & regions

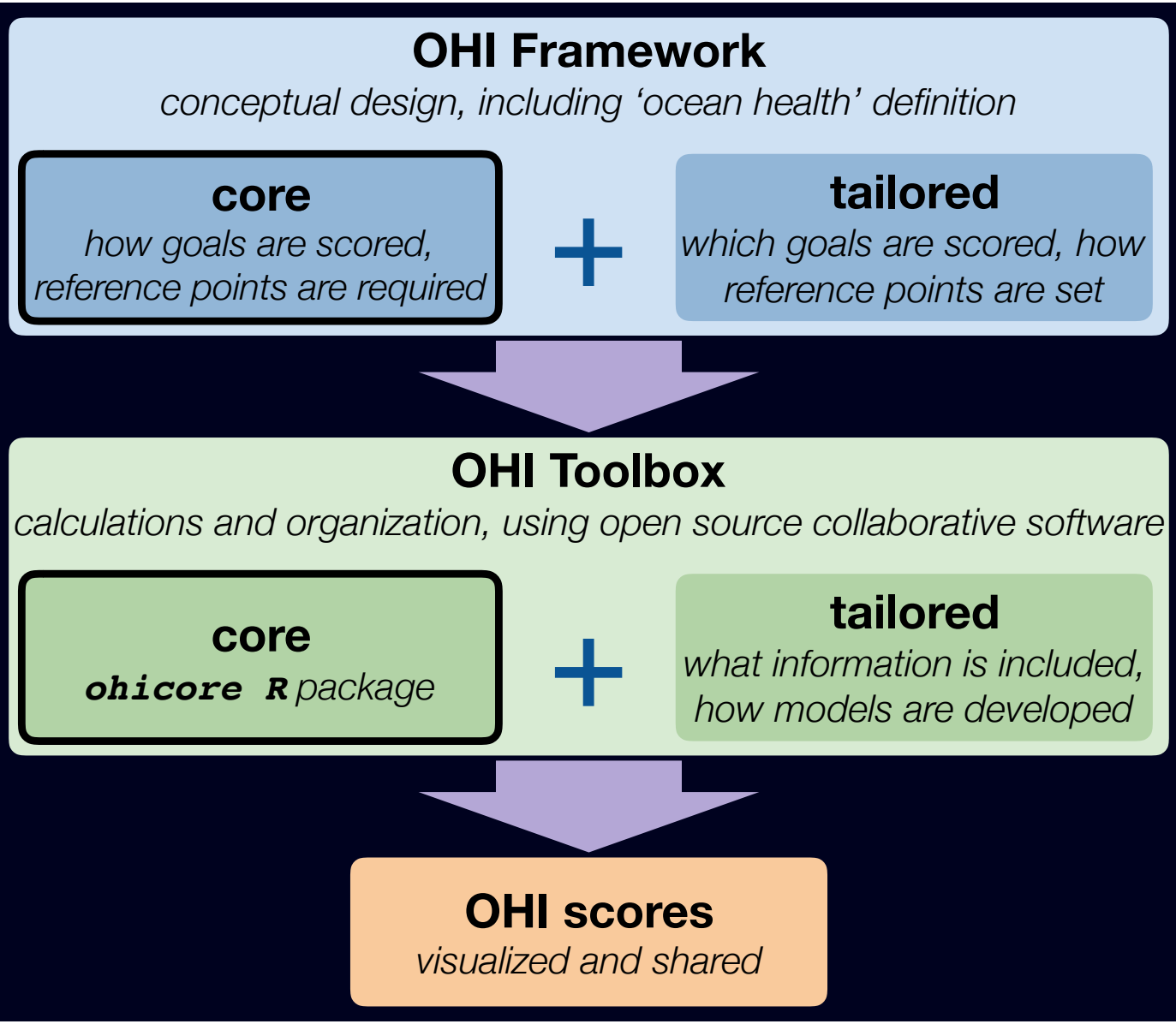
Global assessments

vs.

OHI+ independent assessments



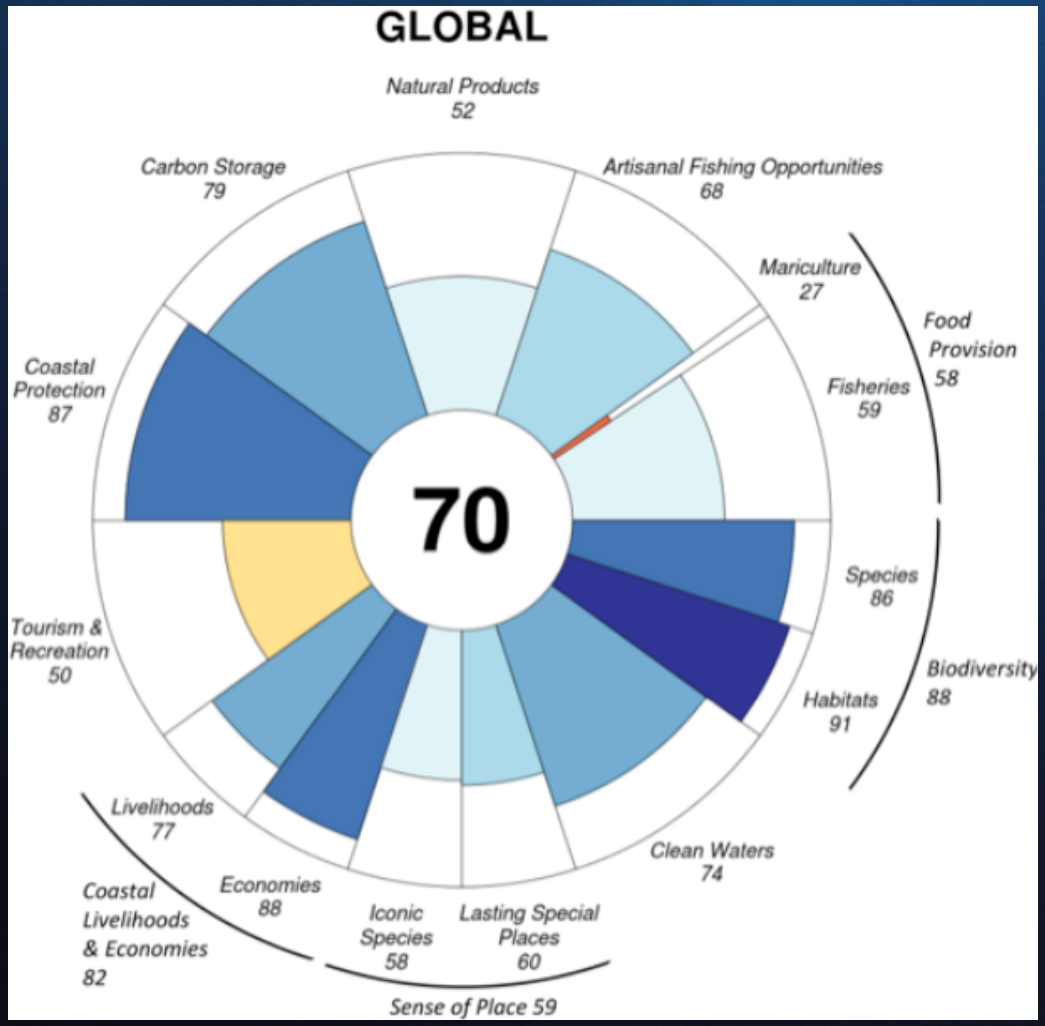
CORE + TAILORABLE framework



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:

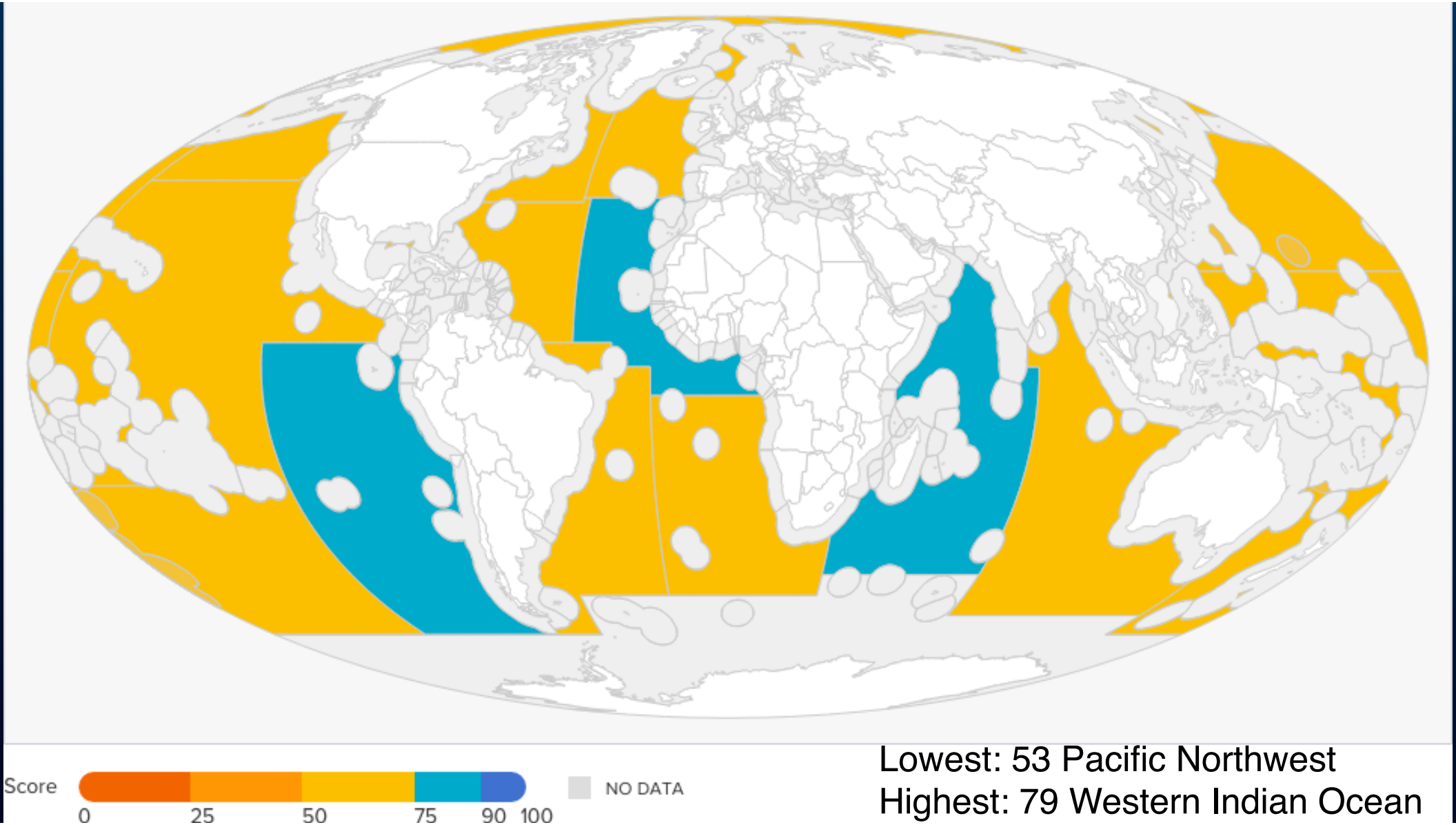
North Korea, Lebanon **50**
Liberia, Nicaragua **48**
Sierra Leone, Ivory Coast, DRC **47**
Dominica **46**
Libya **43**

High Seas Assessment

Based on 15 FAO subdivisions

Only three components assessed:

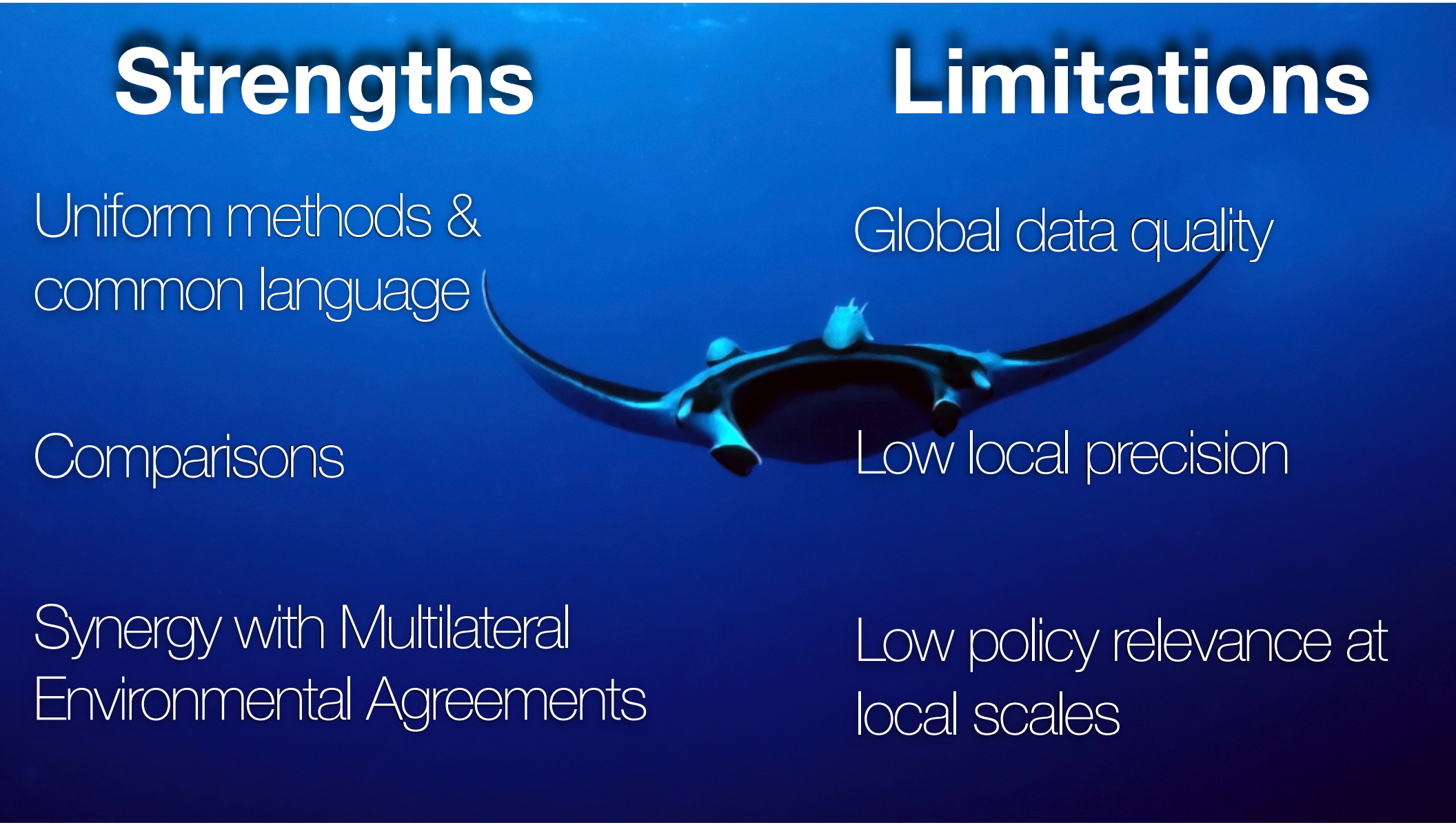
1. Food provision: fisheries
2. Sense of place: iconic species
3. Biodiversity: species



Lowest: 53 Pacific Northwest
Highest: 79 Western Indian Ocean

Limitations and challenges of the global assessment

- 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


Thank You!
Questions?
www.ohi-science.org