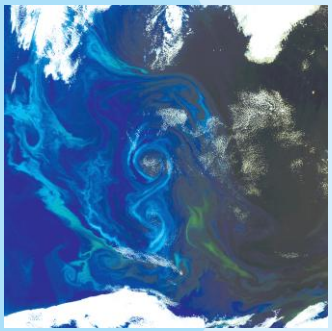
TWAP
TRANSBOUNDARY WATERS ASSESSMENT PROGRAMME

GEF Transboundary Waters Assessment Programme:

Contributing to Indicator-Based Management of Transboundary Aquatic Systems

Sherry Heileman (IOC/UNESCO), Liana Talaue McManus (UNEP)



UNEP
gef
UNEP-DHI CENTRE for Water and Environment
United Nations Educational, Scientific and Cultural Organization
International Hydrological Programme
United Nations Educational, Scientific and Cultural Organization
Intergovernmental Oceanographic Commission
ILEC

Outline

- TWAP background and overview
- LMEs
- LMEs assessment methodology
  - Conceptual framework
  - LMEs modules/themes and Indicators
- Indicator results (examples)
- Assessment products
- TWAP Open Ocean themes and indicators
- TWAP marine components and Regional Seas
- Sustaining TWAP
- Socio-economic indicators

GEF International Waters (IW) Focal Area: Before 2007

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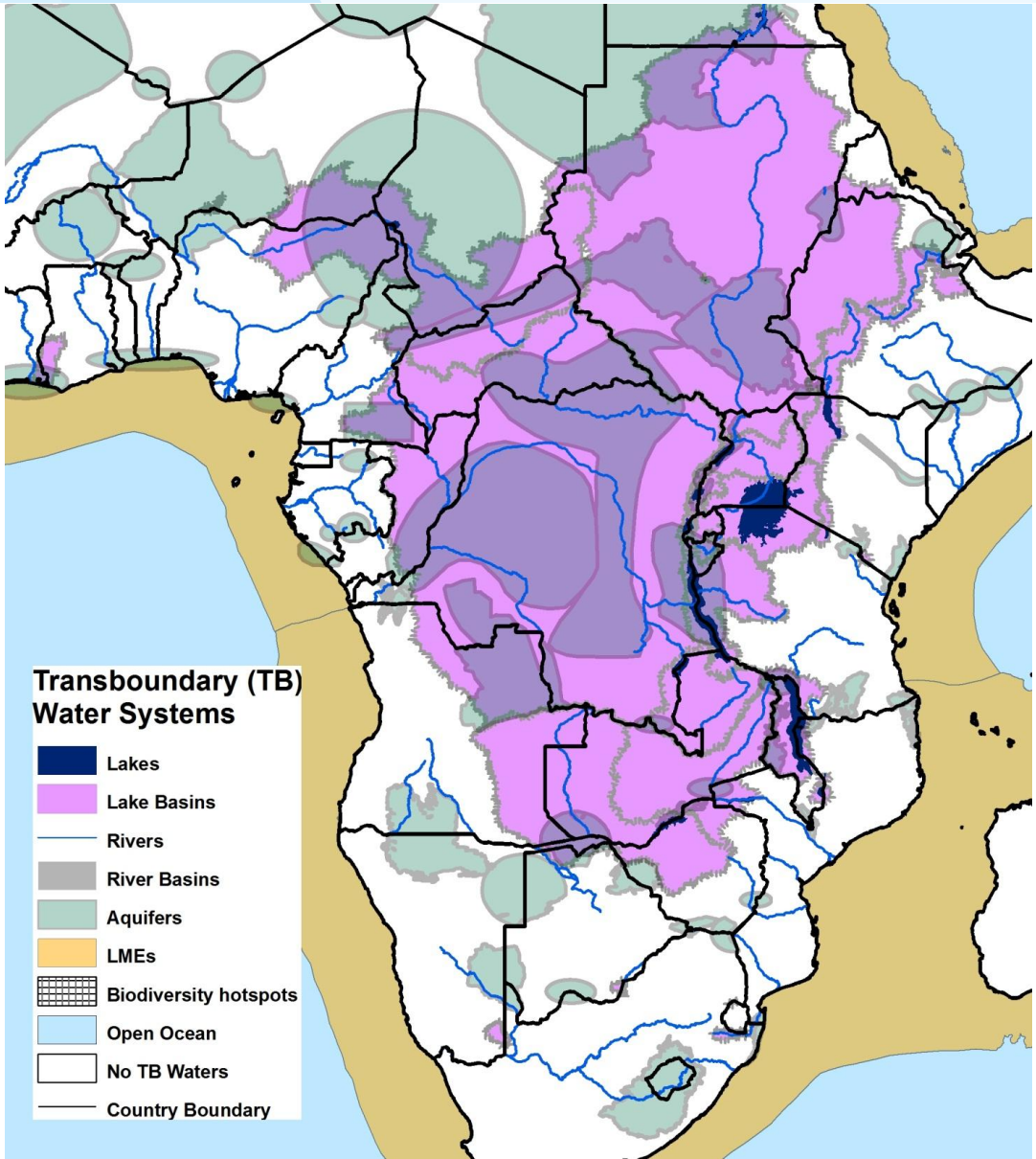
Indicator-based Assessment of Transboundary Waters

Water Systems: Groundwater, Lakes, Rivers, Large Marine Ecosystems, & the Open Ocean

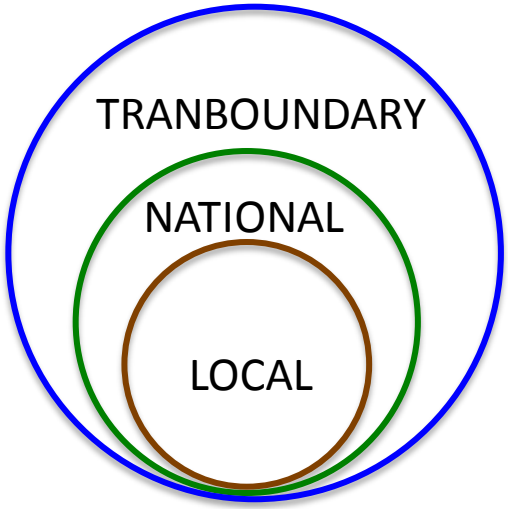
Transboundary Nature: A significant level of complexity

- Geopolitical boundaries define tranboundary (TB) nature
- Resulting human interactions overlay on the natural processes that are linked
- TB properties are greater than sum of TB basin country units
- Emergent properties at TB scale are the major focus of assessment

Transboundary Water Systems: Nested Scales



- Surface and Groundwater Conjunctive Use
- Upstream and downstream connectivity
- Nested scales (natural; geopolitical)
- Attributes at cross-component analysis



Attributes of good indicators

- A measure of the state of a TB water body, subject to pressures
- Should have **directionality**: low to high values indicate trend from good to worse states
- Has a reference state; time series data with good spatial coverage is higher information content than a few points in time and space
- Variability in values is the statistical basis for discriminating bodies at risk, plus science-based threshold values where known

TWAP Full Sized Project (2013-15): Global Indicator-Based Assessment

- *Long-term goal*: Promote financing of **indicator (results) - based** management and development of transboundary water systems

- *Project objective*:

(1) Conduct **first global assessment** to assist GEF and other donors to improve the setting of funding priorities;

(2) (2) Formalize **partnerships with key institutions** aimed at incorporating transboundary considerations into regular assessment programs, & resulting in periodic assessments of transboundary water systems

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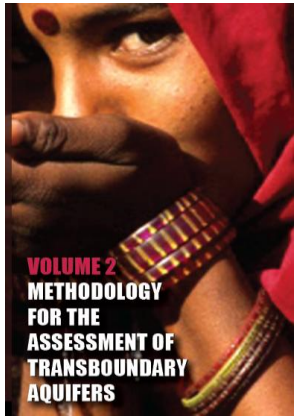
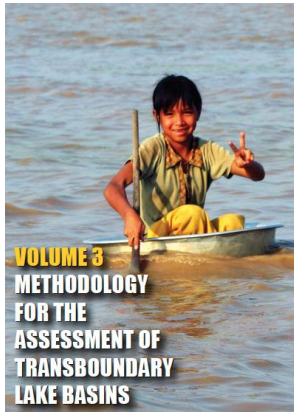
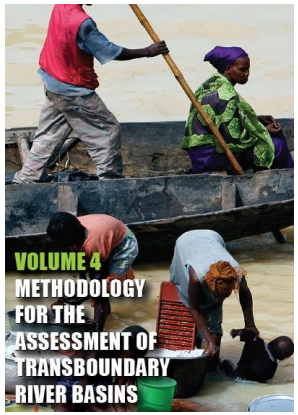
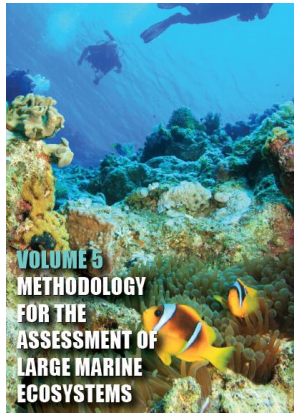
TWAP Medium-Sized Project (2009-10)

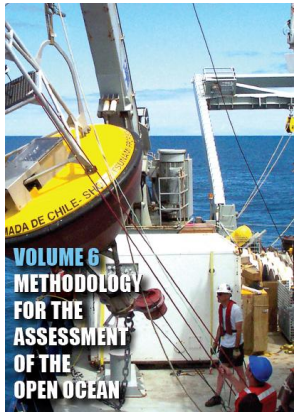
Indicator-Based Assessment Methods











Lead Organizations

United Nations Educational, Scientific and Cultural Organization

International Hydrological Programme

ILEC

UNEP-DHI CENTRE for Water and Environment

UNEP DHI

United Nations Educational, Scientific and Cultural Organization

Intergovernmental Oceanographic Commission

Implementing Agency

UNEP

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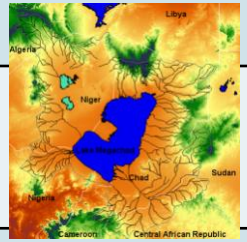
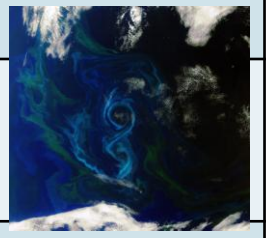
Brief history and project goals

Comparative within a water system ← → **Thematic**

Elements	Transboundary Aquifers:	Transboundary Lakes Basins & Reservoirs	Transboundary River Basins	Large Marine Ecosystems	The Open Ocean
Spatial coverage, 2010, 2030, 2050	166 aquifers 43 groundwater systems in SIDS	200 lakes/ reservoirs	276 river basins	66 LMEs, of which 55 are transboundary	Global Open Ocean
Biophysical indicators					
Socioeconomic Indicators (e.g.)	Water demand by economic sector	Fishing Revenues Tourism Revenues	Access to water Access to sanitation	Deaths due to climate related natural disasters	Vulnerability to sea level rise
Governance architecture/ arrangement (e.g.)	For Water Quantity	For Water Distribution	For Habitat Destruction	For Fisheries	For Biodiversity
Data & Information Management	**URL:** www.geftwap.org				

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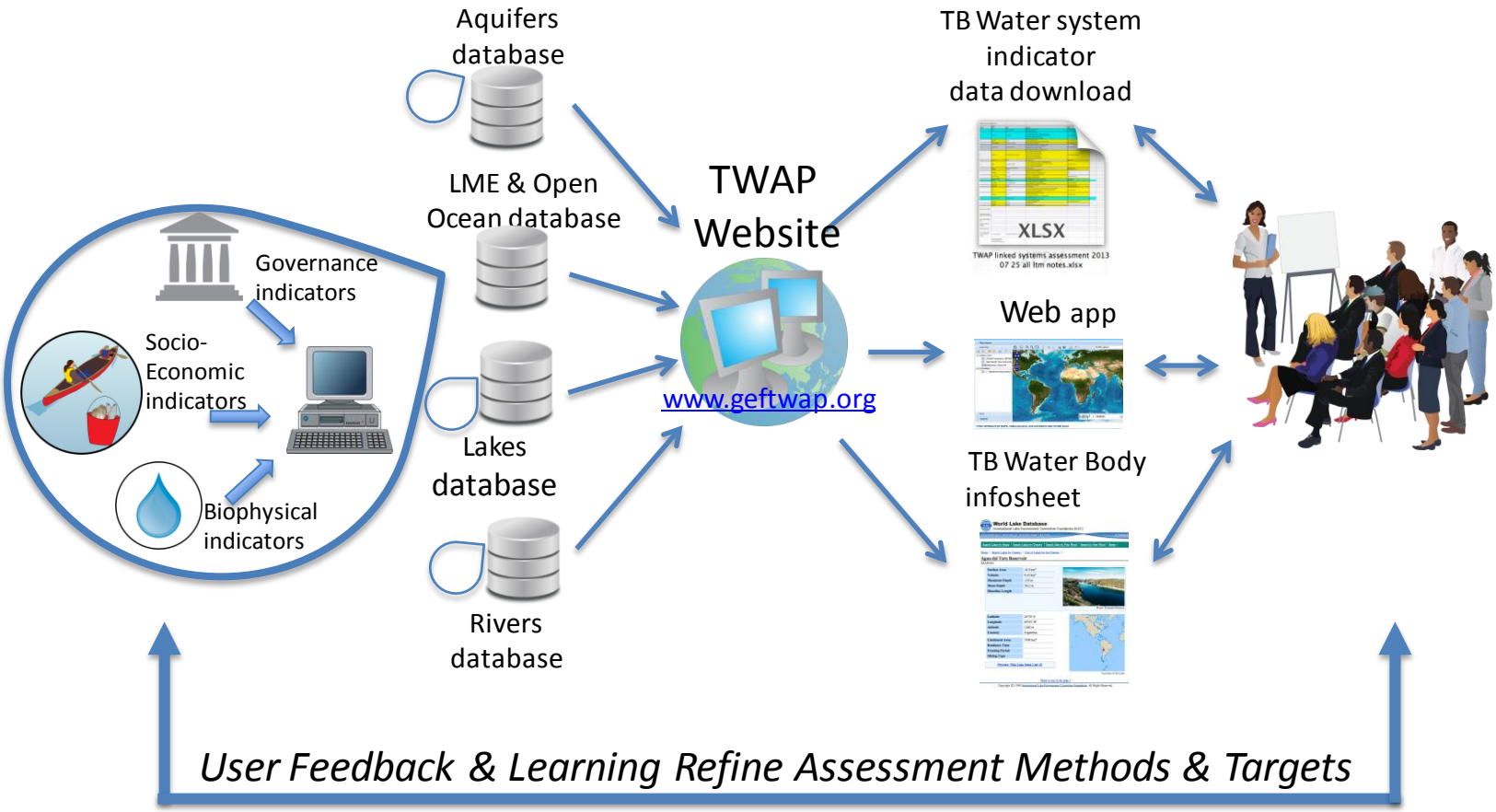
Global Indicator-based Transboundary Waters Assessment Program

Indicator-Based Assessment Data & Product Delivery System



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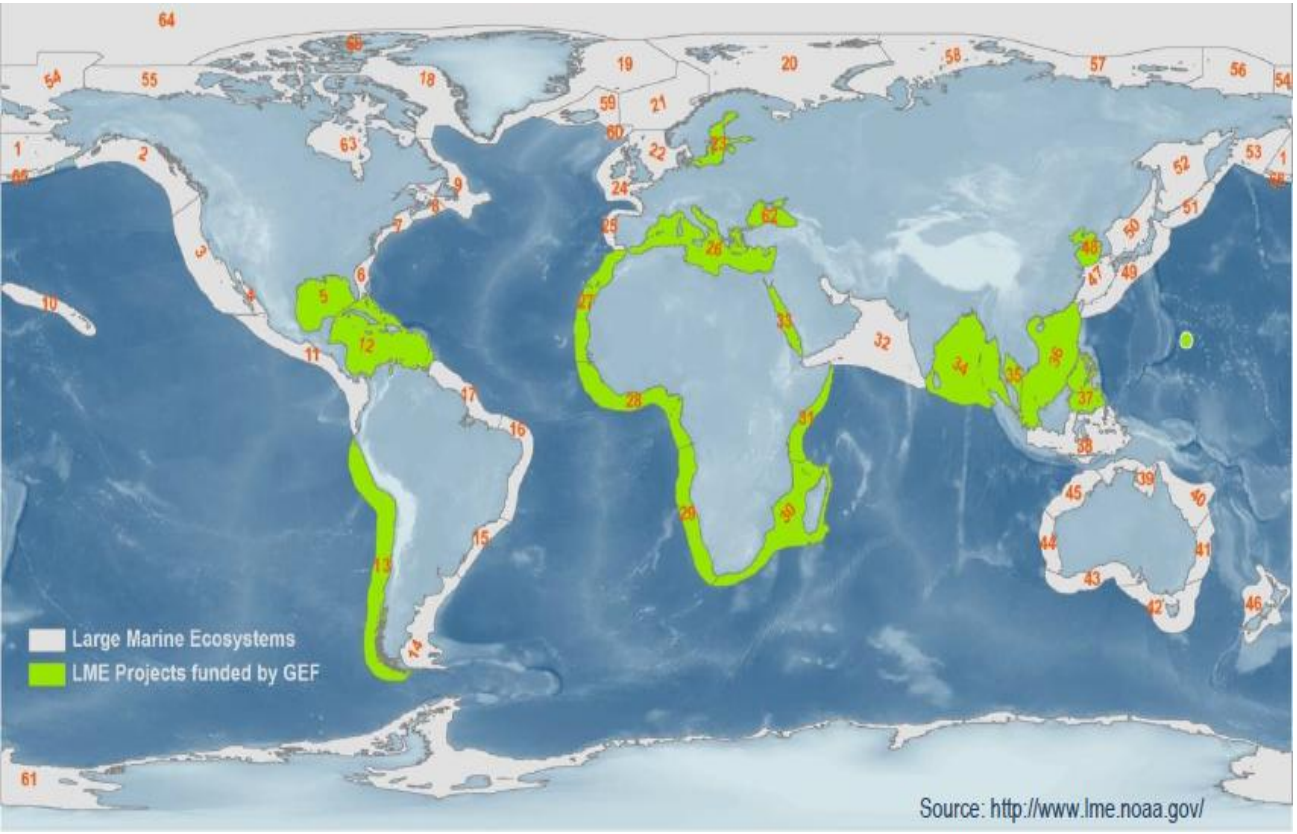
Large Marine Ecosystems Component

Methodology and Indicators

UNEP gef UNESCO IOC

Large Marine Ecosystems (66)



- More than 200,000 sq km.
- Coastal areas from shorelines to continental shelf break/slope or seaward extent of current system.
- Defined by ecological criteria: bottom depth contours, currents, marine productivity, and food webs.
- Located within Regional Seas areas.

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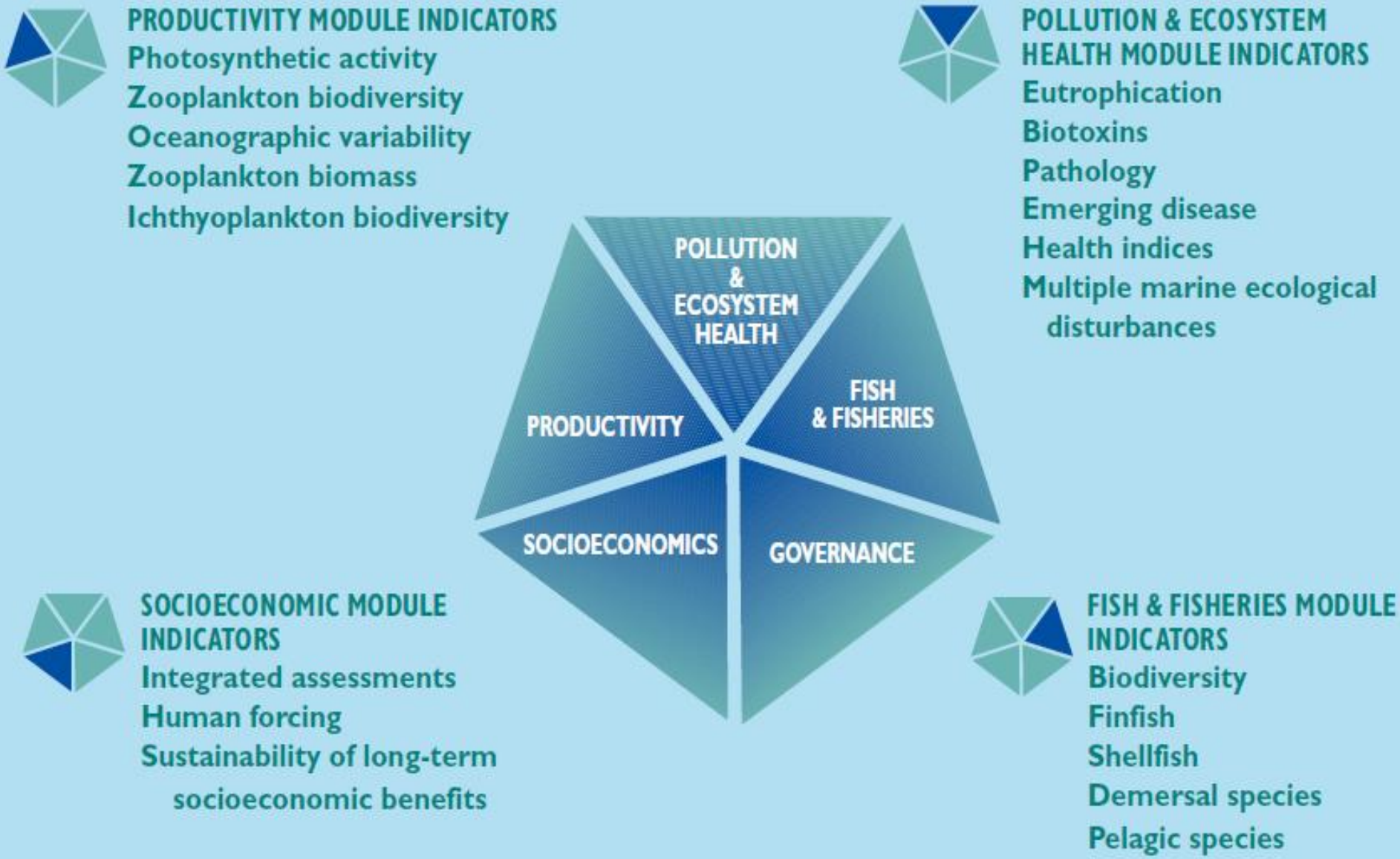
Existing framework for LME assessment (NOAA)



TWAP LMEs assessment methodology

- Developed by Working Group of institutional partners and experts.
- Conceptual framework showing link between human and natural systems, based on DPSIR, ecosystem services explicit.
- Indicator- based.
- Level 1: A **global comparative baseline assessment** across the 66 LMEs and the Pacific Warm Pool – clustering of LMEs into 5 'risk' categories (highest to lowest) according to environmental state/human vulnerability using a subset of indicators.
- Level 2 assessment: More detailed assessment within LMEs (Bay of Bengal LME through GEF BoB LME project).

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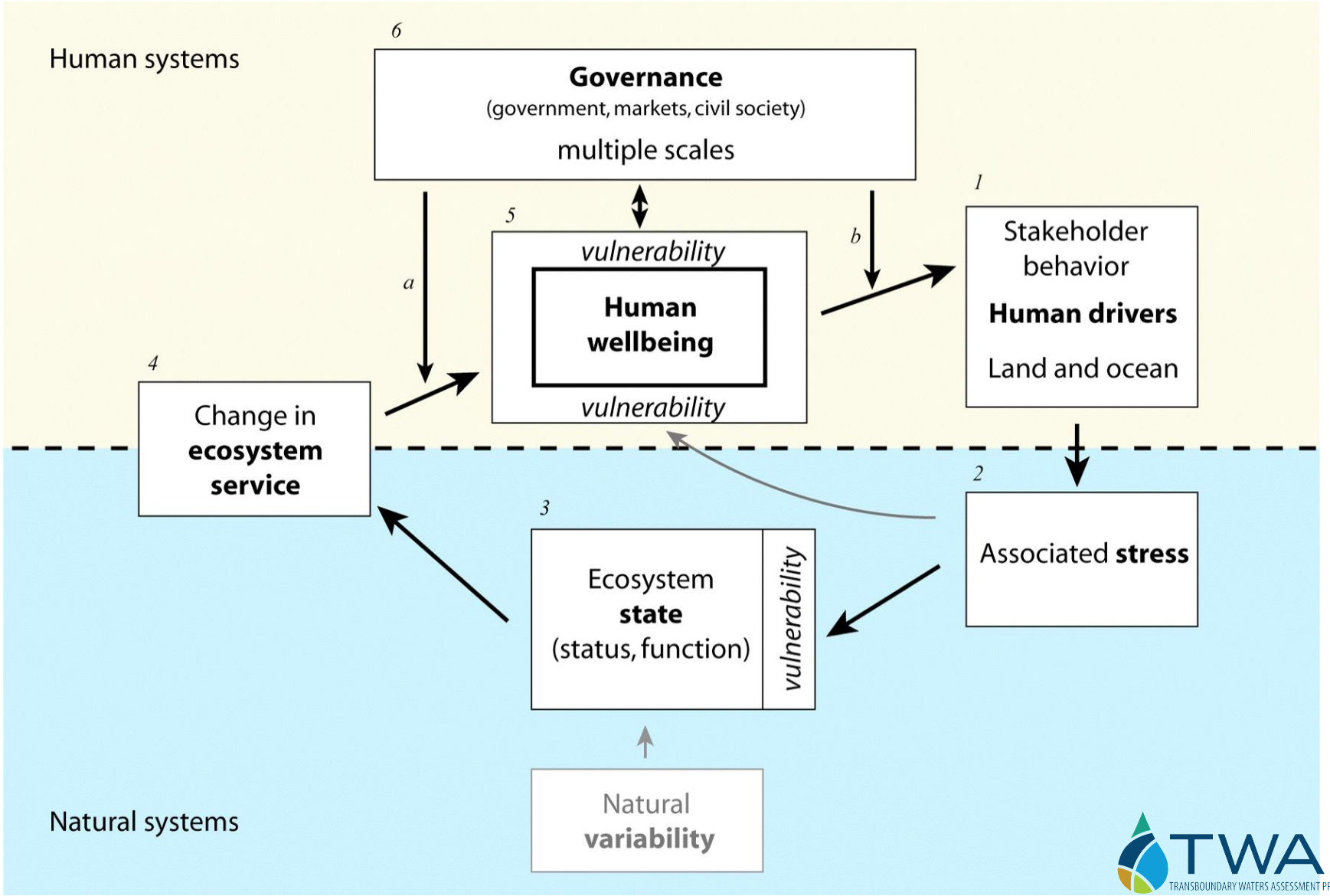
TWAP LMEs & Open Ocean Conceptual Framework



Framing questions

- What are the current trends in LMEs state (and projections)?
- Which LMEs are most heavily impacted?
- Which ecosystem services are at most risk?
- What are the implications for humans? Why should we care?
- Where is human dependency greatest on LME ecosystem services?
- Where are humans most vulnerable to changes in LME condition?
- What is the status of the governance arrangements in transboundary LMEs?
- What are the key emerging issues?
- Others

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Selection of Indicators

- Identification of major environmental issues in LMEs (review of Transboundary Diagnostic Analyses in GEF LME projects):
  - Overfishing
  - Pollution
  - Nutrient over-enrichment
  - Habitat degradation & biodiversity loss
  - Climate change impacts

- Socio-economic importance: human dependence on ecosystem services, human vulnerability to ecological changes

- Availability of global datasets, expertise, partners

These indicators are scalable - they can be measured at any geographic scale, including national and sub-national

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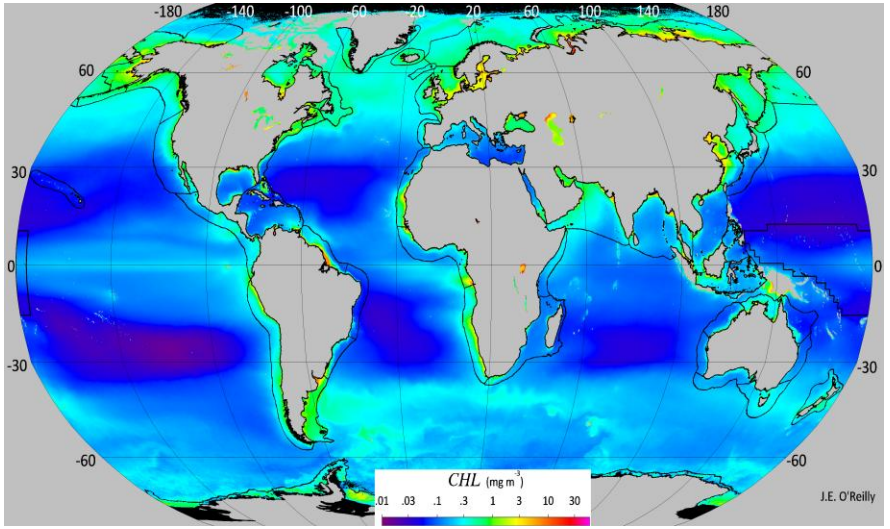
LME indicators: Productivity

*Primary productivity

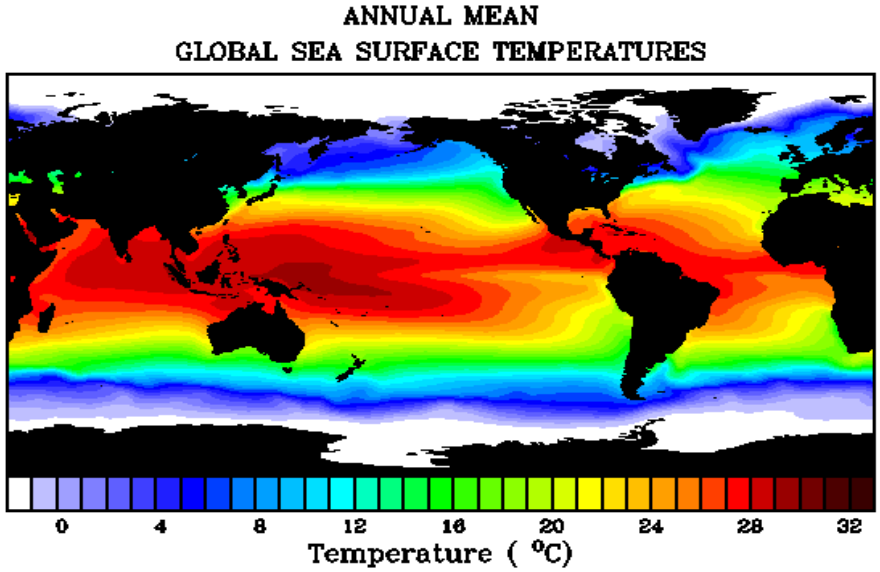
*Chlorophyl a

(*NOAA, Univ. Rhode Is*)



*Sea surface temperature

(*Univ. Rhode Is*)



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LME indicators: Fish and Fisheries

*Annual landings & value
*Marine trophic index/FIB index
*Stock status
*Catch from bottom impacting gear
*Fishing effort
Catch potential projections under global warming

(UBC, Sea Around Us Project)

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LME indicators: Pollution

Nutrients: N, P, Si *(IGBP)*

Index of Coastal Eutrophication Potential *(IGBP)*

Plastic debris density *(GESAMP, individual expert)*

*POPs in plastic resin pellets *(Int'l Pellet Watch Prog/Tokyo Univ. Agric. & Tech; GESAMP)*

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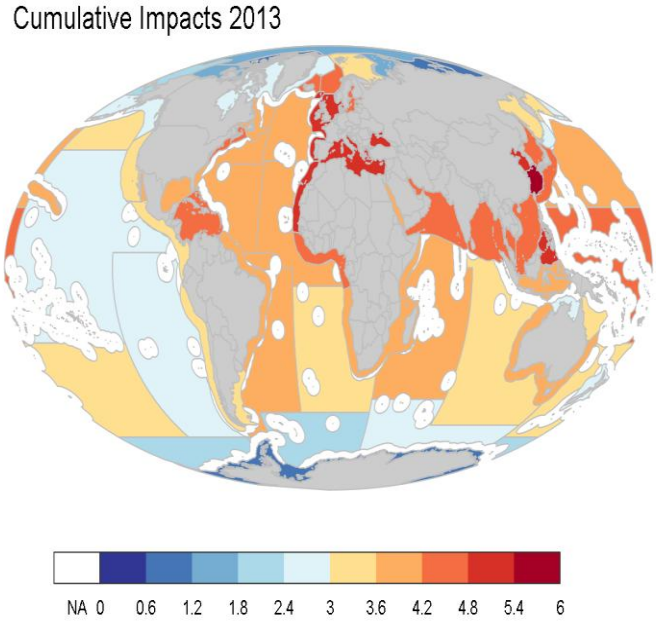
LME indicators: Ecosystem health

*Change in MPA coverage
Reefs at Risk Index
*Mangrove extent
*Coral reef extent
(UNEP-WCMC)

*Cumulative human impacts (+ underlying indicators)
*Ocean Health Index
(Center for Marine Assessment and Planning, UCSB)



LME indicators: Socio-economics & Governance

Socio-economics

*% GDP fisheries

*% GDP international tourism

*Population within 10 m coastal elevation

*Human Development Index

*Night Light Development Index

*Deaths caused by climate related natural disasters

(L. McManus)

Governance

Governance architecture - transboundary LMEs

(R. Mahon, CERMES/UWI & L. Fanning, Univ. Dal)

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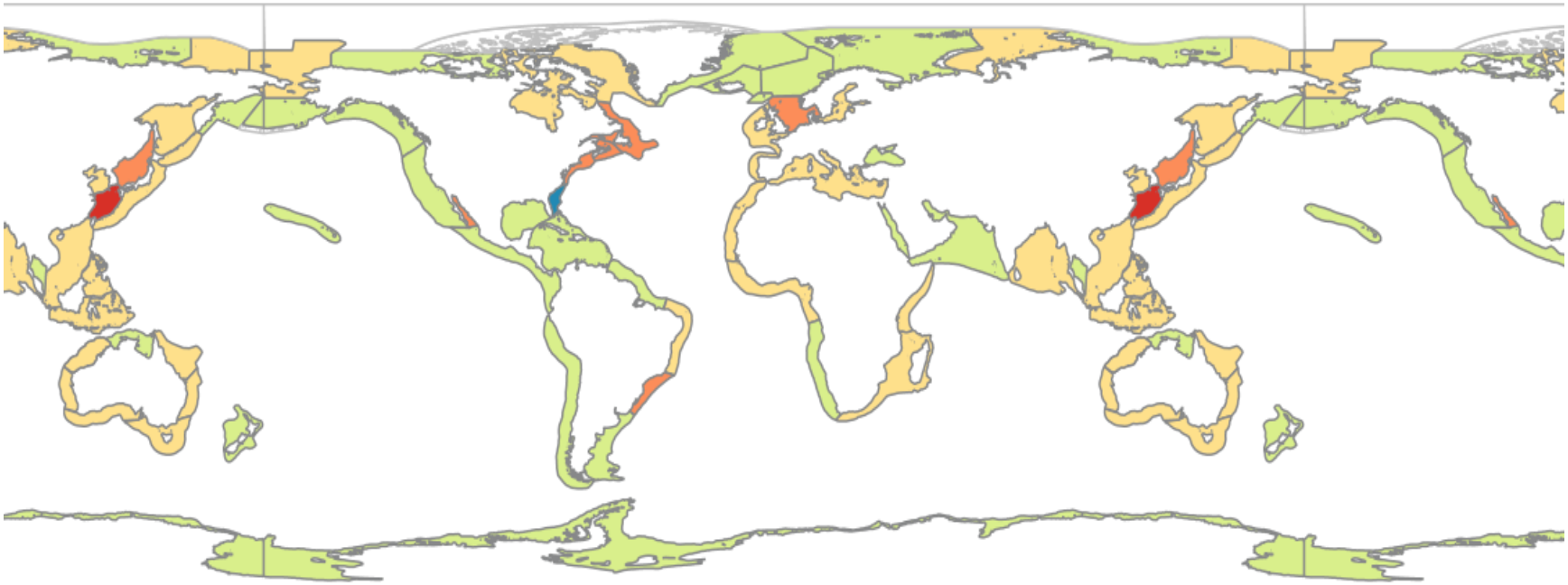
Net SST change 1957-2012



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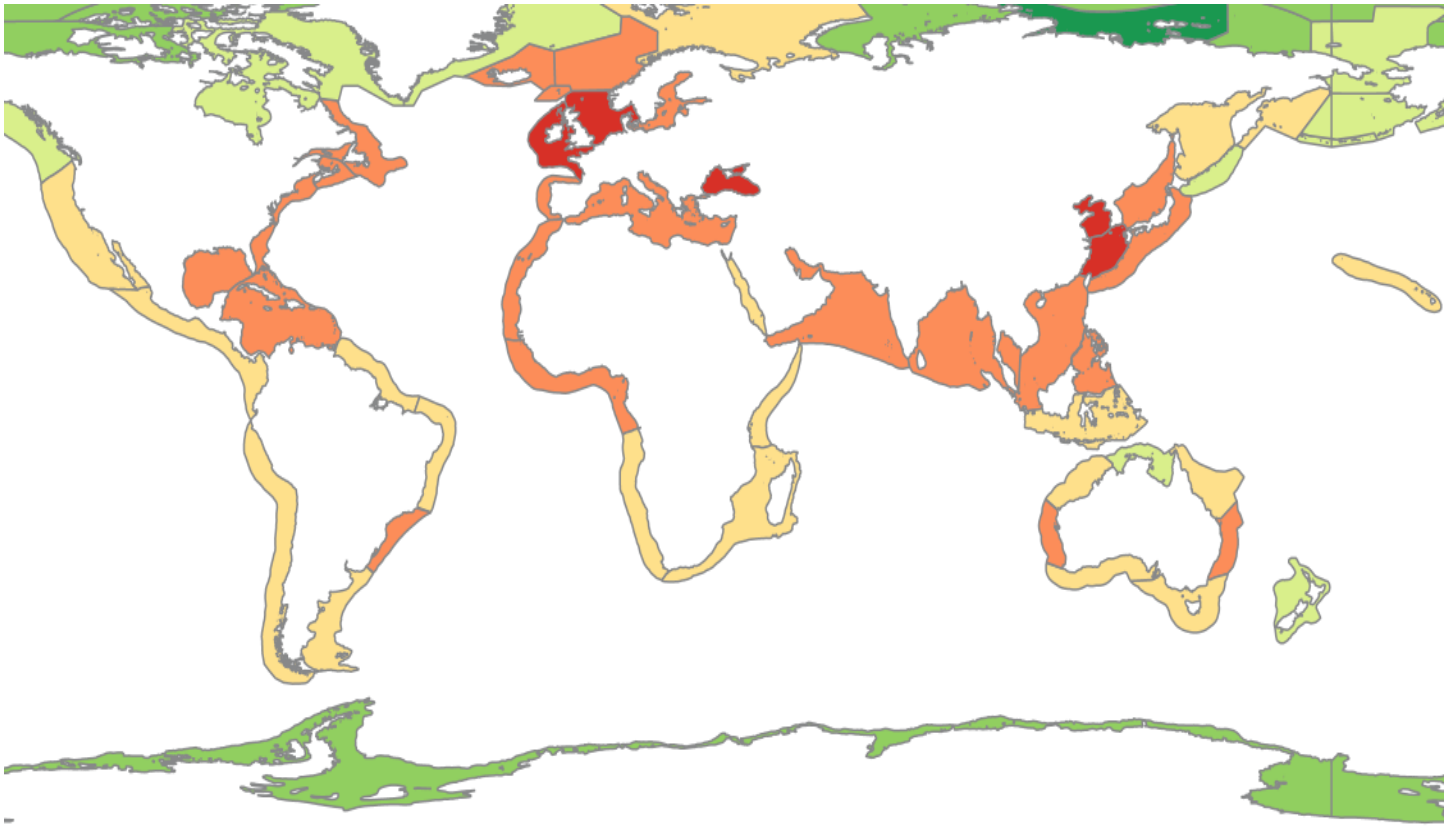
Cumulative human impacts on ecosystems



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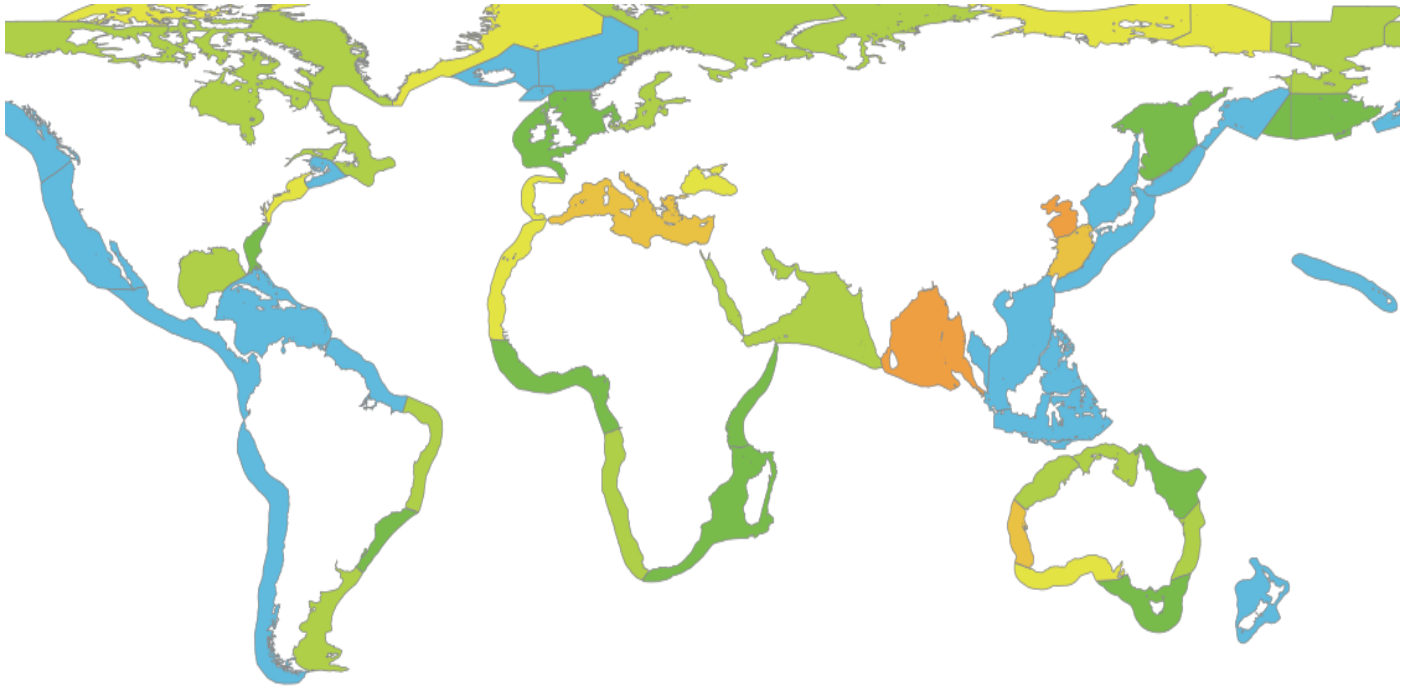
Index of Coastal Eutrophication Potential



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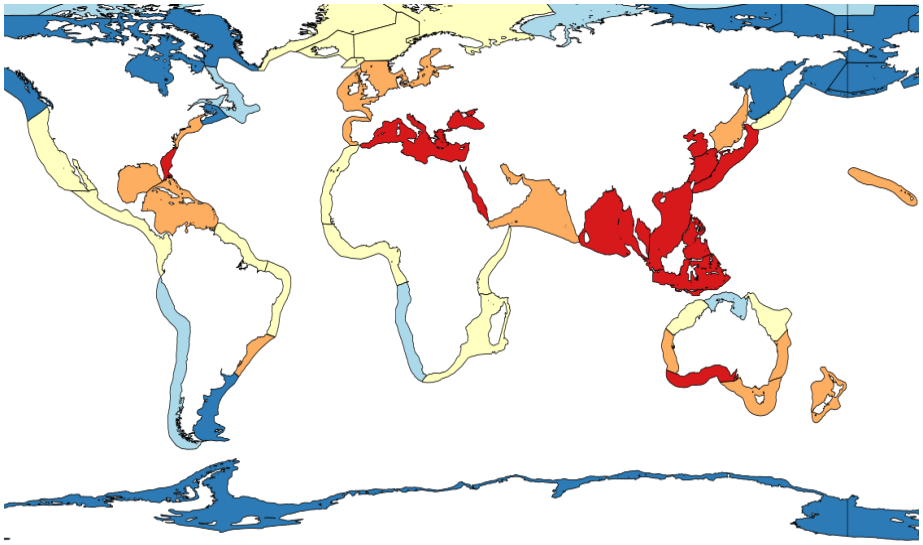
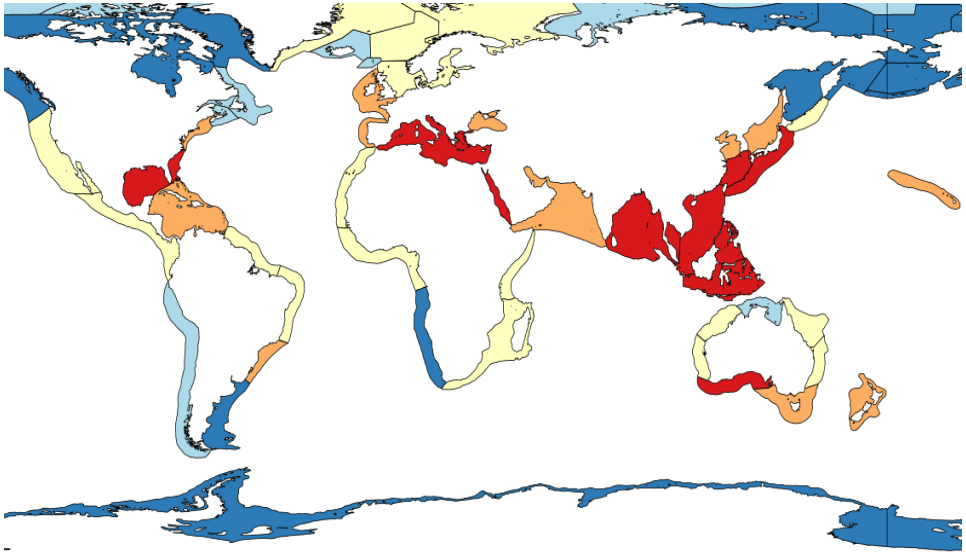
Plastic distribution



Microplastics
(count/sq km)



Macroplastics
(g/sq km)

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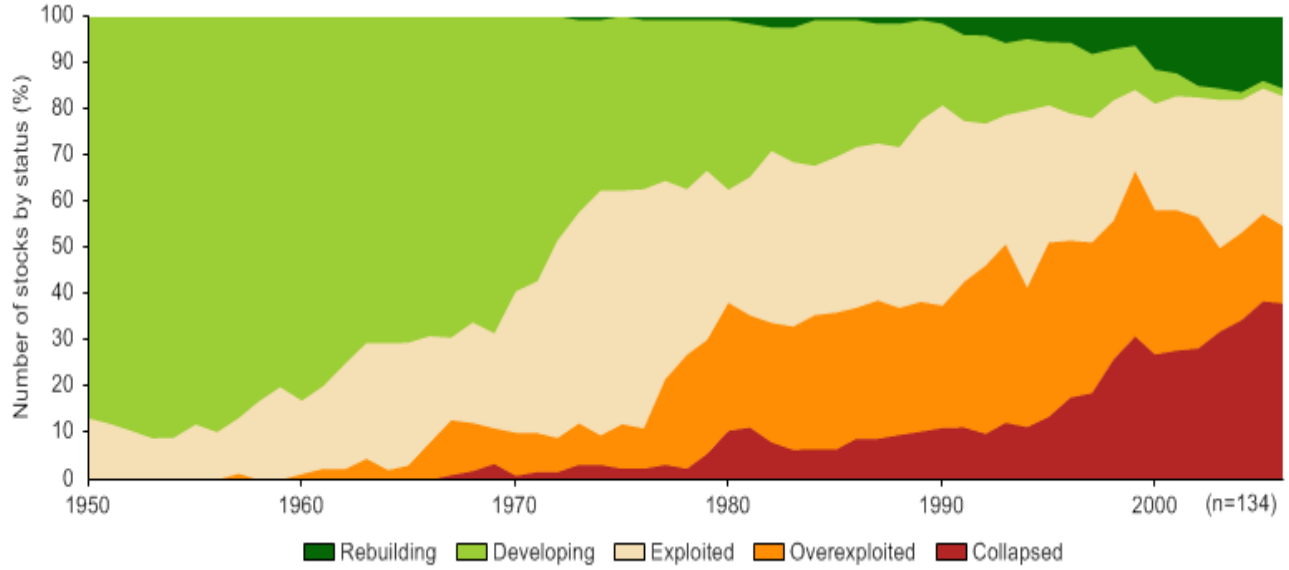
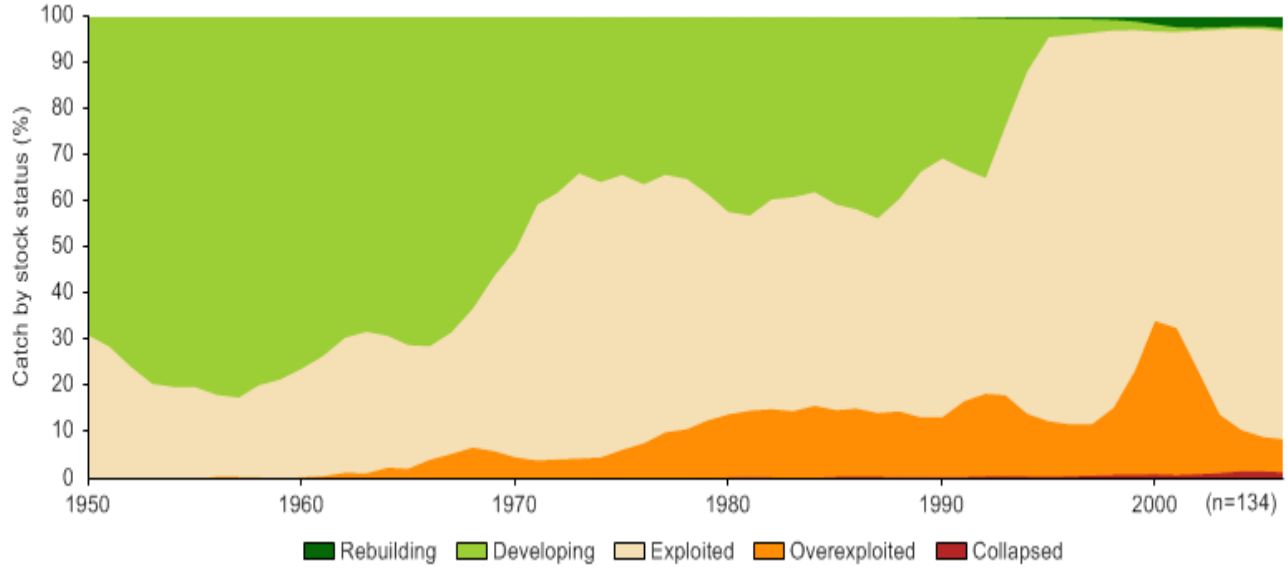
Fish stock status – Annual trends



Stock status



Catch by stock status

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Marine trophic index/Fishing in balance index

Caribbean Sea LME

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Assessment Products

All the assessments products will be available in 2015.

Data

Spatial information and statistics from the TWAP Web portal.

Reports

A synthesis report, summary for decision makers and technical thematic reports.

Indicators

Indicators factsheets and accessible metrics by themes.

Web

Our websites will disseminate all products and results related to LMEs and the Open Ocean.

Target audience and potential users:

The main target audience of the TWAP LMEs assessment will be the GEF Secretariat, who requested the assessment of transboundary waters. Among other key stakeholders will be countries involved in GEF LME projects as well as UN organizations and others with global and regional programmes on assessment and management of the marine environment such as the World Ocean Assessment and Regional Seas Programmes.

All project information can be found at:
http://www.unesco.org/new/twap-lme and www.geftwap.org/large-marine-ecosystems

LME fact sheets

For each LME: Electronic profile on the web portal with all indicators, graphical display, downloadable data and metadata

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TWAP Open Ocean component
Global ocean – local vulnerability

- Focus on themes where a global commons / global environmental issues related to the oceans exist

- Scaleable **mapping approach to indicators**, overlaying open ocean state and projections with **vulnerability** of human system or natural systems

- **Expert assessment** for certain themes (governance, open ocean pollution, high seas fisheries)

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TWAP Open Ocean themes

- **Climate** change, variability and impacts
- **Ecosystems**, habitats and biodiversity
- **Fisheries**, impact and sustainability
- **Pollution** and contaminants
- **Socio-economics:** Human dependency and vulnerability
- **Governance**: architecture linking global with other scales, science-policy interface

(See hand-out for Indicators)

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TWAP and Regional Seas

- TWAP methods/indicators are amenable and adaptable to Regional Seas assessments
- Methods and gridded data available for transboundary water bodies equally applicable for assessing changing states of Regional Seas
- Similar assessment units- LMEs within Regional Seas (UNEP LMEs in Regional Seas Report)
- Similar environmental and natural living resources issues
- Similar countries

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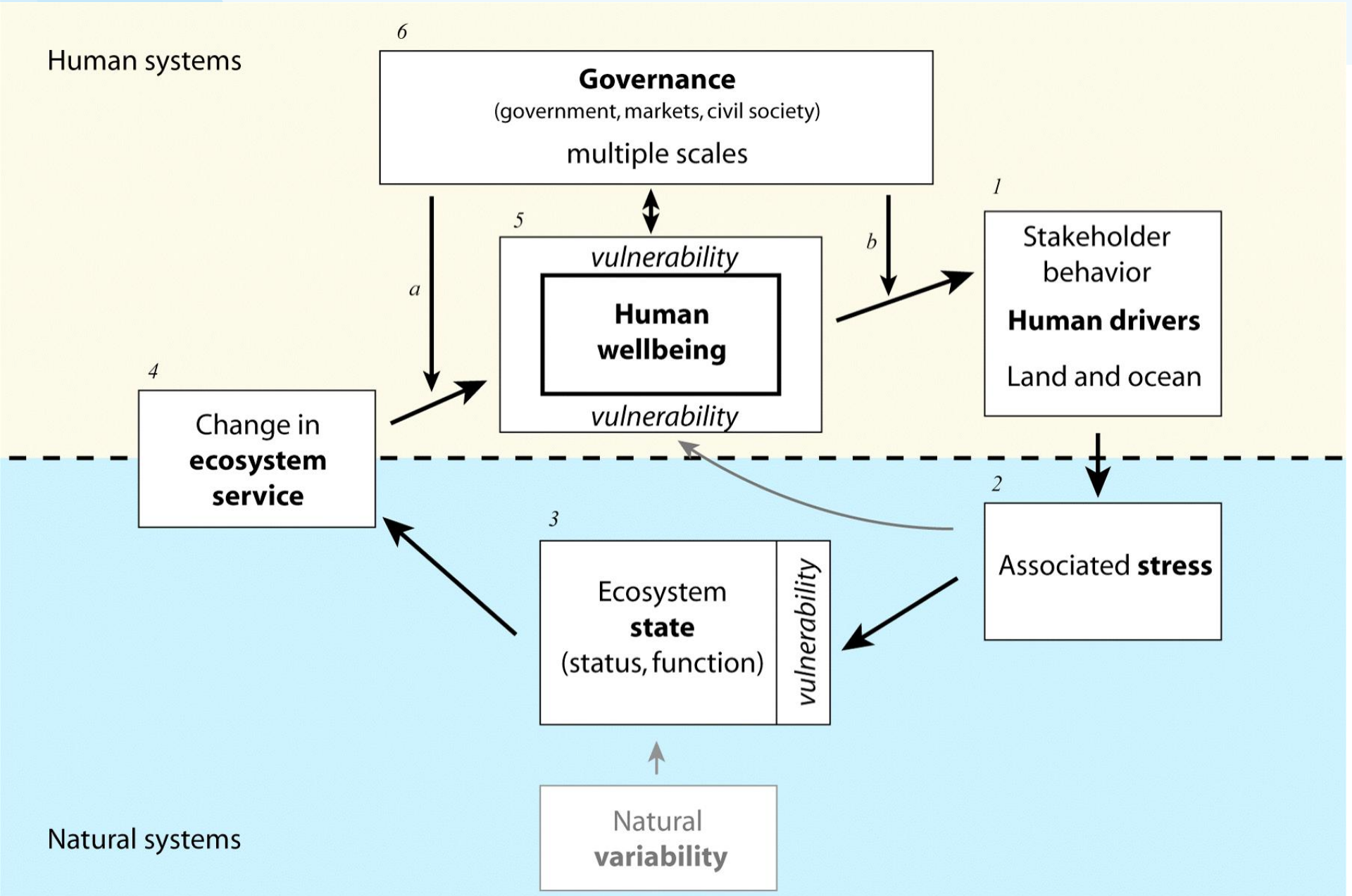
Sustaining TWAP

- Consortium of institutional partners and experts
- Availability of data
- Sustaining and maintaining data portal
- Availability of funding
- Capacity building
- Uptake in Regional Seas, WOA, LME projects, etc

Socioeconomic Indicators

LMES & OPEN OCEAN CONCEPTUAL FRAMEWORK



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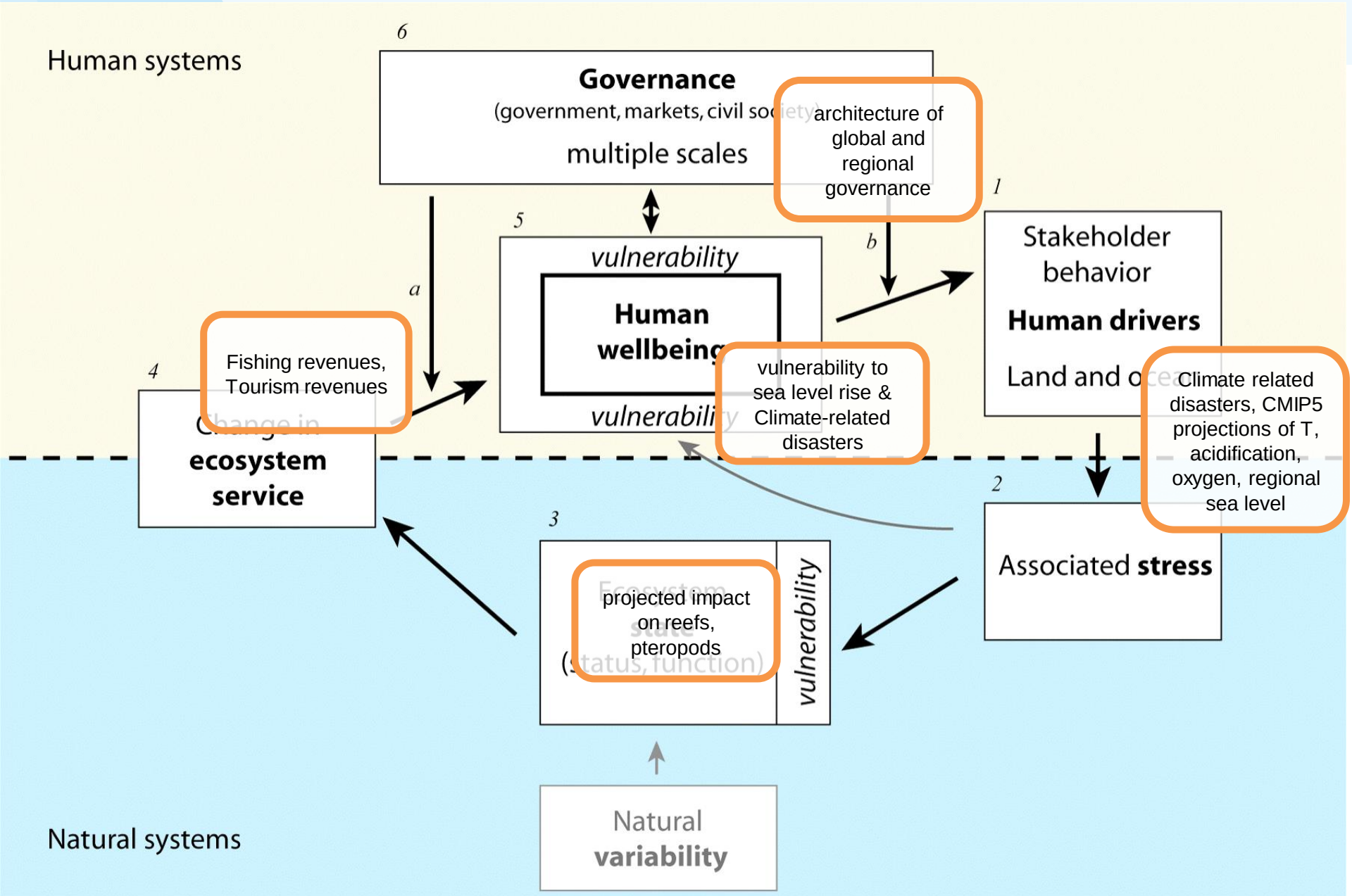

Human systems
6
Governance
(government, markets, civil society)
multiple scales
architecture of global and regional governance
1
Stakeholder behavior
Human drivers
Land and ocean
5
vulnerability
Human wellbeing
vulnerability
a
b
4
Change in ecosystem service
Fishing revenues, Tourism revenues
vulnerability to sea level rise & Climate-related disasters
Climate related disasters, CMIP5 projections of T, acidification, oxygen, regional sea level
2
Associated stress
3
Ecosystem state
(status, function)
projected impact on reefs, pteropods
vulnerability
Natural variability
Natural systems

Transboundary coastal waters (LMEs): Human Dimensions

RISK = Exposure X Vulnerability

where Vulnerability=*f* (*Susceptibility, Lack of adaptive capacity*)

Risks to:

1. Weather-related disasters (fast, seasonal)
2. Slow phenomena
   - Sea level rise
   - Ecosystem degradation

Exposure	Susceptibility	Lack of Adaptive Capacity (long-term)

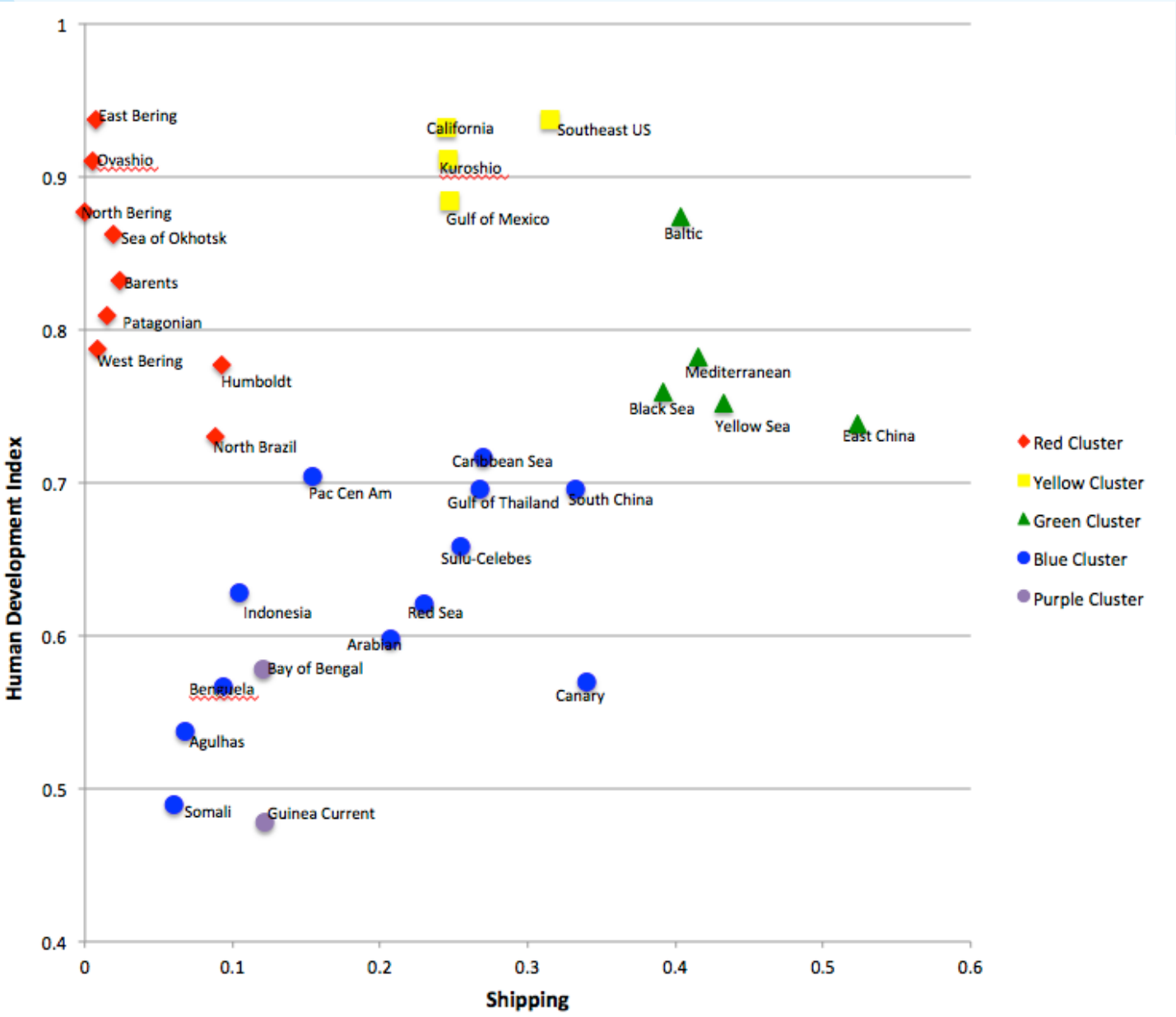
1. Weather related phenomena
- Mortality per 100K population
- Affected per 100K
- Loss in Purchasing Power Parity
- Loss in GDP per capita (percentage)
	• Percent coastal poor
	  - Urban
	  - Rural
	• Coastal labor engaged in tourism
	• Coastal rural population (proxy for fishing population)
	• Income trends from fishing
	• Income trends from tourism
		• Human Development Index metrics
		  - Literacy
		  - Health
		  - Income
		• Transboundary Governance (TB LME scale)

2. Ecosystem degradation – LMEs at highly and very highly degraded biophysical states - Coastal populations		
3. Sea level rise (2100 - Low-elevation coastal populations (10 m elevation within 10 km from shore) - Land use within 10 m elevation within 10 km from shore (agriculture, urbanized land)		

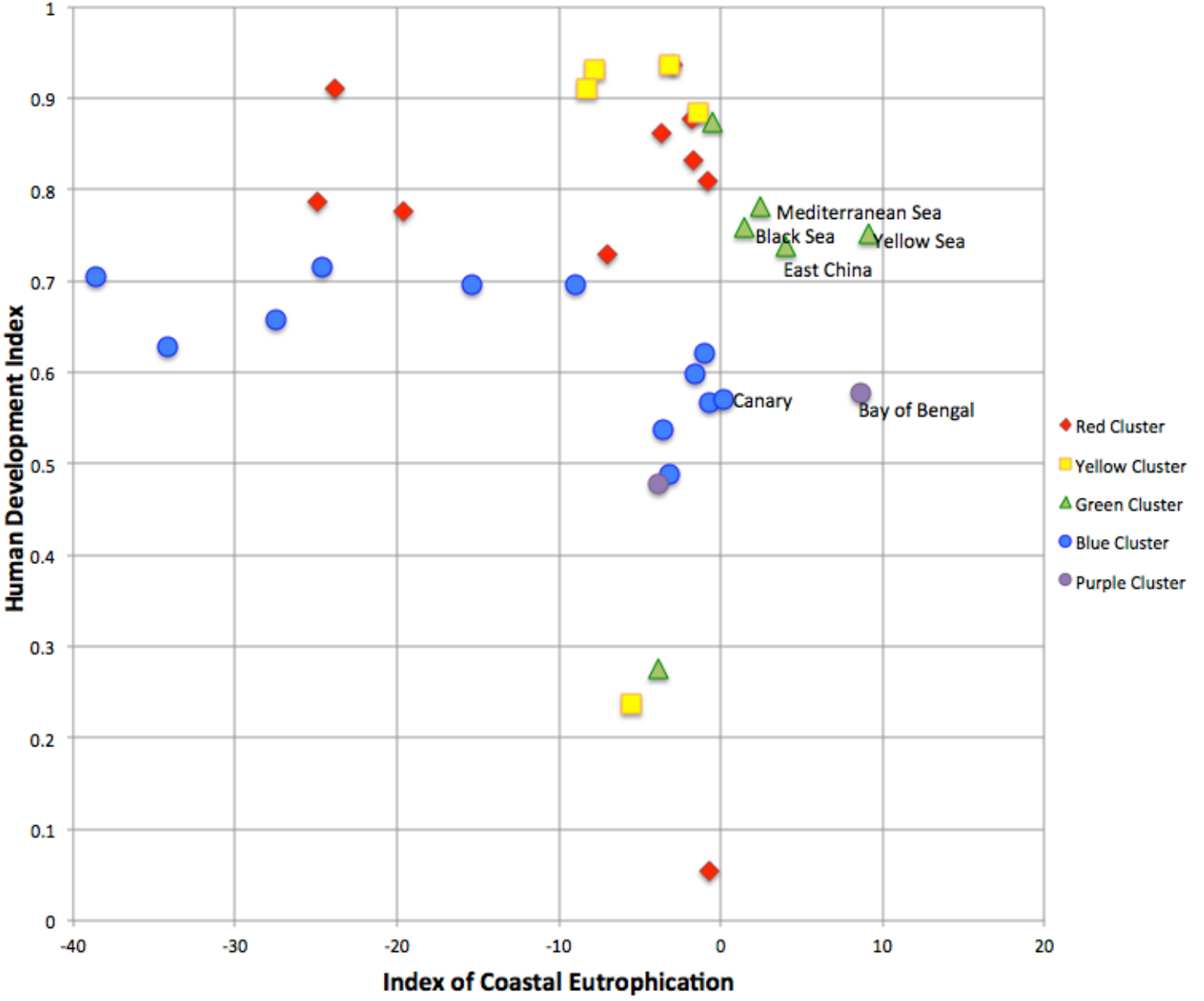
From Indicators to Potential GEF Priorities

- Simultaneously analyze multiple DIRECTIONAL indicators to determine statistically influential indicators
- Discriminate groups of TB bodies
- Identify priorities (geographic, issue-based)
  - Based on global comparative analysis
  - Among GEF-eligible TB water bodies

(Work in progress among components)



HDI- Shipping among 36 GEF-Eligible LMEs



HDI-Index of Coastal Eutrophication for 36 GEF-eligible LMEs

Use of Indicators

- For global and regional comparison – GEF IW, other donors, countries where TB Basin country units have data
- Baseline for better resolved data from subnational and national databases
- For GEF IW TDA and SAP
- WOA, Regional Seas, other regional and global assessment processes

Lessons learned

- Indicators provide rigor and discipline in ecosystem-based assessments, but numbers cannot capture all truth
- Effective within a purposeful conceptual framework
- Need to appreciate explanatory power & limitations (confidence levels, sensitivity to state of science and use of statistics)
- Excellent if driven by need to track environmental management performance

Thank you for your attention