



Assessments at any spatial scale:  
political and ecological

# Scaling Down the OHI Framework

Marine aspects are more or less important

Reference points ~ management objectives

Indirect measurements - estimate the status  
of various dimensions

# OHI+ Assessments

**scales smaller than global: countries, states, provinces,  
eco-regions**

At the scales **where decisions are made**

Relevant to local management

**BALANCE:** needs of people, economic  
development, natural resources

# Adapting the Ocean Health Index

Add or exclude goals

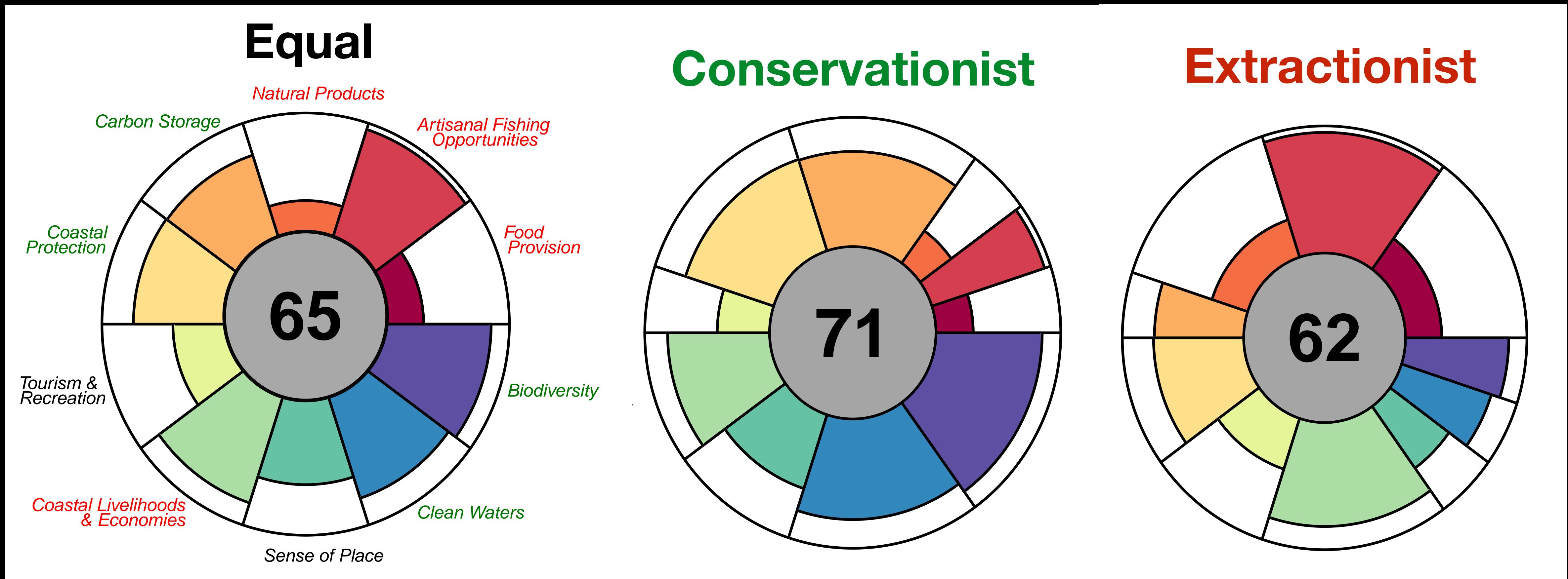
Locally relevant goal models

Stakeholder set reference points

# Weighing Goals

Goal	Global	Conservationist	Strongly Extractive
<b>Food Provision</b>	0.10	0.05	<b>0.18</b>
<b>Artisanal Opportunity</b>	0.10	0.05	<b>0.18</b>
<b>Natural Products</b>	0.10	0.05	<b>0.18</b>
<b>Carbon Storage</b>	0.10	<b>0.15</b>	0.03
<b>Coastal Protection</b>	0.10	<b>0.15</b>	0.09
<b>Coastal Livelihoods &amp; Economies</b>	0.10	<b>0.10</b>	<b>0.18</b>
<b>Tourism &amp; Recreation</b>	0.10	0.05	0.09
<b>Sense of Place</b>	0.10	<b>0.10</b>	0.03
<b>Clean Waters</b>	0.10	<b>0.15</b>	0.03
<b>Biodiversity</b>	0.10	<b>0.15</b>	0.03

# Weighing Goals



# Modifying Goal Models

Capture goal philosophies in a different way

## Reasons:

Management objectives

Data availability

Cultural priorities or preferences

# Example: Tourism & Recreation

Global 2012

International  
Arrivals

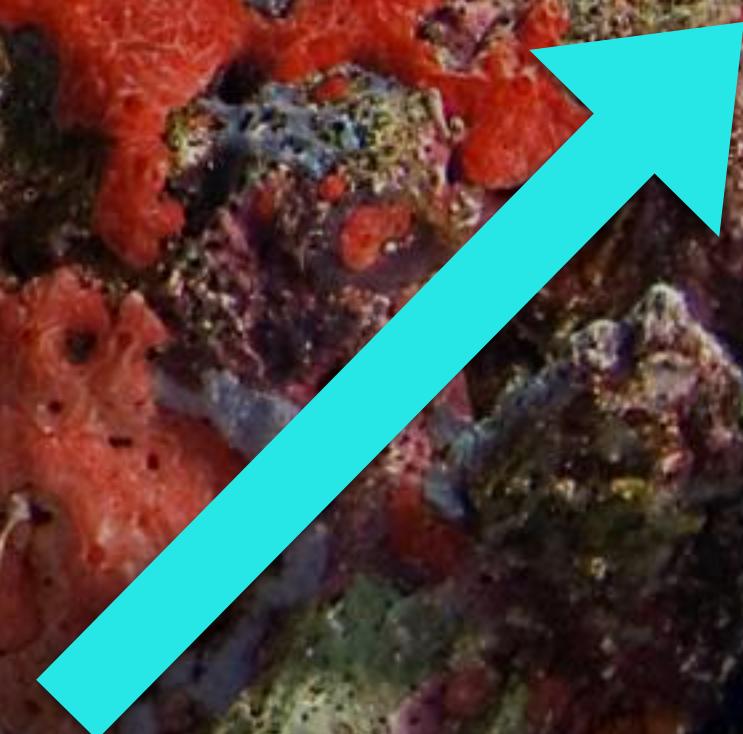
U.S. West Coast

2014

Participation rates in  
tourism activities

Brazil 2014

Employment in  
coastal tourism



# Potential applications

Comparison of productivity and performance  
across regions

Comparison of a region across time

# U.S.A West Coast Assessment



**Study Area: West Coast**

**Region: States**

# U.S West Coast assessment

Higher resolution **data** – 80% local data layers

**Management relevant** geographies

# U.S West Coast assessment

Local model **adaptation:**

- a) wild-caught fisheries: formal stock assessments
- b) mariculture: potential sustainable productivity
- c) tourism & recreation: participation rates

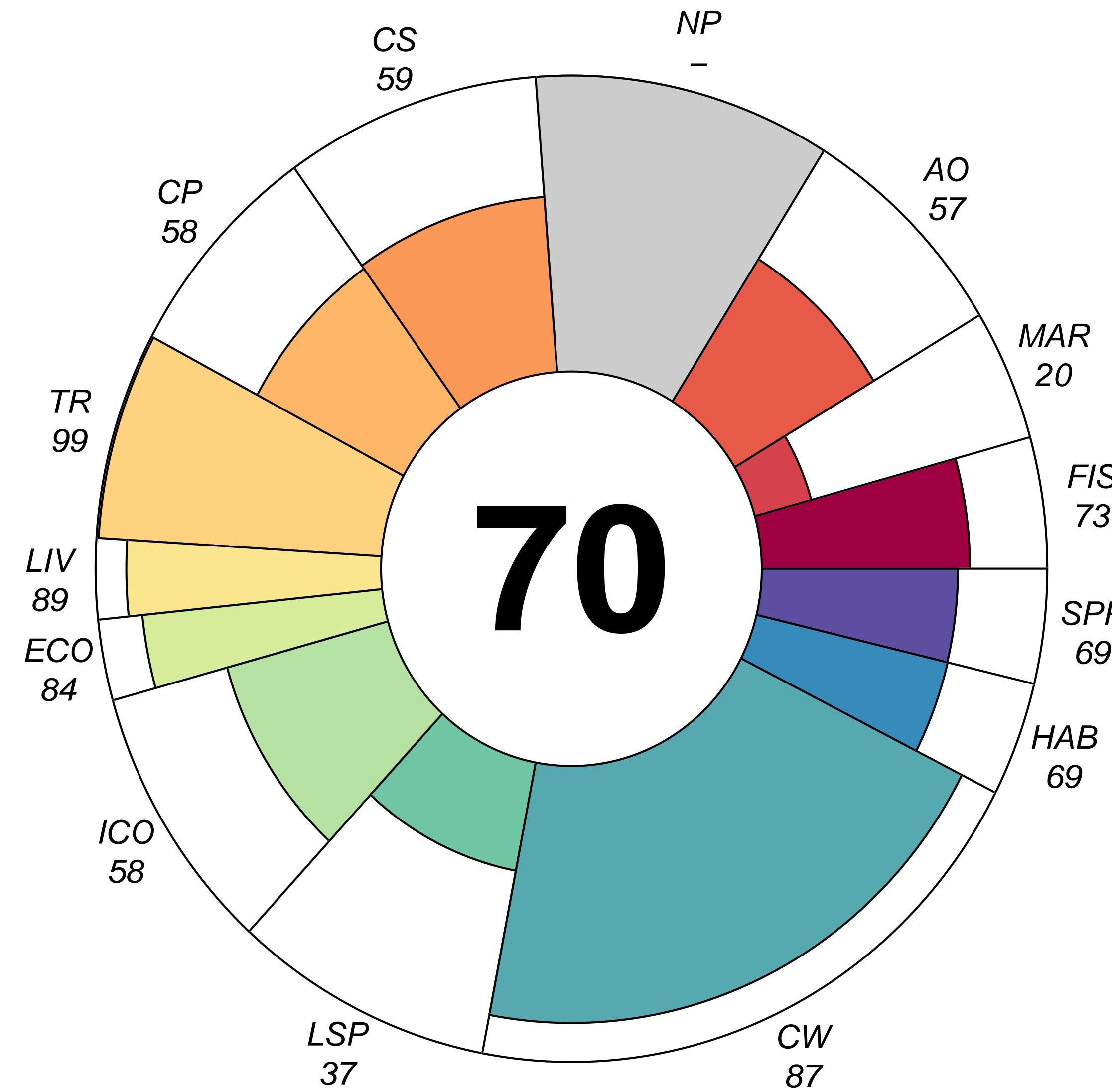
# U.S West Coast assessment

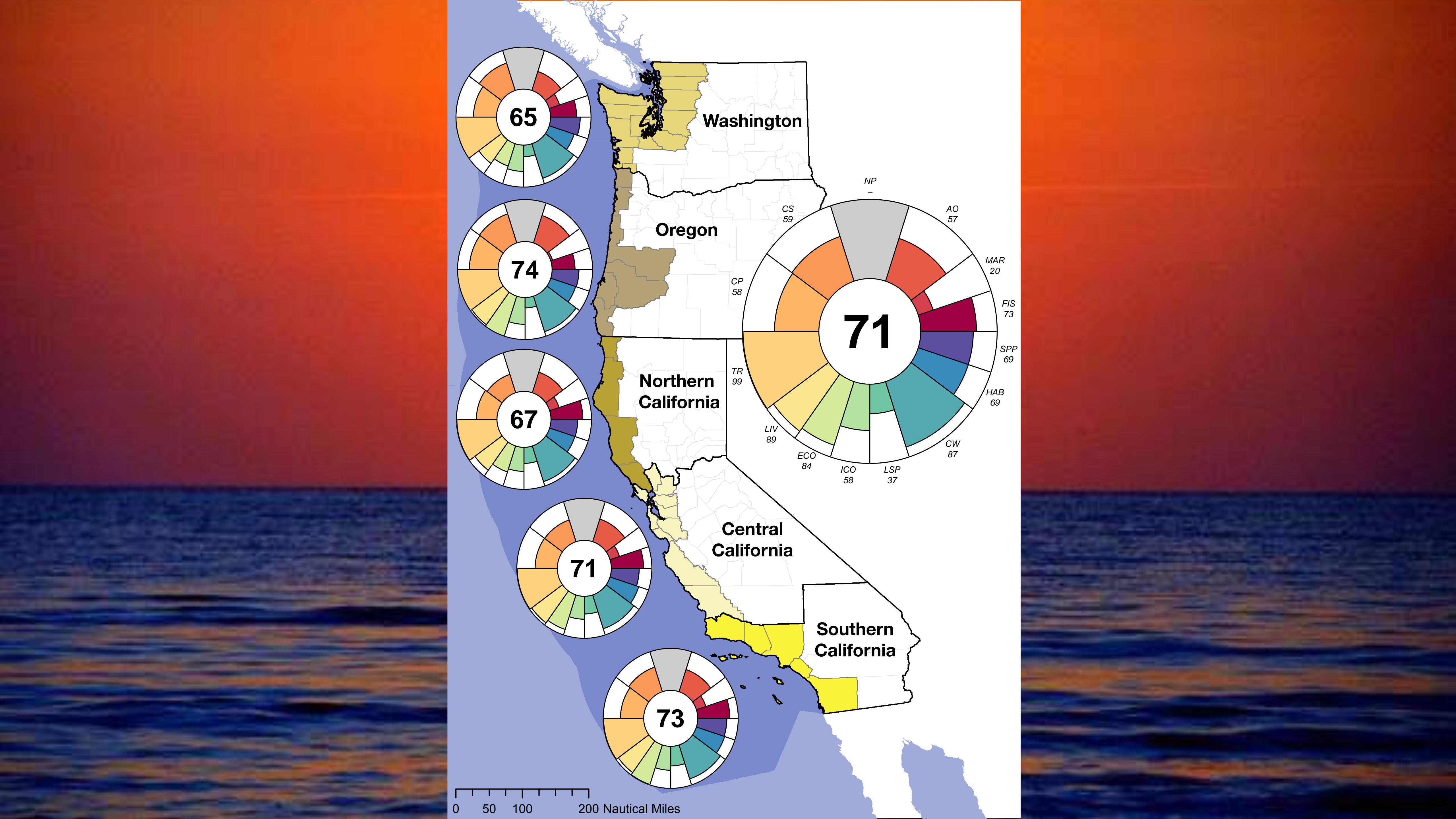
Reference points based on **U.S. west coast priorities:**

- a) mariculture: regional projections of economic and food security targets
- b) habitats: reconstruction of historic extents
- c) lasting special places: included 3-200nm

# U.S.A West Coast Assessment

U.S.A West Coast 2014





# U.S.A West Coast Assessment

## Goal Weights

Food Provision	0.086
Artisanal Opportunity	0.075
Natural Products	0.102
Carbon Storage	0.087
Coastal Protection	0.073
Coastal Livelihoods & Economies	0.053
Tourism & Recreation	0.068
Sense of Place	0.177
Clean Waters	0.205
Biodiversity	0.075

# Analysis of management scenarios

Types and relative magnitudes of change

Responds to common management interventions

Consequences of management actions

# Example

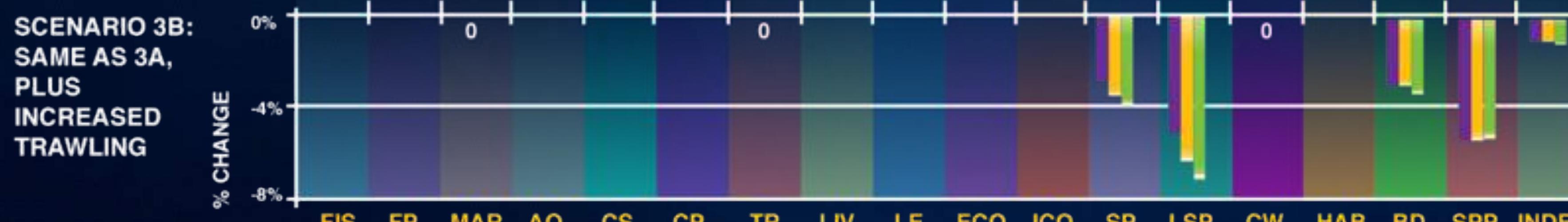
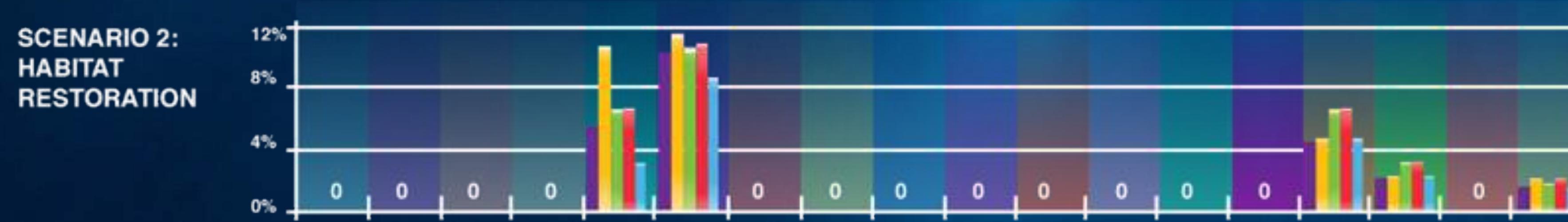
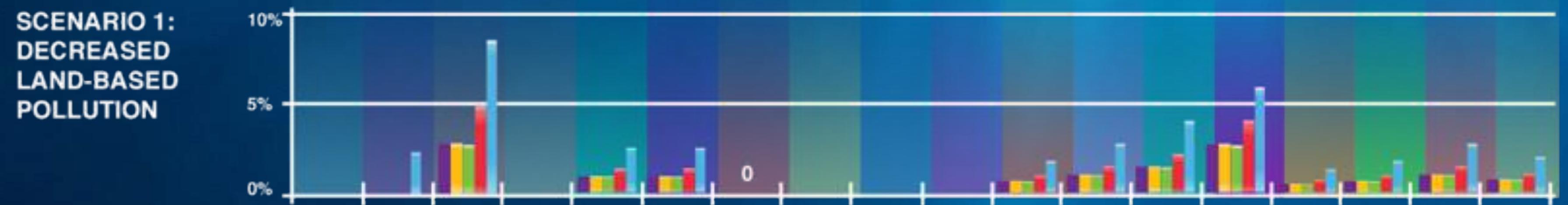
HOW WOULD SCORES CHANGE IF:

land-based pollution is decreased?

marine protected areas are removed?

trawling is increased?

# Management Scenarios



GOALS/SUBGOALS

Northern California  
Central California  
Southern California  
Oregon  
Washington



advanced search

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PEER-REVIEWED

RESEARCH ARTICLE

# Assessing the Health of the U.S. West Coast with a Regional-Scale Application of the Ocean Health Index

Benjamin S. Halpern , Catherine Longo , Courtney Scarborough , Darren Hardy , Benjamin D. Best, Scott C. Doney, Steven K. Katona, Karen L. McLeod, Andrew A. Rosenberg, Jameal F. Samhouri

Published: June 18, 2014 • DOI: 10.1371/journal.pone.0098995

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Subject Areas

Oceans	?
Marine fish	?
Ecosystems	?
California	?
Fisheries	?

## Abstract

Introduction

Methods

Results

Discussion

Supporting Information

Acknowledgments

Author Contributions

References

## Abstract

Management of marine ecosystems increasingly demands comprehensive and quantitative assessments of ocean health, but lacks a tool to do so. We applied the recently developed Ocean Health Index to assess ocean health in the relatively data-rich US west coast region. The overall region scored 71 out of 100, with sub-regions scoring from 65 (Washington) to 74 (Oregon). Highest scoring goals included tourism and recreation (99) and clean waters (87), while the lowest scoring goals were sense of place (48) and artisanal fishing opportunities (57). Surprisingly, even in this well-studied area data limitations precluded robust assessments of past trends in overall ocean health. Nonetheless, retrospective calculation of current status showed that many goals have declined, by up to 20%. In contrast, near-term



# OHI Application in China Seas

- Launched in June, 2012
- Strong supports from SOA, using OHI to improve China Seas monitoring system

## Main partners

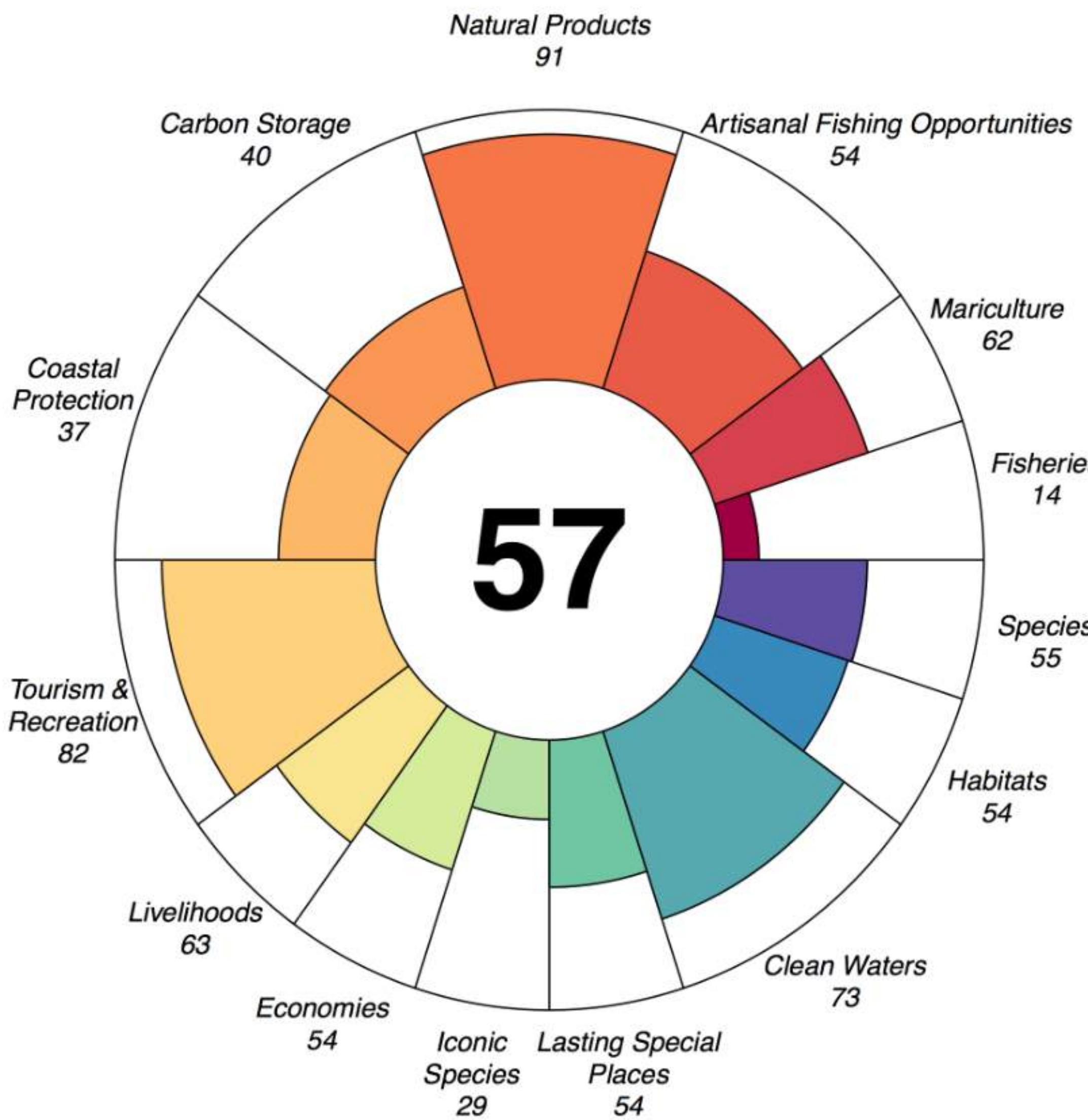
- SOA
- Marine Environmental Monitoring Center of China
- South China Sea (SCS) Branch, SOA
- East China Sea (ECS) Branch, SOA
- North China Sea (NCS) Branch, SOA
- The First Institute of Oceanography, SOA
- The Third Institute of Oceanography, SOA



# Timeline of Activities and Achievements 2013-2015

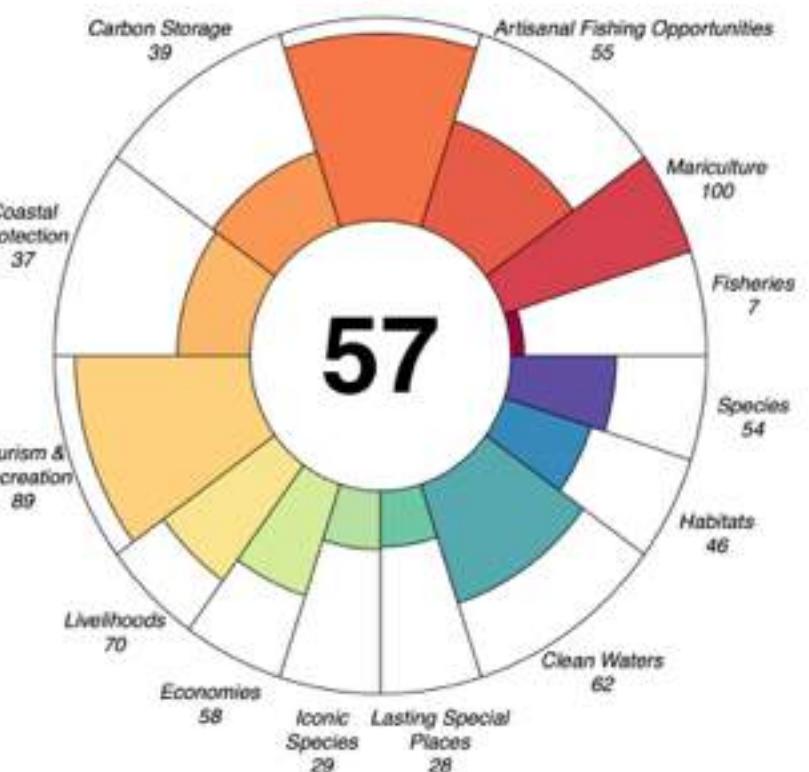
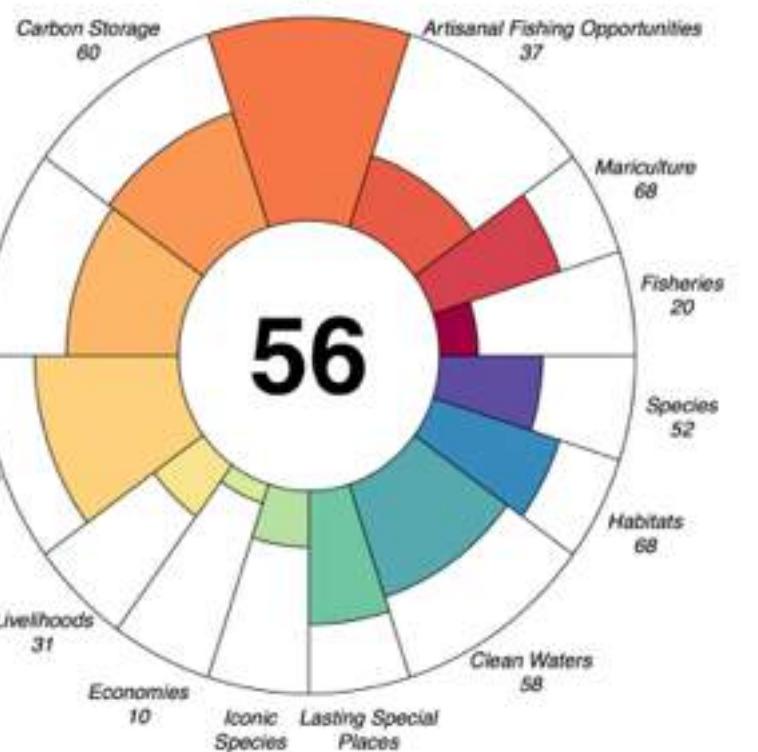
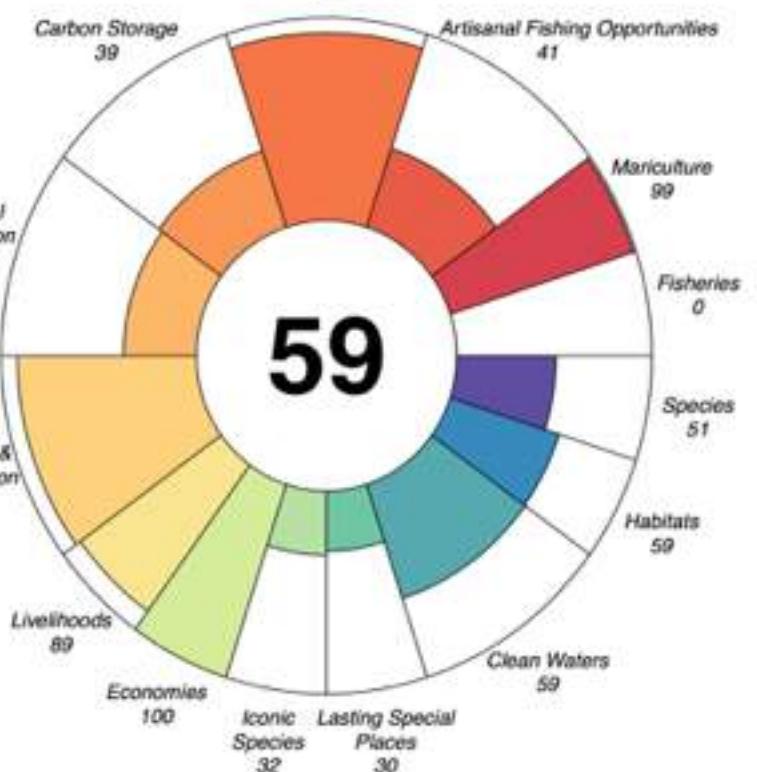
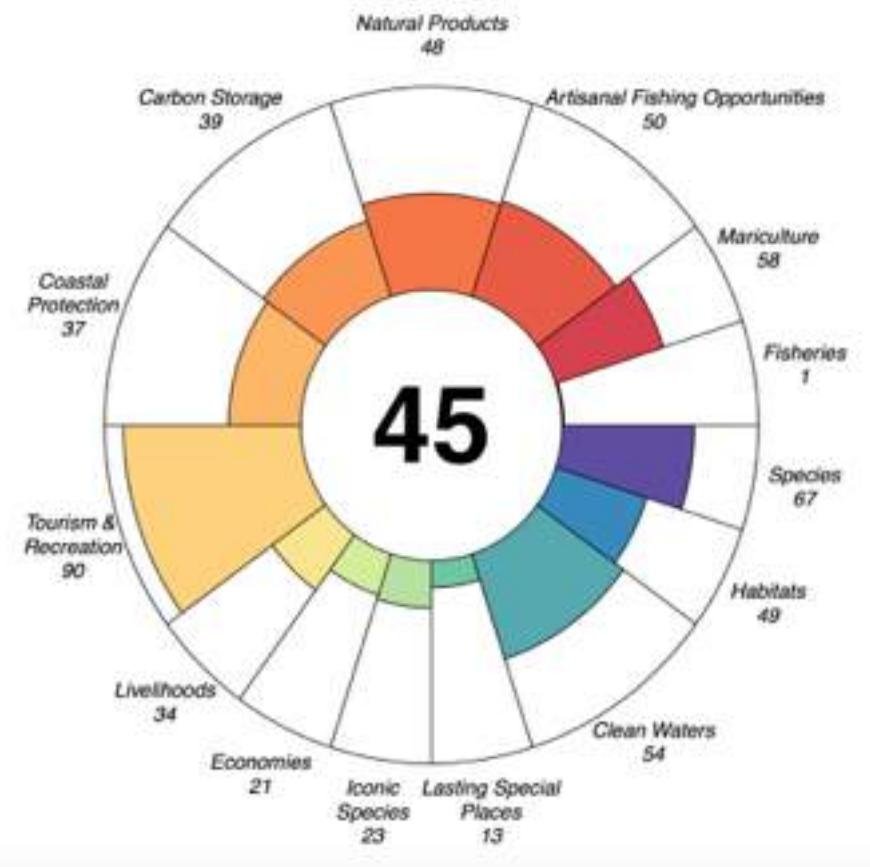
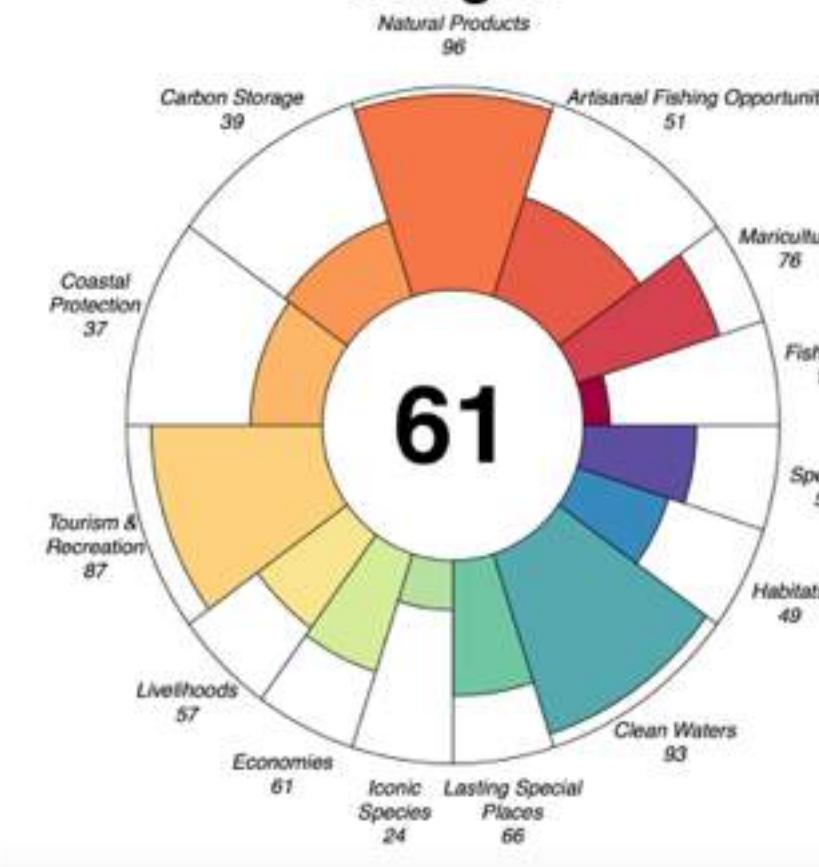
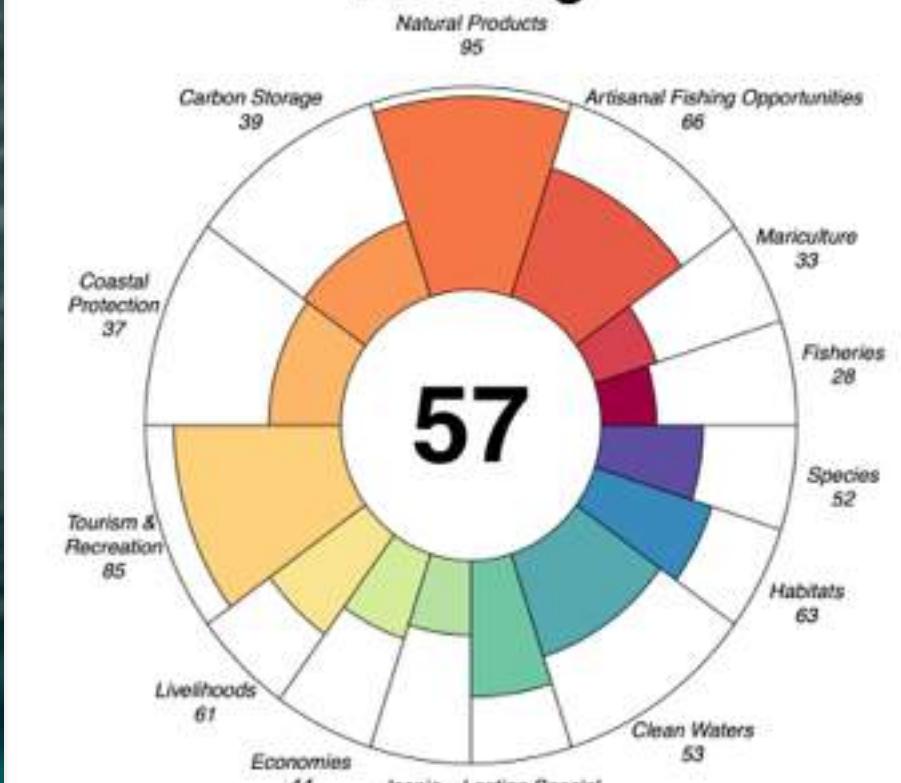
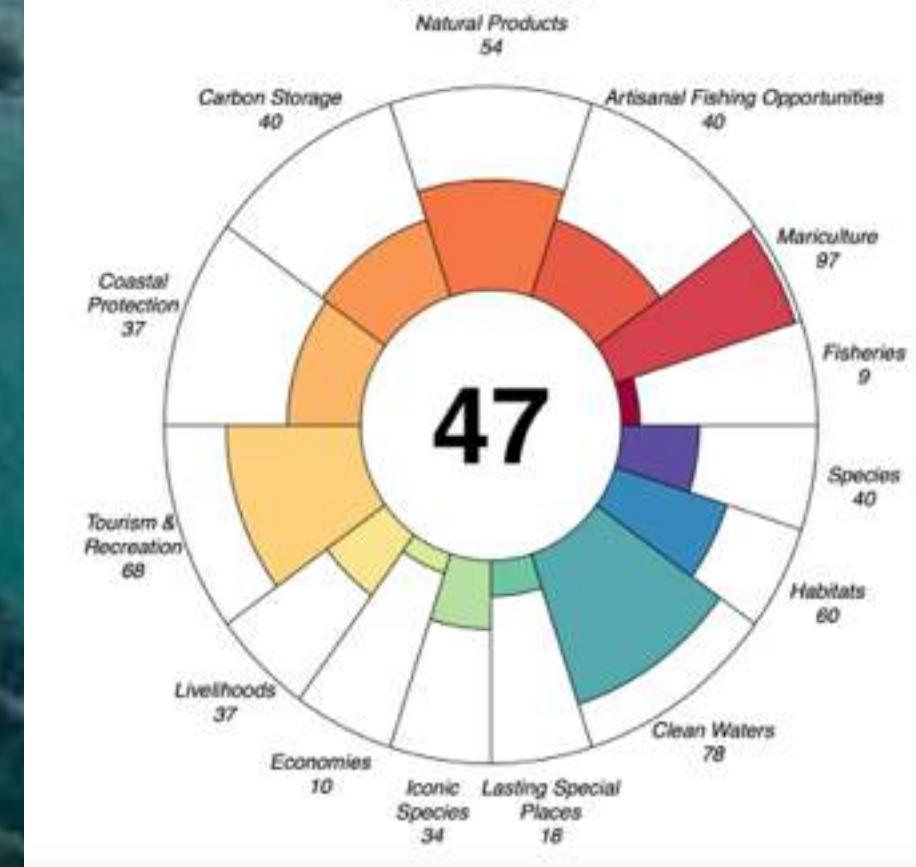
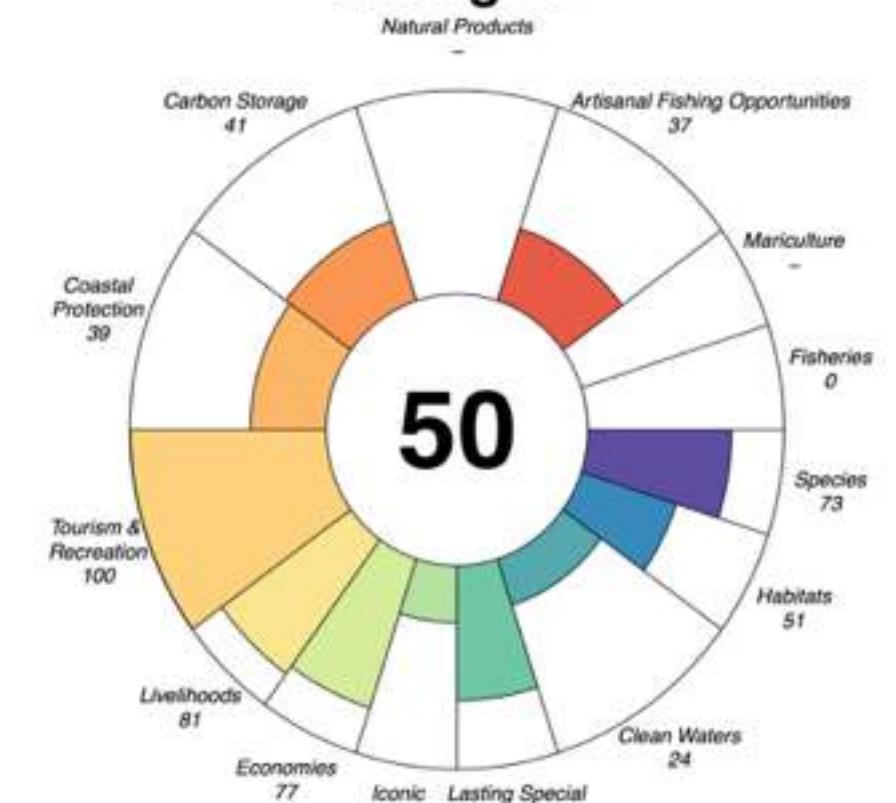
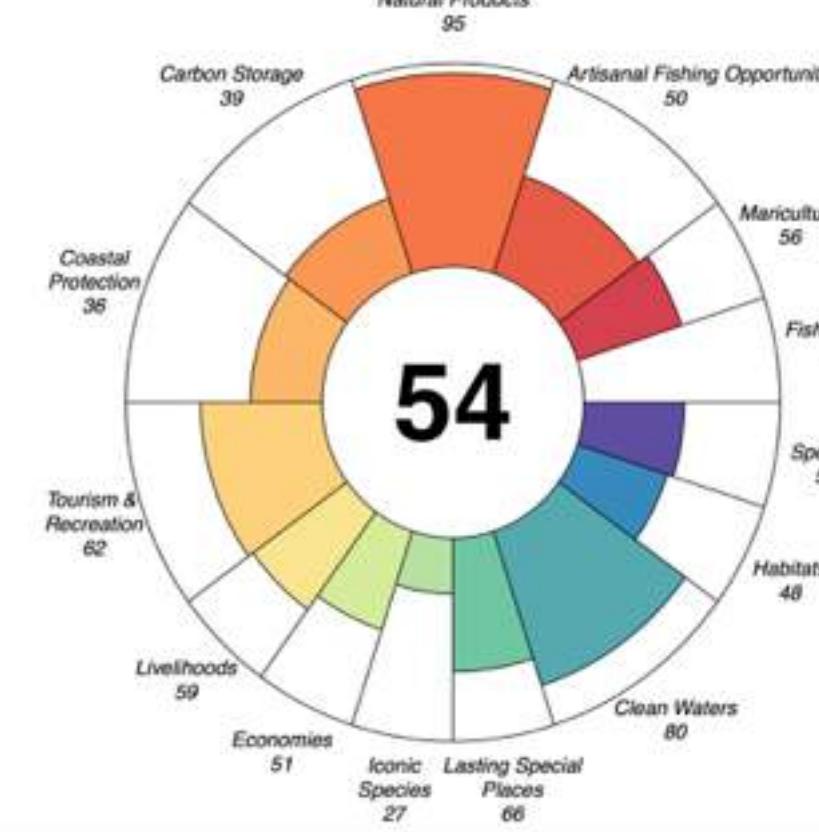
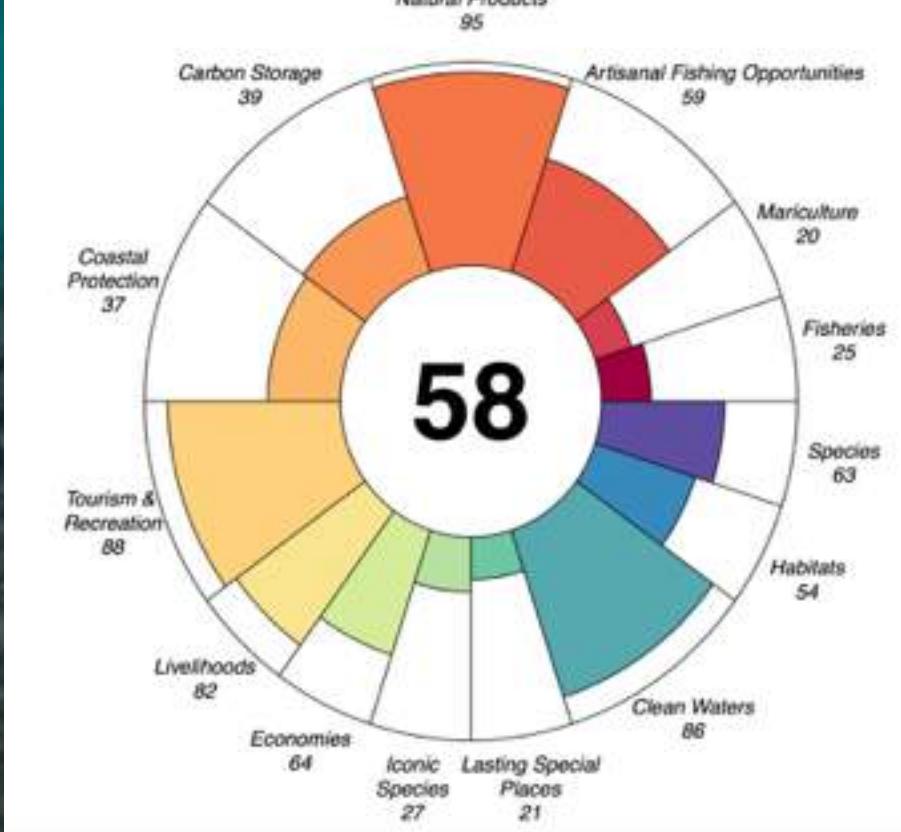
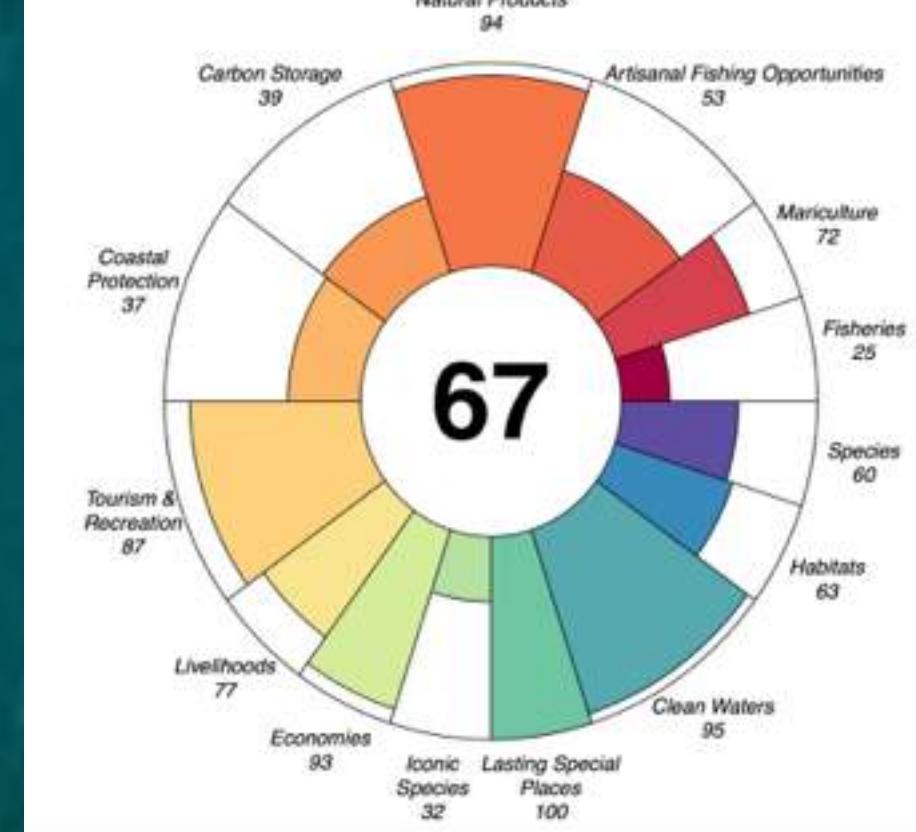
- 2013-2014: two trainings for SOA staff at University of California, Santa Barbara
- 2014-2015: nine working group meetings in China , CI-China & SOA
- April 2015: China model developed and National data collected
- August 2015: China regional scores calculated
- Oct-Dec 2015: two workshops – launch OHI China results, and discuss how to improve the regional study

# China



## 海洋健康指数 中国适用性研究报告 (初稿)

Preliminary Assessment Report: Ocean Health Index for China

**Fujian**Natural Products  
92**Guangxi**Natural Products  
100**Guangdong**Natural Products  
93**Hebei**Natural Products  
48**Jiangsu**Natural Products  
96**Liaoning**Natural Products  
95**Hainan**Natural Products  
54**Shanghai**Natural Products  
-**Tianjin**Natural Products  
95**Zhejiang**Natural Products  
95**Shandong**Natural Products  
94



Select Language

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APP REGIONS LAYERS GOALS SCORES



Branch/Scenario: published/province2015

Data

Compare

## 1. Choose variable type:

Output Score

## 2. Choose target (Index or goal):

0 Index

## 3. Choose dimension:

score

0 Index: The overall Index represents the weighted average of all goal scores.

score: This dimension is an average of the current status and likely future.

Index : score

count, not NA: 12  
min: 40.48  
mean: 51.72  
max: 63.91

Map Histogram Table



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# Golfo de Guayaquil 2015



Select Language  
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APP REGIONS LAYERS GOALS SCORES

Branch/Scenario: published/region2015

Data

Compare

## 1. Choose variable type:

Output Score

## 2. Choose target (index or goal):

0 Index

## 3. Choose dimension:

score

**0 Index:** The overall Index represents the weighted average of all goal scores.

**score:** This dimension is an average of the current status and likely future.

Index : score

count, not NA: 4  
min: 58.62  
mean: 63.14  
max: 66.7

Map Histogram Table



# Gulf of Guayaquil 2015

85.4% data layers from local sources

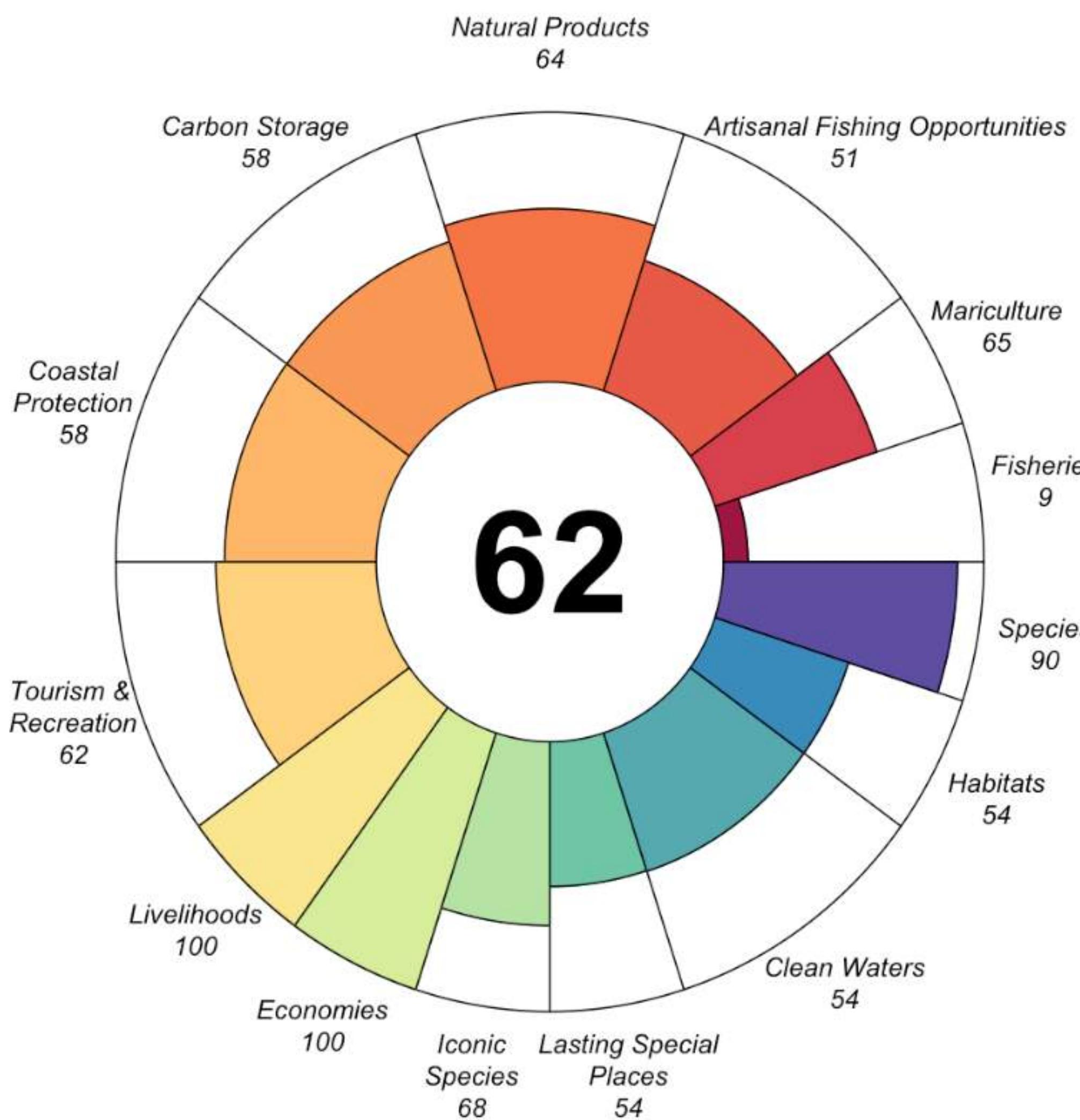
96 indicators total: 52 status, 25 pressures,  
19 resilience

Modified 5 reference points w/ priorities

Context specific models for 4 goals

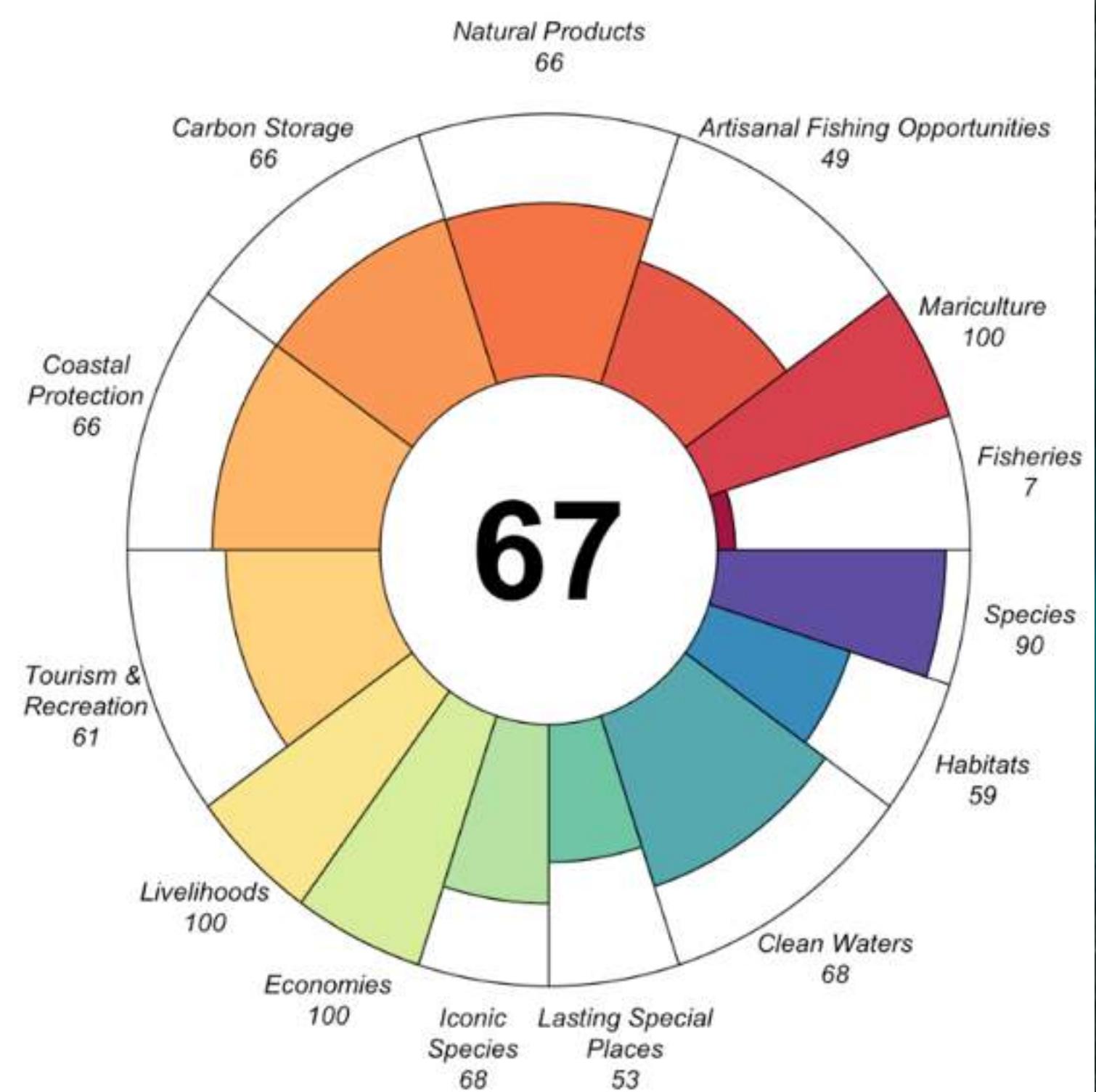
# Gulf of Guayaquil 2015

## Golfo de Guayaquil

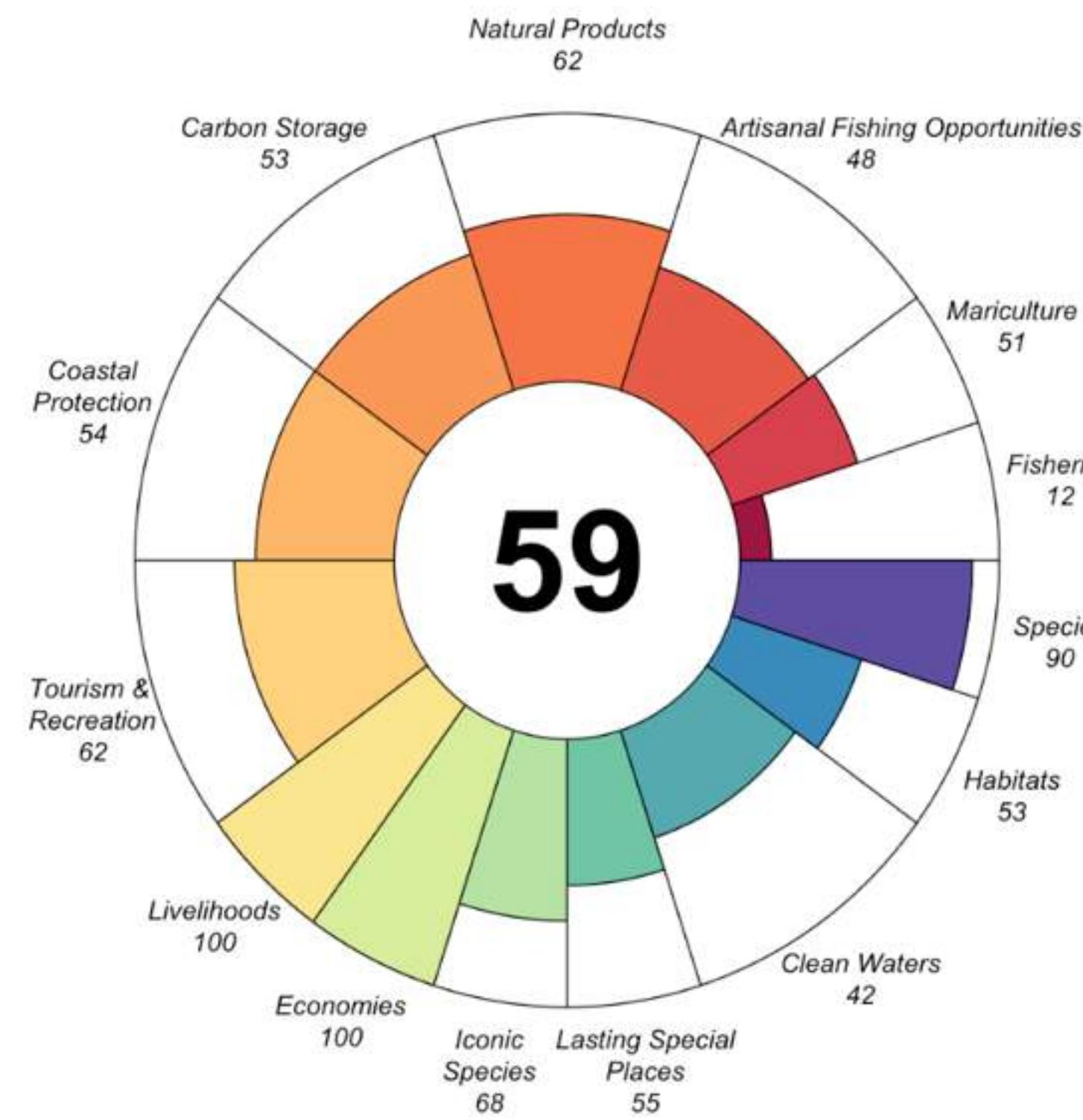


# Gulf of Guayaquil 2015

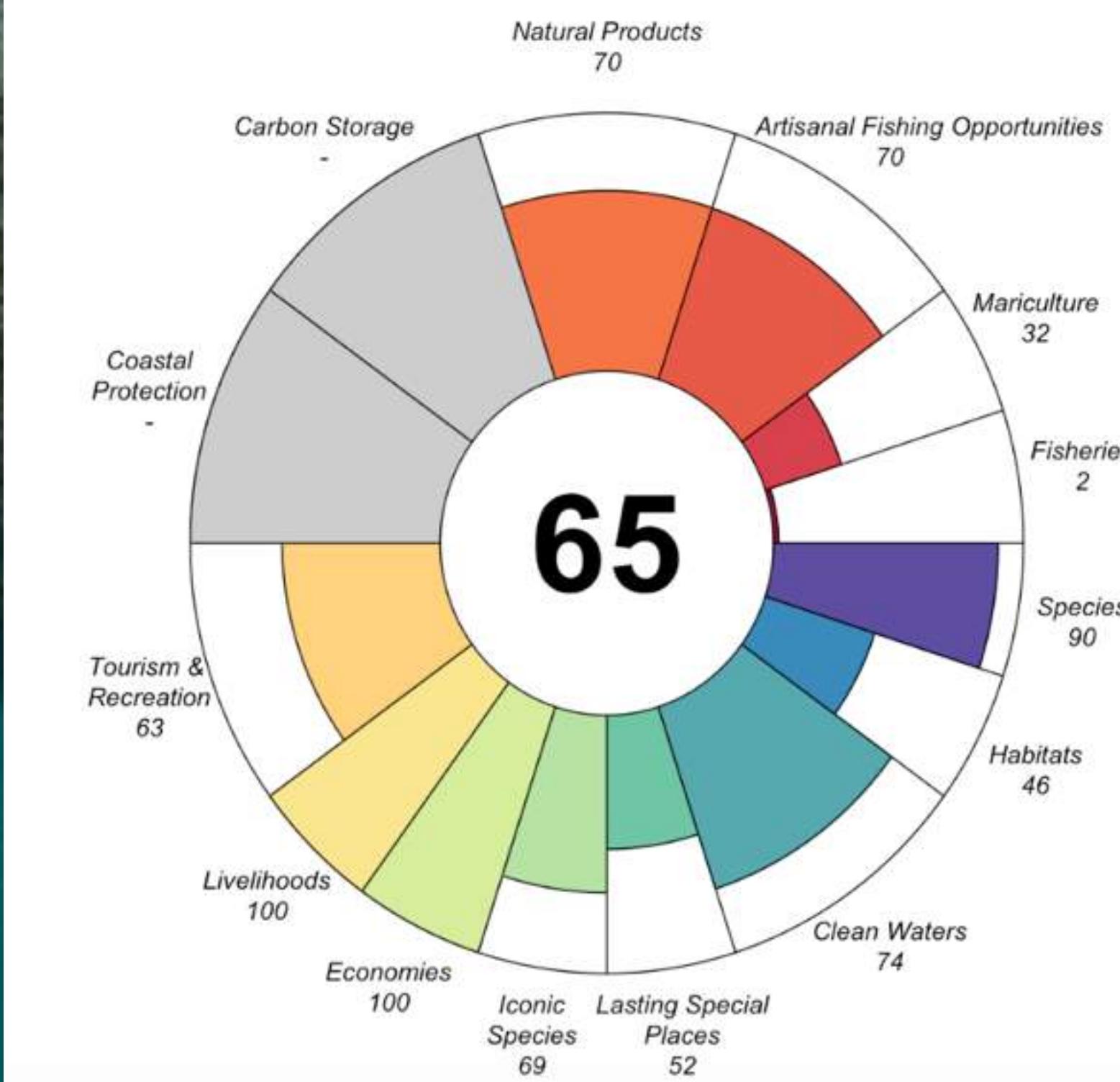
El Oro



Guayas



Santa Elena



# Gulf of Guayaquil 2015

**Team of 12:** 8 analysts, 1 coordinator, 1 R programmer, 1 GIS specialist, 1 statistician

1 year planning/engagement + 9 months of technical work

Leadership of the SETEMAR \$2mill/2yr



# What else?

## Sub-regional case studies

1. Xiamen case study (independent assessment by Xiamen university)
2. Wenzhou case study:
  - in data collection process
  - Led by East China Sea
  - will contribute to Wenzhou 13th five-year plan

# Adaptive Management Tool

Establish **targets** and evaluate the effectiveness of interventions

Assess management **tradeoffs** and identify a win-win balance

**Efficient use** of funds

# OHI+ Benefits

Identify local data & knowledge gaps

Assess positive feedbacks of management actions

Identify management priorities: Geographic and thematic

# Other Potential Applications

Governance support

Strategic environmental assessments

Resource allocation

Tracking performance

Risk mitigation and Return on Investment

Support Blue Economy

# Stakeholder Forum

include local **values & perspectives**

discuss **place & responsibility**

collaboratively establish **management  
targets**

# OHI+ Toolbox

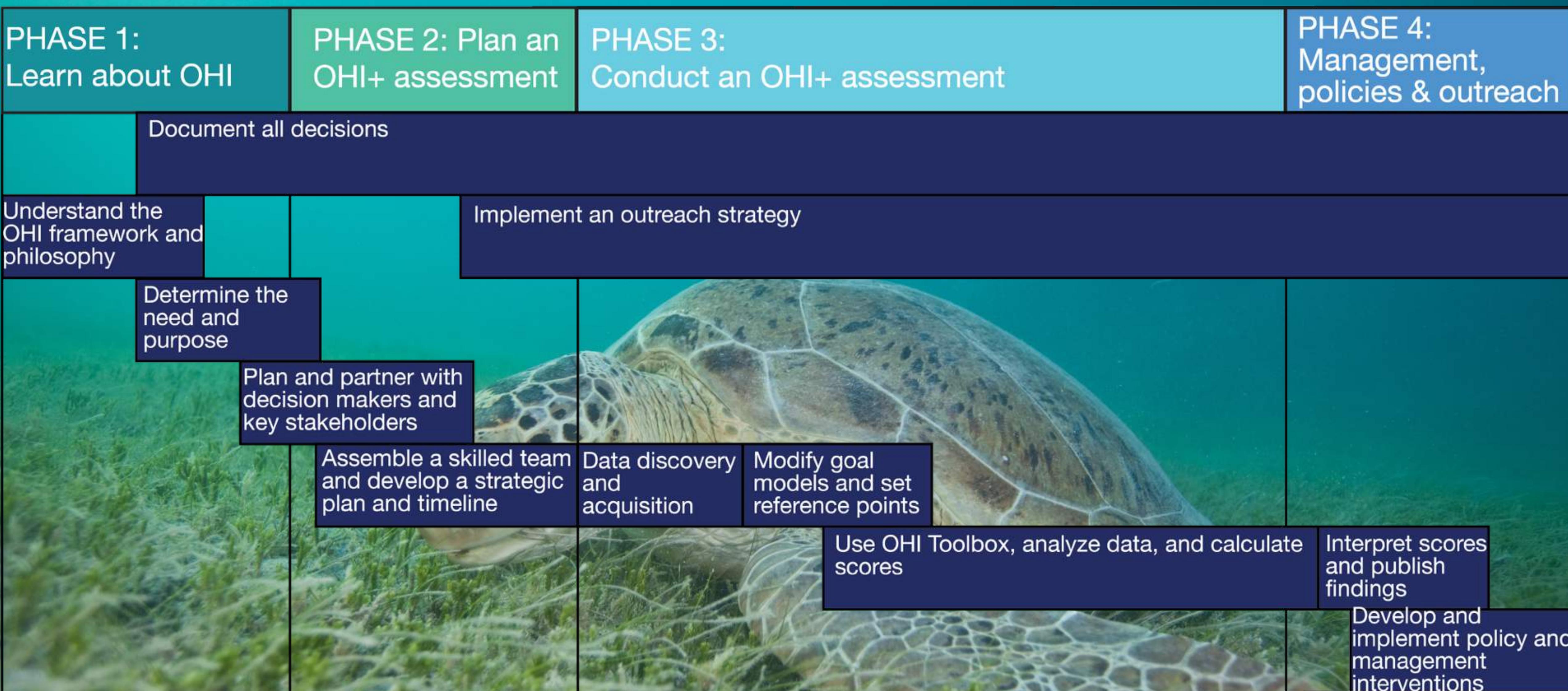
OHI+ Toolbox: Software and virtual data  
repositories

Technical guides and manuals

Virtual Capacity Building Portal (Dec 2015)

[ohi-science.org](http://ohi-science.org)

# Planning an OHI+ Assessment



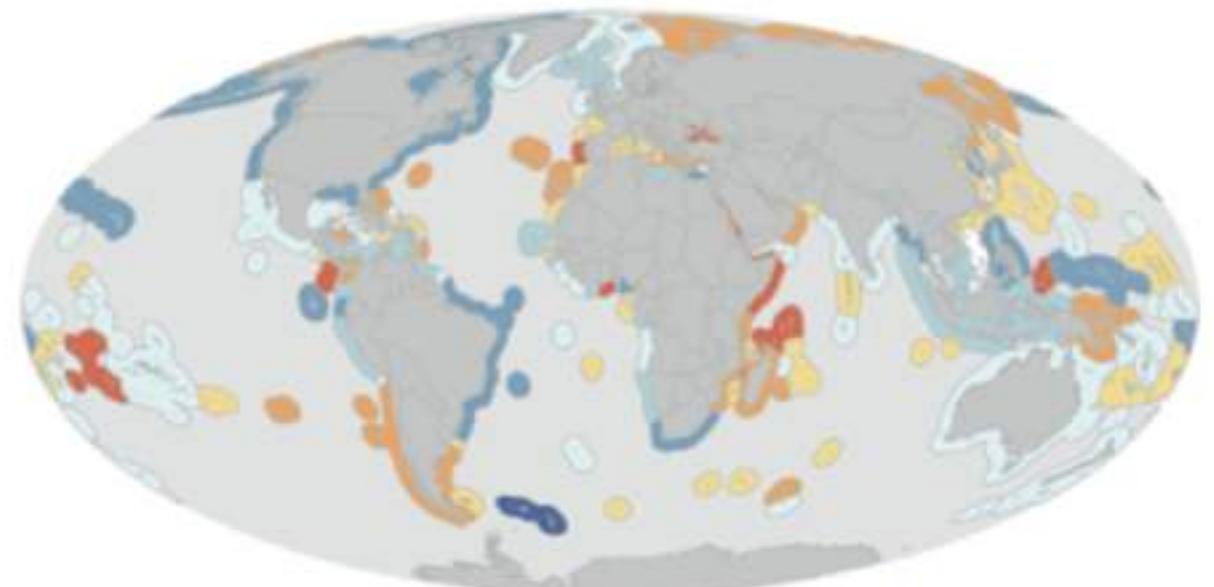
# Where We Work



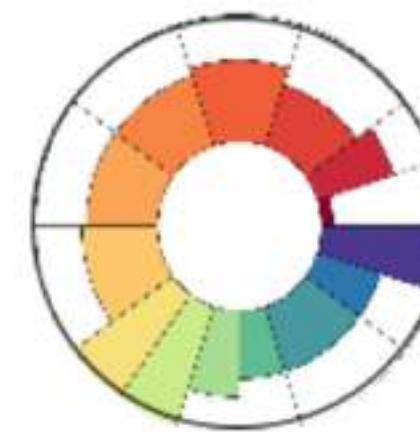
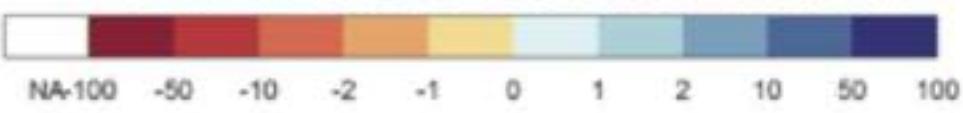
# An index to assess the health and benefits of the global ocean

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

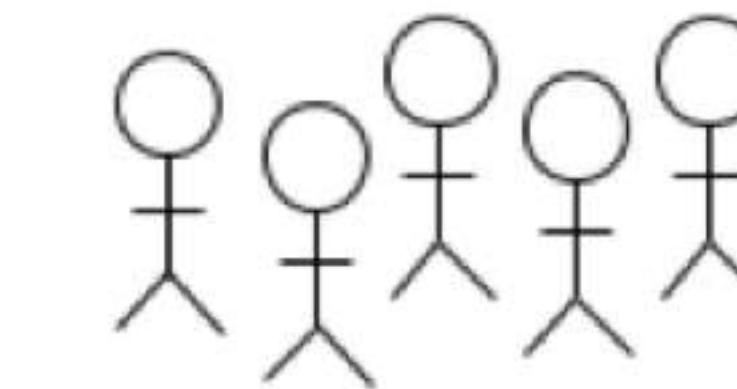
Nature, 2012



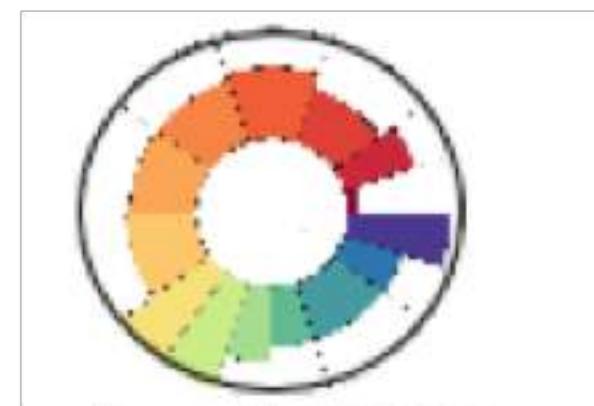
The Ocean Health Index



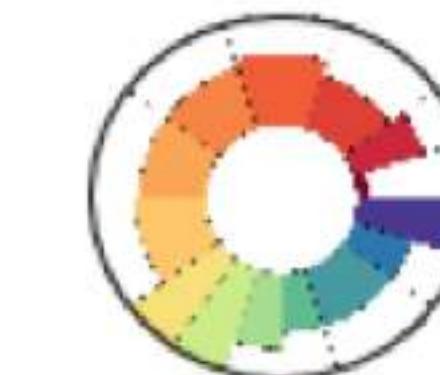
global 2012\*, 2013\*, 2014, 2015



OHI team:  
NCEAS & CI



Brazil 2013\*



US West Coast 2013\*



Fiji 2013\*

independent  
assessments (OHI+)



Canada 2013



Ecuador's Gulf of  
Guayaquil 2015



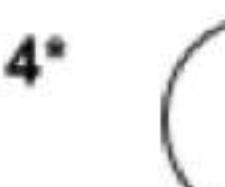
Peru



Spain



Israel 2014\*



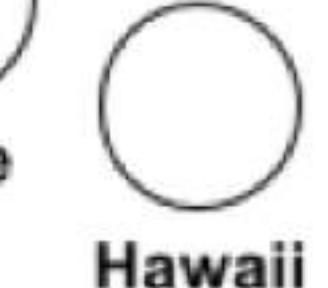
British  
Columbia



Arctic



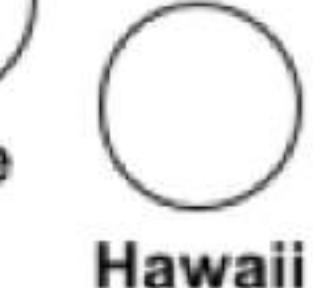
China 2014



Chile



Colombia



Hawaii

Toolbox and resources to enable  
independent assessments (OHI+)

open-source  
software

visualization tools

training program

\*published

# Conclusion



**10 Goals**  
**Two Scales**

**Global:**

- Global data
- National scores
- Comparisons between countries

**OHI+:**

- National & local data/indicators
  - Scores by political boundaries
  - Comparisons between regions
- +
- Integrate indicators
  - Country specific goal models
- +
- Improve decision-making
  - Effective use of public funds
  - Local impact & adaptive

# A Framework

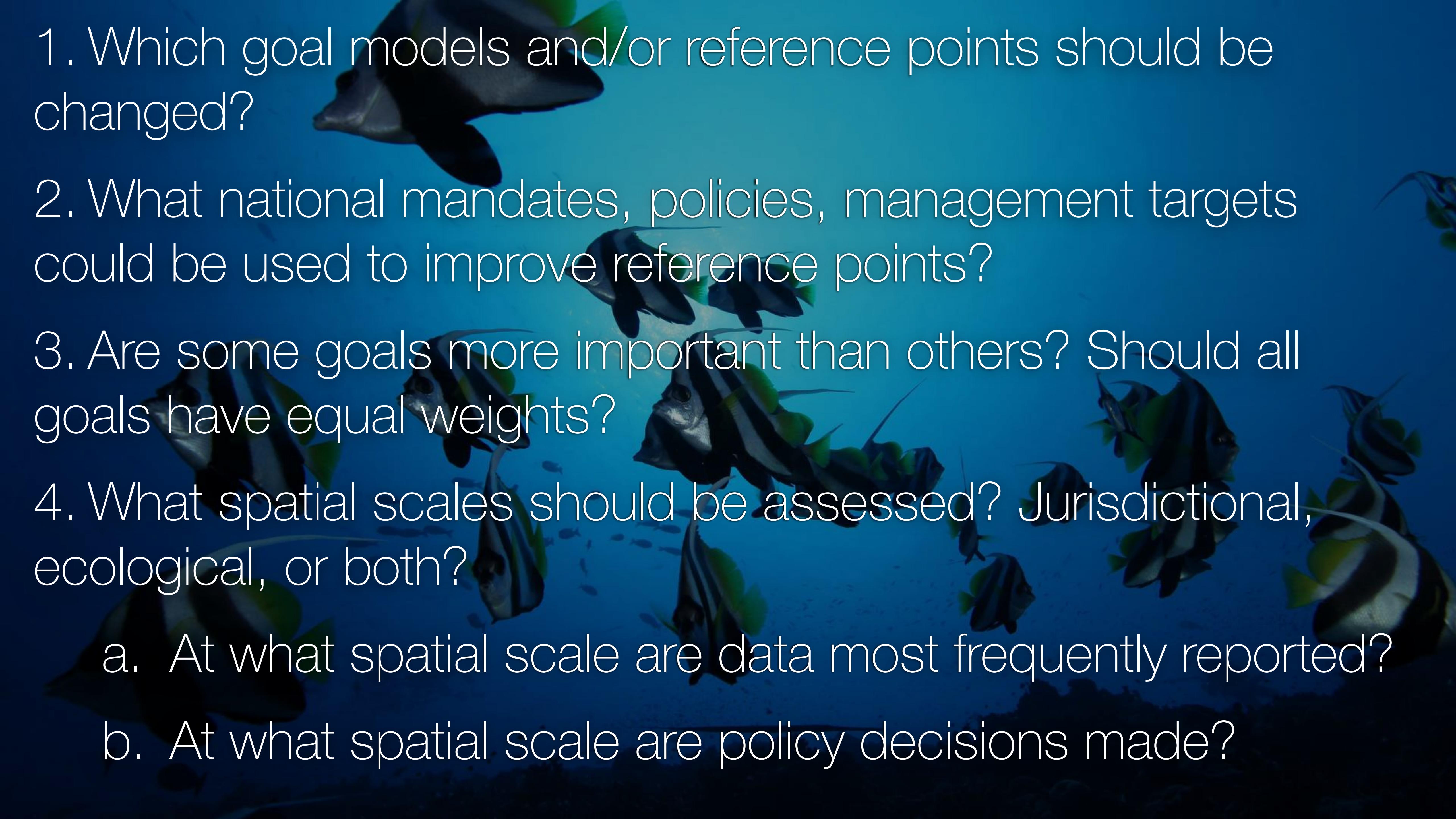
- For science- & data-based discussions on policy and management priorities;
- To objectively balance competing uses and weigh tradeoffs; and
- To sustainably maximize the ecological and economic productivity of the ocean.

A composite image. The top half shows a man with a beard and dark skin, wearing white shorts, sitting in a long, narrow, traditional wooden boat. He is holding a long wooden oar. The boat is on a wide river with a rocky bank and lush green hills in the background under a cloudy sky. The bottom half is a close-up view of a coral reef, showing various types of coral in shades of brown, green, and yellow. The water is clear, allowing a good view of the marine life.

thank You!  
Questions?

# GROUP ACTIVITY:

- Get back with your groups
- Discuss and answer the following questions (30 minutes)
- Each group presents back (15 minutes)

- 
- A dark blue background image showing a large school of fish, likely tangs or surgeonfish, swimming in the ocean. They are silhouetted against a lighter blue background.
1. Which goal models and/or reference points should be changed?
  2. What national mandates, policies, management targets could be used to improve reference points?
  3. Are some goals more important than others? Should all goals have equal weights?
  4. What spatial scales should be assessed? Jurisdictional, ecological, or both?
    - a. At what spatial scale are data most frequently reported?
    - b. At what spatial scale are policy decisions made?