Communication is a two-way process: bringing science to the people and people to the science

Alida Bundy, Fisheries and Oceans Canada
Co-Chair IndiSeas, Chair IMBER Human Dimensions WG

PICES FUTURE program

- ...communicate how North Pacific marine environments may change due to natural and anthropogenic stressors and how societies will be affected by these changes.
  - Products
  - Communicating Uncertainty
  - Decision Support Tools
  - Human Dimensions

Outline

- IndiSeas – Indicators for the Seas

  www.indiseas.org

- IMBER Human Dimensions Working Group
  - www.imber.info

- Links to the PICES FUTURE program

IndiSeas – Indicators for the Seas

- **OVERALL GOAL**: to conduct comparative analyses of ecosystem indicators from the world's marine ecosystems to quantify the impact of fishing and to provide decision support for fisheries management in a context of climate variability and change
- Established in 2005 as an international collaborative program
  - co-funded by the NoE EUROCEANS , FP7 MEECE project, IRD, UCT
  - endorsed by IOC/UNESCO
- IndiSeas I (2005-2009) focused on ecological indicators
- IndiSeas II (2010-2014) aims to address issues raised during phase 1 analyses, based on extensive sets of indicators including climate, biodiversity and human dimension indicators.



Co-Leads: Yunne Shin (IRD), Lynne Shannon (UCT), Alida Bundy (DFO)

IndiSeas I Aims

To gather and share indicator expertise across marine ecosystems and member institutions to:

1. develop a set of synthetic ecological indicators,
2. build a generic dashboard using a common set of interpretation and visualisation methods, and
3. evaluate the exploitation status of marine ecosystems in a comparative framework.

Image Source: www.indiSeas.org

IndiSeas I Indicators

Final indicators selected from a list of candidates on the basis of:

1. Ecological significance,
2. Sensitivity,
3. Measurability, and
4. General public awareness

West Coast Vancouver Island

Jennifer Boldt

Caihong Fu

Ian Perry

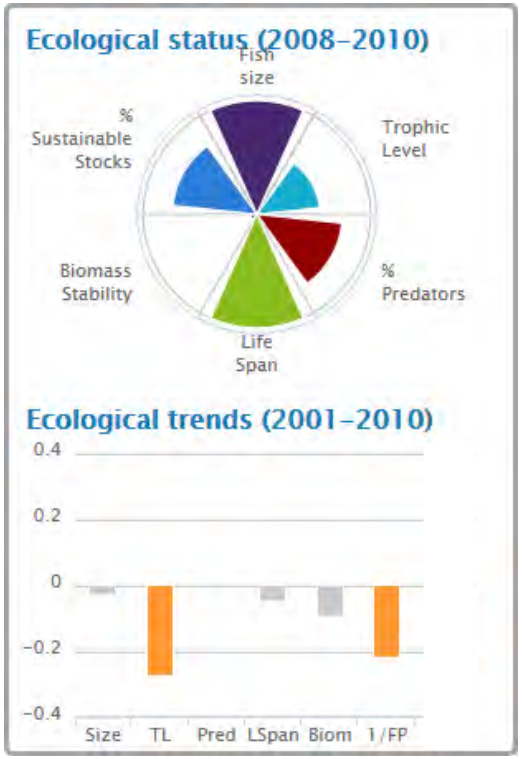


Table 3. Summary of ecological indicators selected by the IndiSeas WG and the corresponding management objectives.

Indicators	Headline label	Used for State or Trend	Management objective[a]
Mean length	Fish size	S, T	EF
TL of landings	TL	S, T	EF
Proportion of under- and moderately exploited stocks	% healthy stocks	S	CB
Proportion of predatory fish	% predators	S, T	CB
Mean lifespan	Lifespan	S, T	SR
1/CV of total biomass	Biomass stability	S	SR
Total biomass of surveyed species	Biomass	T	RP
1/(landings/biomass)	Inverse fishing pressure	T	RP

[a]CB, conservation of biodiversity; SR, maintaining ecosystem stability and resistance to perturbation; EF, maintaining ecosystem structure and functioning; RP, maintaining resource potential.

Image Source: www.indiSeas.org

Table Source: Shin et al. (2010a)

IndiSeas I Main Results

Table 2

Comparison of results from different methods of assessing the status of exploited marine ecosystems using a suite of 8 ecosystem indicators from IndiSeas. Trends were for years 1980–2005, state for 2003–2005. TRENDS: P = significant positive trend, N = significant negative trend (Blanchard *et al.*, 2010); TREE: — = no change; ↓ – deteriorating, ↑ – improving (Bundy *et al.*, 2010); RANKING: 1 = top rank, lowest impact, 4 = bottom rank, highest impact (Coll *et al.*, 2010); DRIVERS: E = environmental dominated, H = human dominated (Link *et al.*, 2010).

Ecosystem[a]	TRENDS Long time trends (80-05)	TREE Decision Trees 80-05	RANKING Multi-variate ranking – Long term only	RANKING Multi-variate ranking State and long term	DRIVERS Multi-variate Analysis of Human and Environmental drivers	Synthesis
North Central Adriatic Sea	1P/3N	↓	3	4	H	similar
Southern Catalan Sea	1N	↓	4	4	E	similar
Baltic Sea	4N	↓	4	4	E	similar
Eastern Scotian shelf	1P/3N	↓	4	3	H	similar
Senegal EEZ	2N	↓	4	3	H & E	similar
Barents Sea	1P	—	2	2	H & E	similar
Bering Sea, Aleutian Islands	2P	↑	1	1	H	similar
North East US	2P	↑	2	1	H	similar
West Coast Canada	2P	↑	1	1	E	similar
Northern Humboldt	2P/2N	↓	3	4	H & E	mixed
Guinea EEZ	3P/1N	↓	1	2	E	mixed
North Sea	2P/2N	↓	2	1	H & E	mixed
Irish Sea	2P/2N	↓	2	2	H & E	mixed
Southern Benguela	2P/1N	↓	2–3*	2	H & E	mixed
Mauritania	2N	↓	2–3*	2	H & E	mixed
Portuguese EEZ	1N	↓	1	2	H	mixed

[a] Three ecosystems (Bay of Biscay, Sahara Coastal–Morocco and Southern Humboldt) were excluded from this synthesis since their time-series were too short to perform long term analyses.

* Median values.

Bundy et al. 2012, COSUST, 4:292–299

IndiSeas I Products

USA (West-Coast)

Despite management actions that recovered many harvested species, survey biomass declined 2003-2010, coincident with 4-5 years of a warm, unproductive phase of the Pacific Decadal Oscillation and attenuation of a strong 1999 groundfish cohort . Since 2000, increasing catches of Pacific hake, Pacific sardine, market squid and Dungeness crab dominated landings (of these, only hake contribute substantially to survey biomass). Increased pelagic catches and decreased surveyed groundfish biomass led to a decline in inverse fishing pressure. Rockfish (*Sebastes* spp.) drive the long average life span. Episodic climate forcing and upwelling keep biomass stability low. Management and governance indicators reflect frequent stock assessments, fishery management plans with long term ecological, social, and environmental objectives, and the recently developed Fishery Ecosystem Plan.

Kristin Marshall, Isaac Kaplan, Jameal Samhouri



1. Publication of 9 papers in a special issue of *ICES J. Mar. Sci. 2*010 to describe process of indicator selection and results.
2. Publication of synthesis paper (Bundy et al. 2012, COSUST 4:292–299,.)
3. Publication of indicators through website (www.indiseas.org), along with descriptions of fisheries and systems to assist public interpretation and knowledge of systems.

USA (West-Coast) - Time Series


www.indiSeas.org

North America | South America | Europe | Africa | All ecosystems

Indicators for the Seas

Expertise from over 70 scientists, 49 research institutes and 36 countries.

Indiseas is a scientific program which evaluates the effects of fishing on the health status of marine ecosystems.
A panel of indicators is provided, characterizing the ecological status of exploited resources, their environment, and the human dimension of fisheries.

IndiSeas is endorsed by IOC/UNESCO and the European Network of Excellence Eur-Oceans.

IndiSeas I Issues

- Two major challenges highlighted, which form the basis for IndiSeas II:

1. The need to consider multiple drivers including the human dimension and climate forcing that interact with ecological processes in complex ways (e.g. Link et al. 2010; Shannon et al. 2010, Bundy et al. 2012); and

2. The need to determine how indicators can be effectively used for improving management and conservation. (e.g. Shin et al. 2010b)

IndiSeas II

6 task groups created to address issues:

1. Climate and Environmental Indicators
   - Assess the relative importance of fishing and environment for different ecological indicators and across ecosystems;
   - Identify years where the environment was more important than fishing;
2. Biodiversity and Conservation Indicators
   - Select and test new ecological indicators that emphasize biodiversity and conservation-based issues in the diagnosis of ecosystem state and trends in response to fishing.
3. Human Dimensions Indicators
4. Reference Levels for Indicators
   - standardise indicators to compare the status of exploited marine ecosystems
   - propose a control rule framework for EAF.

TG3 Human Dimensions

GOAL 1: Assess the effectiveness and efficiency of management and quality of governance:

- effectiveness of management
- quality of governance

GOAL 2: Assess contribution of fisheries to broader society:

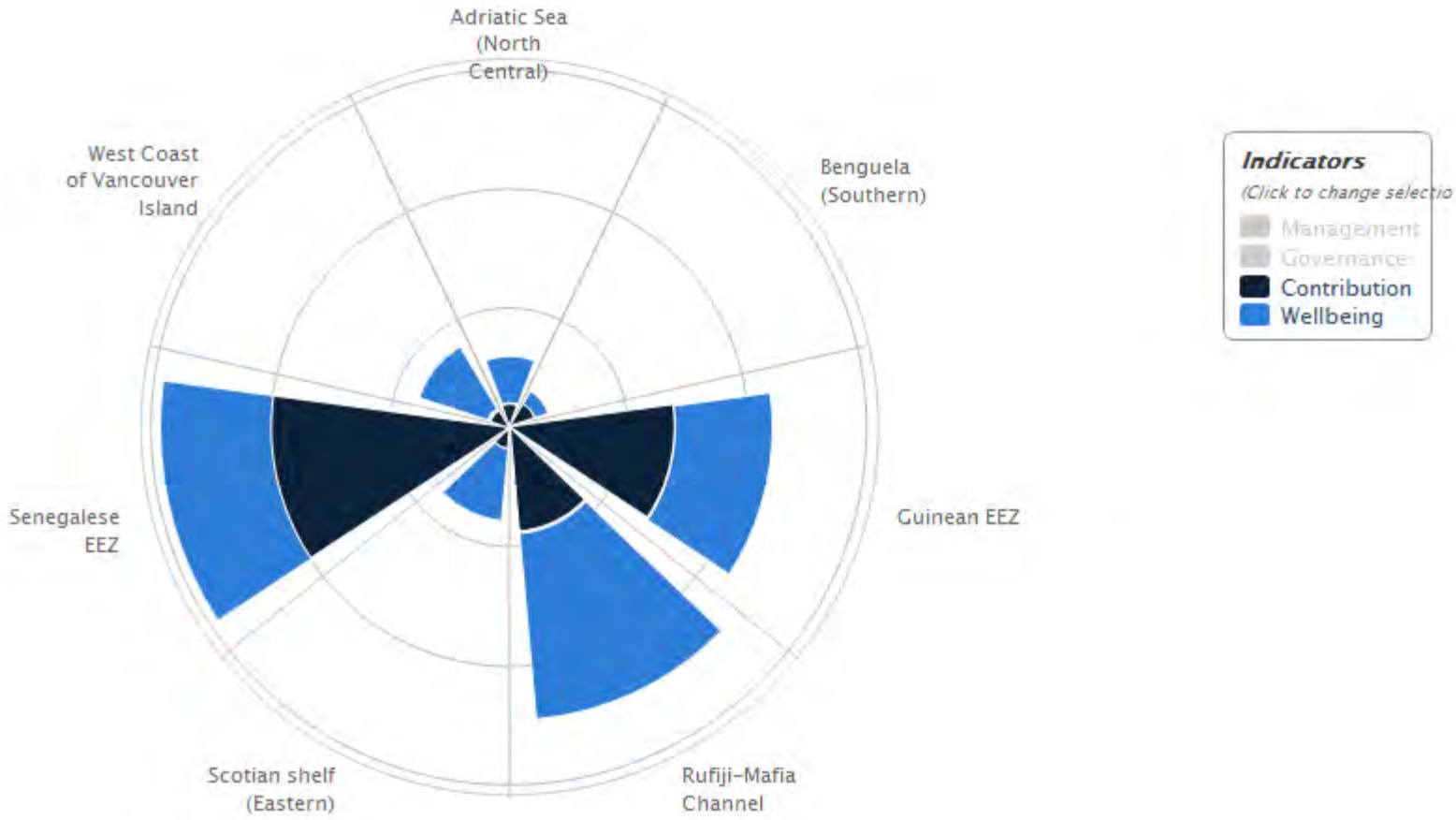
- economic contribution of fisheries
- contribution of fisheries export to availability of hard currency
- contribution of fisheries sector to employment
- importance of fish in the regional diet

GOAL3: Assess wellbeing and resilience of fisher communities.

- fish harvesters' "apparent" social wellbeing
- capacity of fishers' to adapt to change

Comparative tool - Human dimension indicators result

Comparison of ecosystems



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IndiSeas II

5. Performance of Indicators and links to Management

To advance understanding of how ecosystem indicators can be used in management by:

- empirically testing how particular indicators might signal deteriorations and thresholds in ecosystem state through time;
- developing decision rules that account for different environmental conditions; and
- simulation-testing the performance of a range of indicator and decision rules

TG6: Integration

Explore techniques for the integration of multiple and multi-disciplinary indicators to compare and evaluate ecosystem status for an EAF

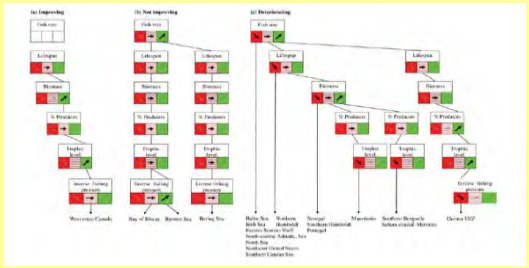
Drivers

(a) Management and governance

(b) Climate change and environmental variability

Assessments

(c) Ecological status of the exploited ecosystem



(d) Wellbeing of fisheries dependent peoples

(e) Integrative global analysis for EAF

Some IndiSeas Conclusions

- *Combining and integrating multi-disciplinary indicators.*
  - Important to include main drivers of ecosystem changes
  - Need to display this information in a way that is objective and easily communicated.
- *Develo*
  - Im … in the … inc…
  - Mo… … the ap…
- *Using*
  - Im…
  - Cu… …pts to plu…
- *Being …*
  - Enables investigations into common global patterns of fishing effects; successful management strategies can be indentified and communicated to other systems.
  - Inclusion of ecosystem experts enables informed interpretation of results and avoids mid-diagnosis
  - Inclusion and integration of multiple ecosystems ensures that contributing ecosystems have access to analyses and comparison to other systems.

Indicators are not as simple as we once thought!

Shin et al. Rev Fish Biol Fisheries, 22:835–845 2012

THURSDAY : S8 - BIO/FIS/MEQ/TCODE/FUTURE Ecosystem indicators to characterize ecosystem responses to multiple stressors in North Pacific marine ecosystems

@ 14:00

Yunne-Jai Shin, Jennifer Houle, Alida Bundy, Marta Coll, Penny Johnson, Chris Lynam, Lynne Shannon and Laure Velez (Invited)

A multi-model evaluation of ecosystem indicators' performance (S8-9119)

@ 14:25

Caihong Fu and Yunne-Jai Shin

Exploring ecological indicators to evaluate fishing and environmental impacts on ecosystem attributes (S8-8999)

IMBER-ADApT: Assessment of responses based on Description, Appraisal and Typology

IMBER Human Dimensions Working Group

Ratana Chuenpagdee
Interdisciplinary – governance
Too Big Too Ignore (TBTI)

Sarah Cooley
Marine Chemistry &
Geochemistry
OBC

Omar Defeo
Conservation of biological diversity

Bernhard Glaeser
German Society for Human Ecology,
Social sciences

Moeniba Issacs (co-Chair)
Social science

Patrice Guillotreau
Economics
CLIOTOP

Mitsutaku Makino
Policy and Economics
PICES S-Human Dimensions

Ian Perry
Fisheries Oceanography
Globec Focus 4 WG
PICES S-Human Dimensions

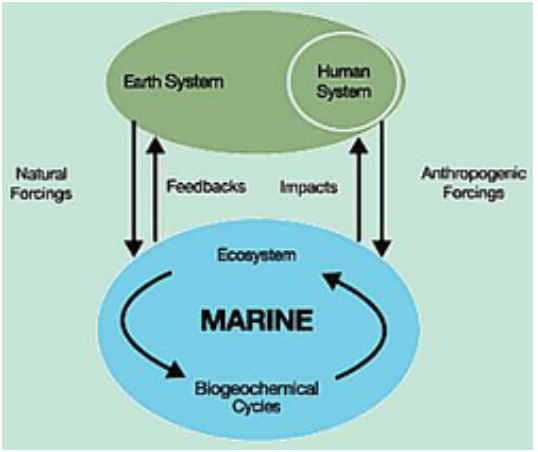
Integrated Marine Biogeochemistry and Ecosystem Research

IMBER

OVERALL GOAL: To provide a comprehensive understanding of, and accurate predictive capacity for, **ocean responses to accelerating global change** and the **consequent effects on the Earth System and human society.**

4 RESEARCH THEMES

- **Interactions between biogeochemical cycles and marine food webs**
- **Sensitivity to global change**
- **Feedbacks to the Earth System**
- **Responses of society**
  - Promote an understanding of the multiple feedbacks between human and ocean systems,
  - Clarify what human institutions can do, either to mitigate anthropogenic perturbations of the ocean system, or to adapt to such changes



Why we need IMBER-ADApT

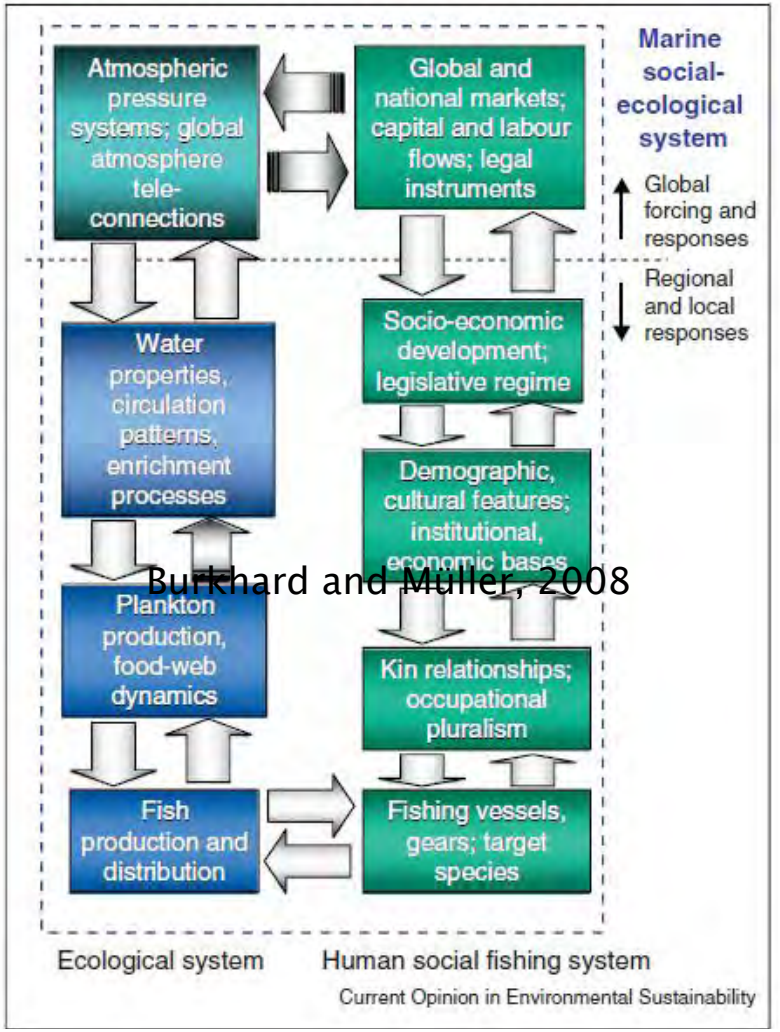
- Global change is happening now, locally, regionally, globally
- Adaptation :“making anticipatory adjustments to prepare for expected climate variability and changing average climate conditions, in order to moderate harm and exploit beneficial opportunities” (IPCC, 2007a).
- Identifying the most appropriate response for a given system remains a challenge.
- Climate change is just one of several local challenges facing marine ecosystems and resource dependent communities
- Lack of coherent framework to identify what coping strategies have worked elsewhere and what adaptive/coping/preventative options are possible

IMBER-ADApT

- ....is a decision support tool that builds on knowledge learned from past experience of responses to global change, to enable decision makers, researchers, managers and local stakeholders to:
  - triage and improve their responses;
  - make decisions efficiently to transition towards marine sustainability
  - evaluate where to most effectively allocate resources to reduce vulnerability and enhance resilience of coastal peoples to global change.
- .... relies on the use of contextualised, place-based case studies derived from interdisciplinary teams
- .....is global in reach, but does not gloss over heterogeneities in ecological, social or cultural context, governance or geography

Theoretical Background

- Systems thinking approach, eg, linked social-ecological systems, human-environment systems, "humans-in-nature", etc....
- DPSIR (Driver-Pressure-State-Impact-Response)
- Interactive Governance



Burkhard and Müller, 2008

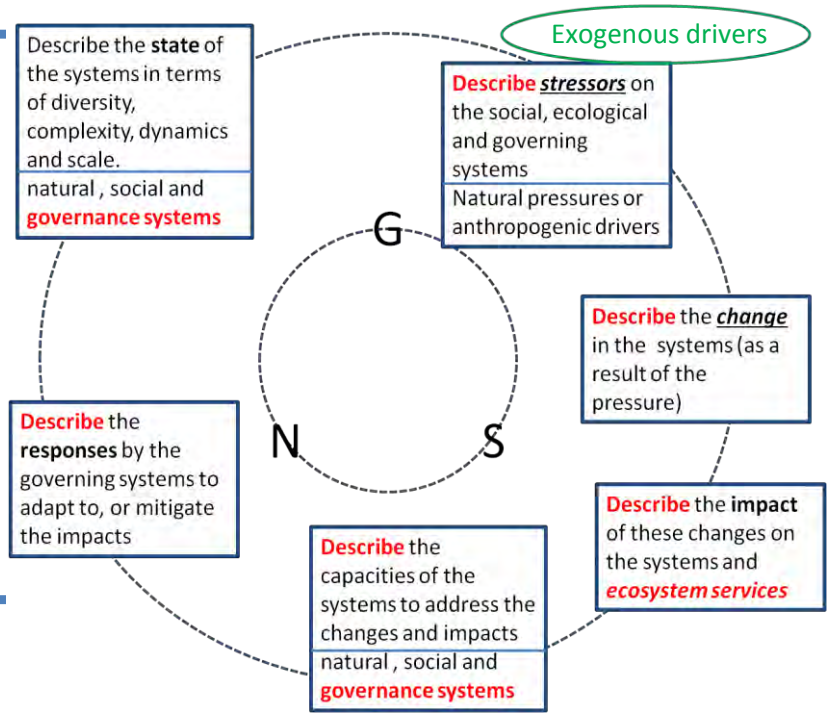
Kooiman et al. 2005, Chuenpagdee

Perry RI, Ommer R, et al.. 2010. Interactions between changes in marine ecosystems and human communities. In Marine Ecosystems and Global Change. Edited by Barange M, et al., pp . 221-252

Three key elements of ADApT

Description

- Issues (what's going on?)
- Systems (natural, social, governing)
- Stressors (natural, anthropogenic)
- Change (caused by stressors)
- Impact (consequence of change)
- Responses (reaction to change)



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- Outputs (objectives of response achieved?)
- Outcomes (issues addressed, side effects?)

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Appraisal

- Outputs (objectives of response achieved?)
- Outcomes (issues addressed, side effects?)

Typology

- Tool for decision support and policy evaluation

Current Status

- Focus on fisheries and aquaculture
- Survey template available at:
  http://www.imber.info/index.php/Science/Working-Groups/Human-Dimensions/IMBER-ADApT
- Typology development
- First results to be presented next June at the IMBER Open Science Conference.

Links to PICES-FUTURE

- Products
  - IndiSeas suite of indicators for ecosystem assessment
    - IndiSeas for the Pacific Ocean?
    - IMER-ADApT open-access database
- Decision Support Tools
  - IMBER-ADApT
  - IndiSeas TG6
- Human Dimensions
  - IndiSeas HDTG
  - IMBER-ADApT
    - Case studies from the Pacific Ocean?

The IMBER Open Science Conference will provide a synthesis of a range of topics related to marine biogeochemistry and ecosystem research and the human dimension of global marine change.

- Not so simple: developing robust approaches to the use of indicators for ecosystem based fisheries management

  Alida Bundy; Yunne-Jai Shin; Lynne Shannon

- Responses of society to marine and global changes as a core mandate for IMBER: ways forward (co-sponsored by PICES)

  Alida Bundy; Ian Perry; Bernhard Glaeser; Thomas Therriault

Summer School ClimEco4

4-9 August 2014 in Shanghai, China

Delineating the Issues of Climate Change and Impacts to Marine Ecosystems and Human Societies: Bridging the Gap Between Research, Policy and Management

Focus on indicators to evaluate marine ecosystems and human populations who depend on them in the context of climate change

Learn about:

- Climate pressures on marine systems from a bio-physical and human perspective
- Modelling complex systems
- Data access, management and analysis
- The role of indicators, how to use them and the trade-offs
- Using and communicating indicators to inform management and policy

Daily 'hands-on' sessions with databases (BYO), indices and models

Registration opens in November. Email IMBER@imr.no to be added to the mailing list