NOAA brown bagger

Marine conservation on the high seas:

strategies to move forward with limited knowledge

24 Mar 2010, NOAA HQ, Silver Spring

Jeff Ardron

Director High Seas Program, Marine Conservation Biology Institute

IUCN-WCPA Scientific Advisor MPA Design, Tools, & Software

President, Pacific Marine Analysis and Research Association

MCBI

Outline: three talks in one!

1. Developments in high seas conservation:
   a) Ecological / human use issues
   b) Policy developments
   c) International scientific response (GOBI)
2. Example of global stony coral modeling
3. Accounting for limited knowledge & uncertainty
   a) Epistemology
   b) The unexpected
   c) aMSP
   d) Strategies

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The good ol' days...

"...for the sea is of so vast an extent that it is sufficient for all the uses that nations can draw thence, either as to water, fishing, or navigation."

--Huig de Groot (1583-1645)

Greatest threat to the oceans when I was a lad…

"I don't know why I don't care about the bottom of the ocean, but I don't."

Slide adapted from Kristina Gjerde, IUCN; cartoon from New Yorker magazine

Greatest threats to oceans now:

Increasing players with corresponding pressures…

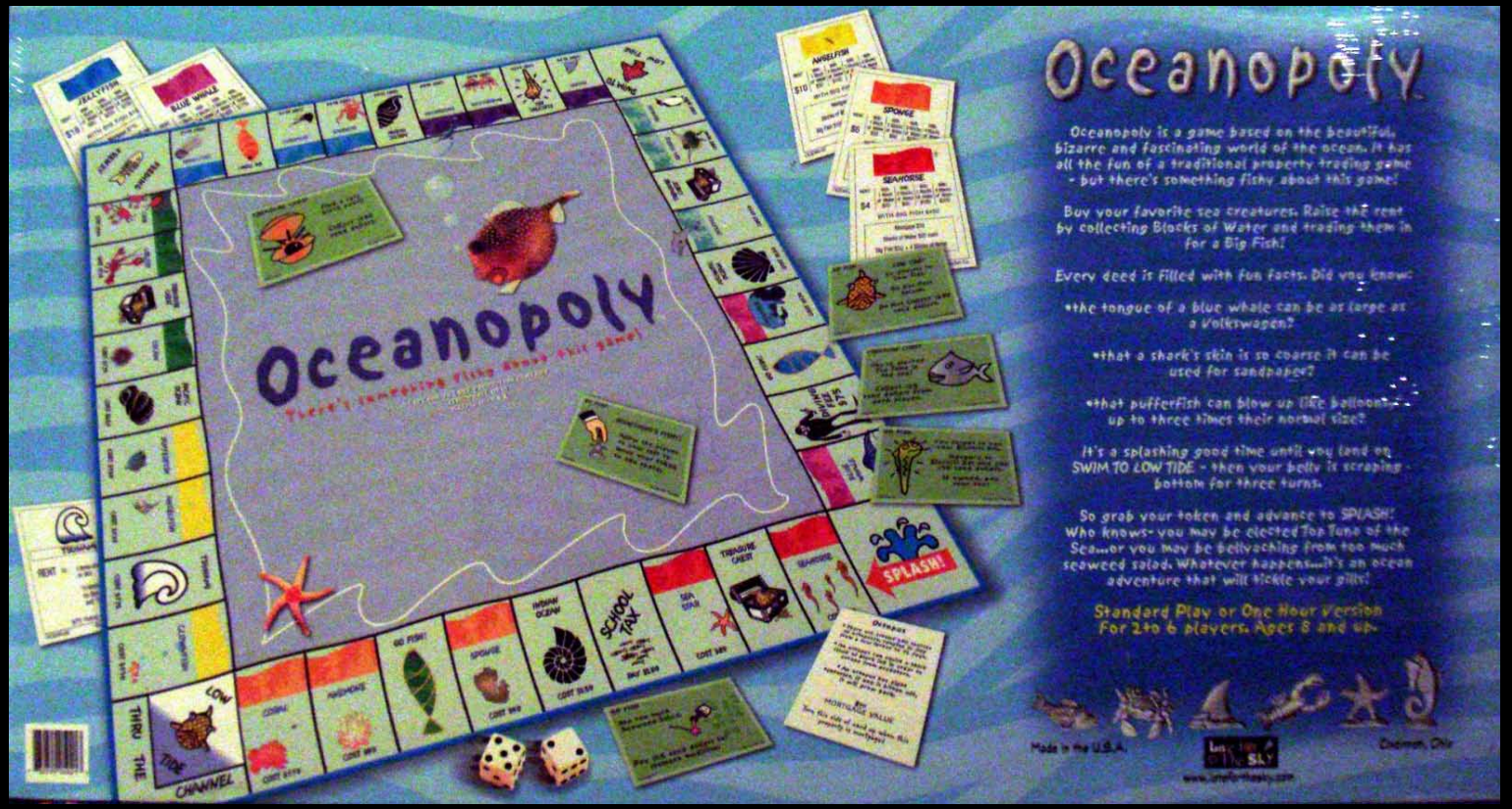
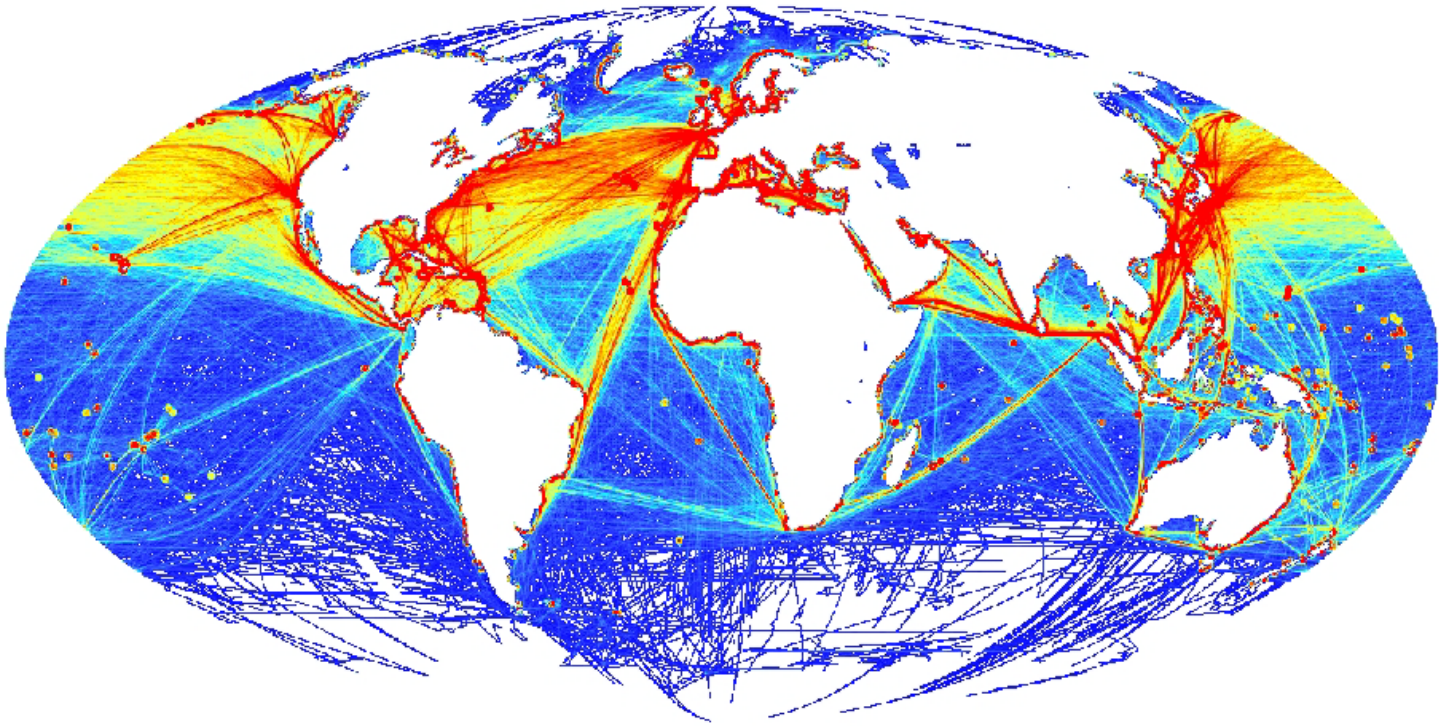


Image from Kristina Gjerde, IUCN

Global shipping / ocean-based pollution



Source: NCEAS / Halpern et al, Science: 319, 2008

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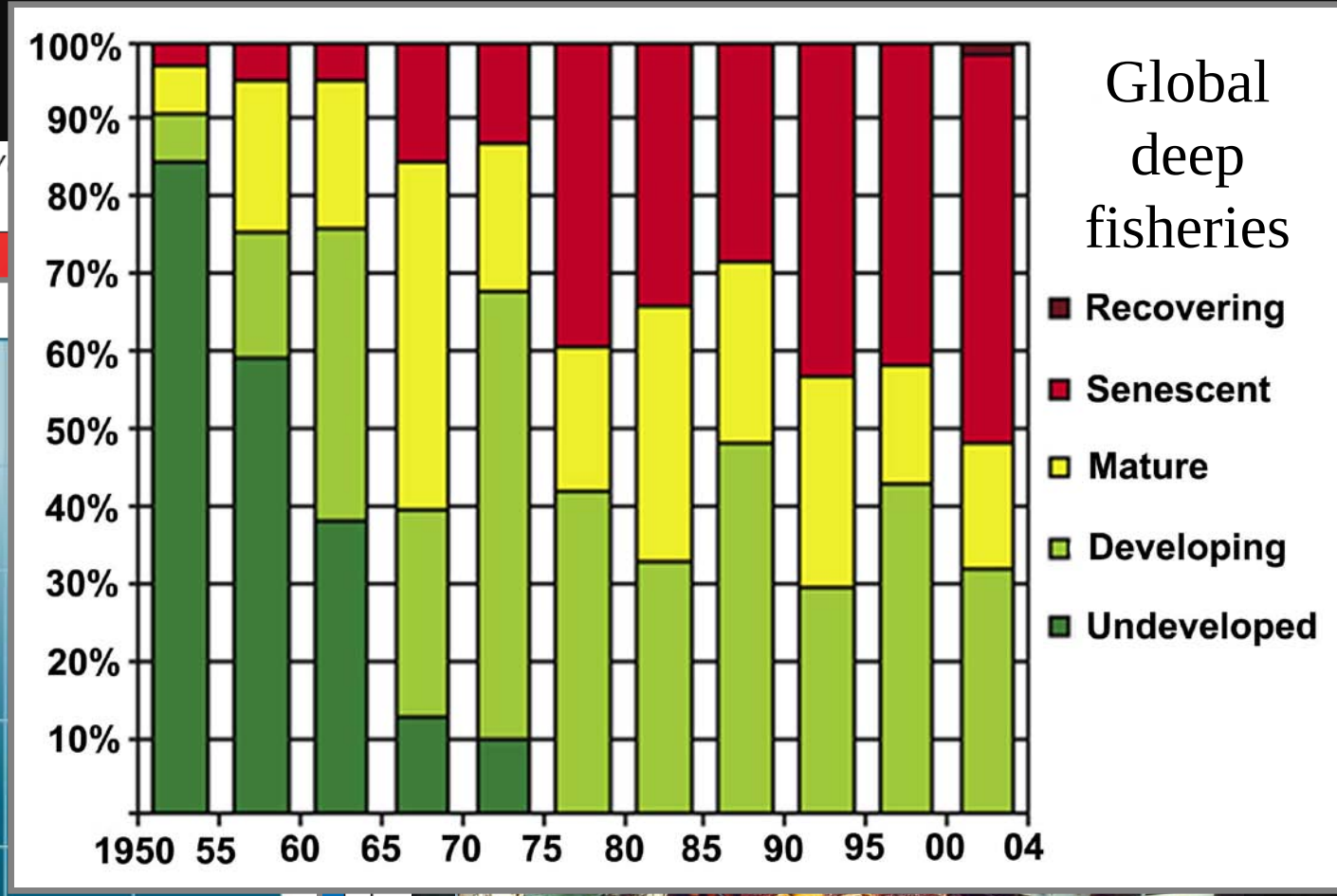
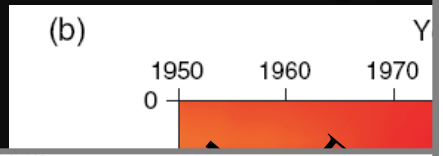
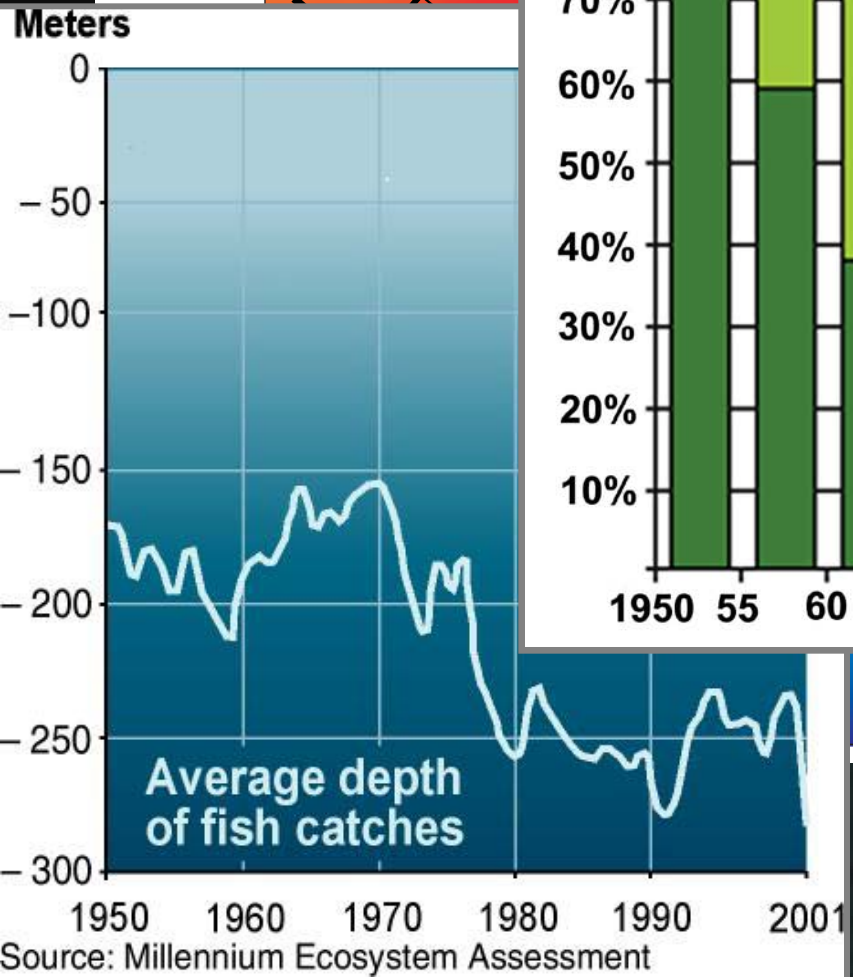
Fisheries are moving deeper and further offshore

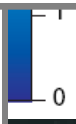


Global deep fisheries





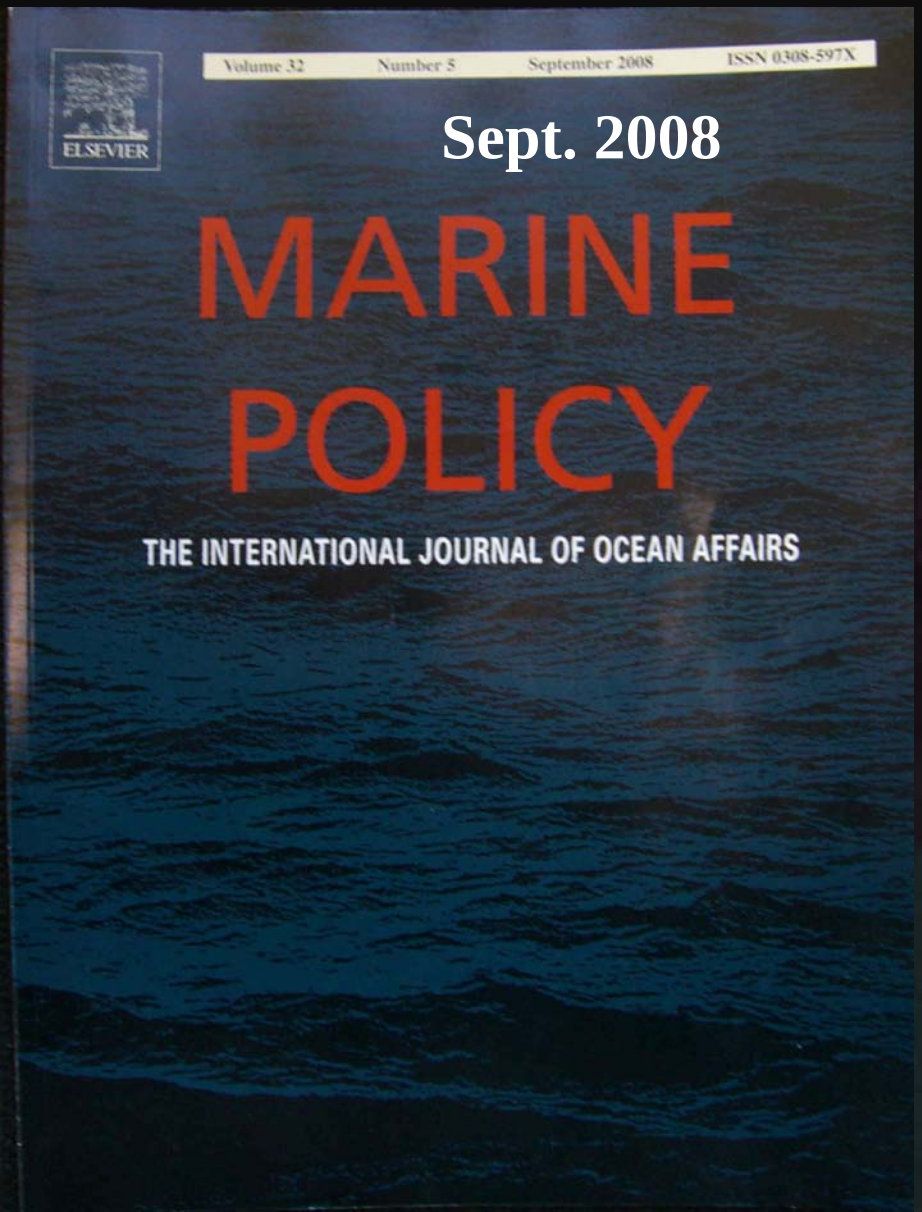
Source: Millennium Ecosystem Assessment



ries

Adapted from FAO Fisheries Technical Paper 495
UN Food and Agriculture Organization, 2007.

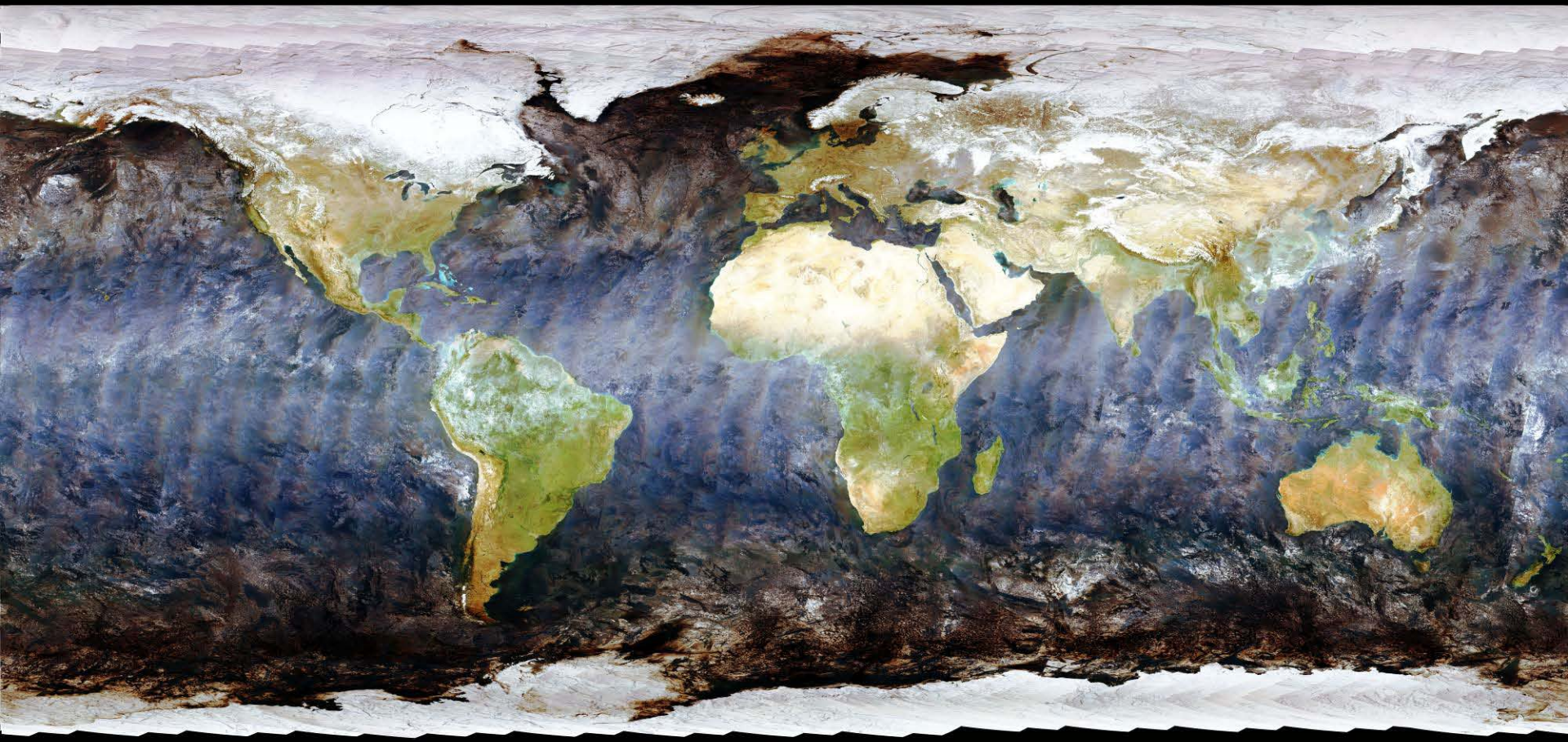
Spatial Planning: the star ascendant



- Spatial issues should be managed spatially…
- Piecemeal approaches cannot fully address ecosystem issues;
- But, avoid the "mother of all processes" which could take decades…
- We need *spatial triage*.

The problems of ocean space are closely interrelated and need to be considered as a whole

(Preamble to the UN Convention on the Law of the Sea, 1982)



SeaWiFS Project/NASA

CBD COP9 Decision 20 (2008)

Annex I: Site Criteria

"Ecologically or Biologically Significant Areas" (EBSAs)

1. Uniqueness / rarity
2. Special importance for life history of species
3. Importance for threatened, endangered or declining species / habitats
4. Vulnerability, fragility, sensitivity, or slow recovery
5. Biological productivity
6. Biological diversity
7. Naturalness

Easier said than done…
Therefore we formed the Global Ocean Biodiversity Initiative (GOBI.org).

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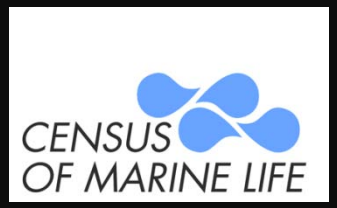
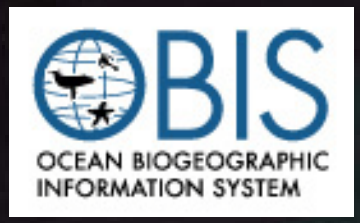
Global Ocean Biodiversity Initiative (www.GOBI.org)





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GOBI objectives (abridged)

- Scientific collaboration process to assist States and relevant regional and global organisations to identify ecologically significant areas (the CBD “EBSAs”)

- To provide guidance on how the CBD’s scientific criteria can be interpreted and applied

- To assist in developing regional analyses with relevant organisations and stakeholders

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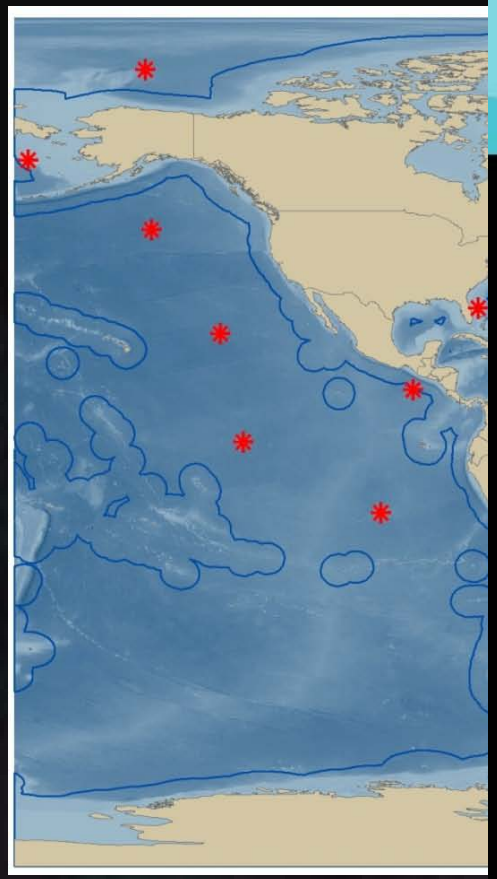
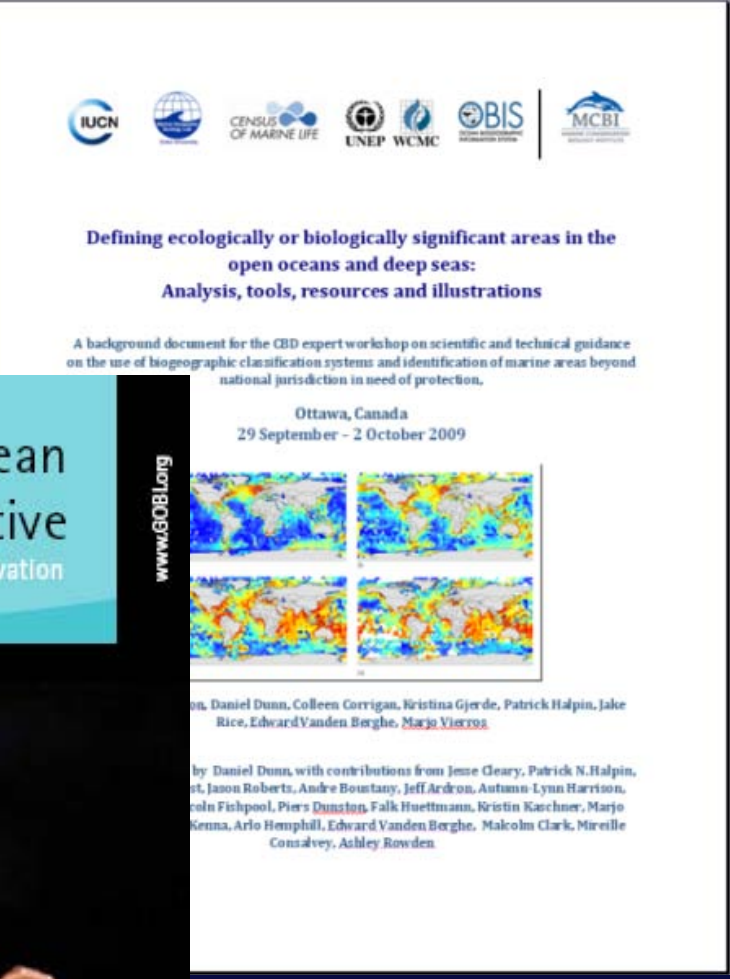
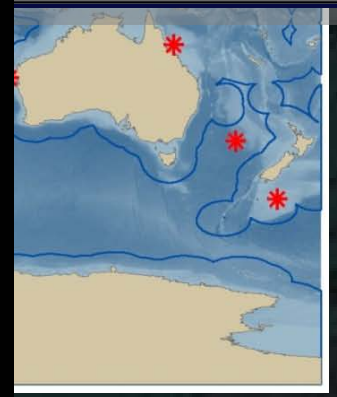
GOBI.org
Illustrations, reports, brochure…







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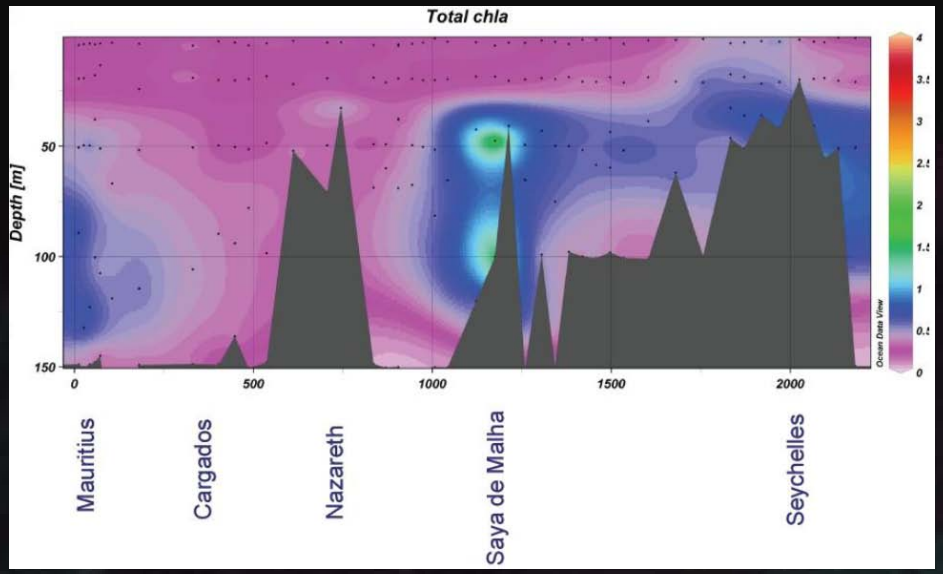
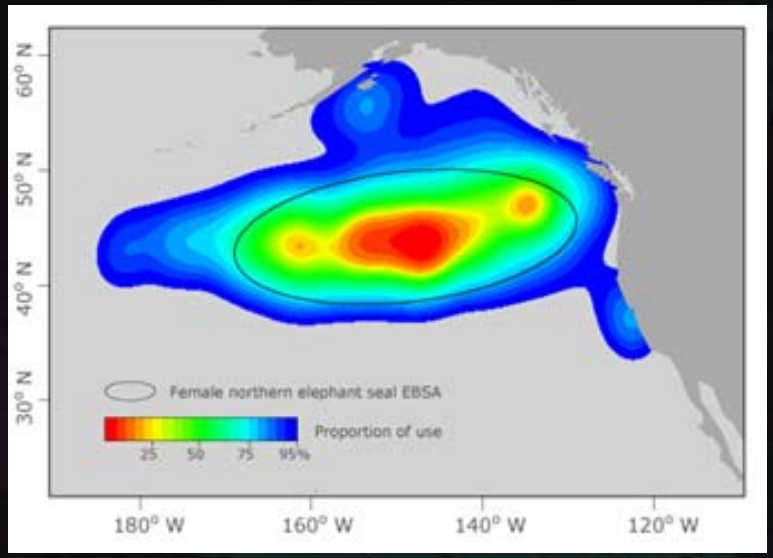
GOBI: CBD EBSA criteria
illustrations...

Uniqueness or rarity



Saya de Malha Banks
Credit: Marjo Vierros, UNU/IAS

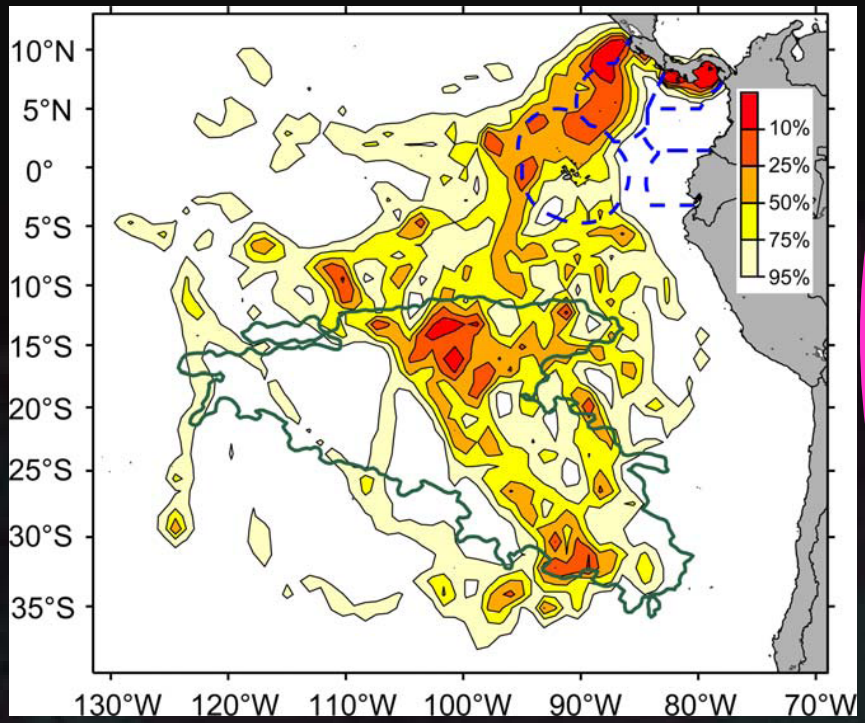
Special importance
for life history of species



Northern Elephant Seals
Credit: Autumn-Lynn Harrison, UCSC/TOPP

GOBI: CBD EBSA criteria
illustrations …cont'd

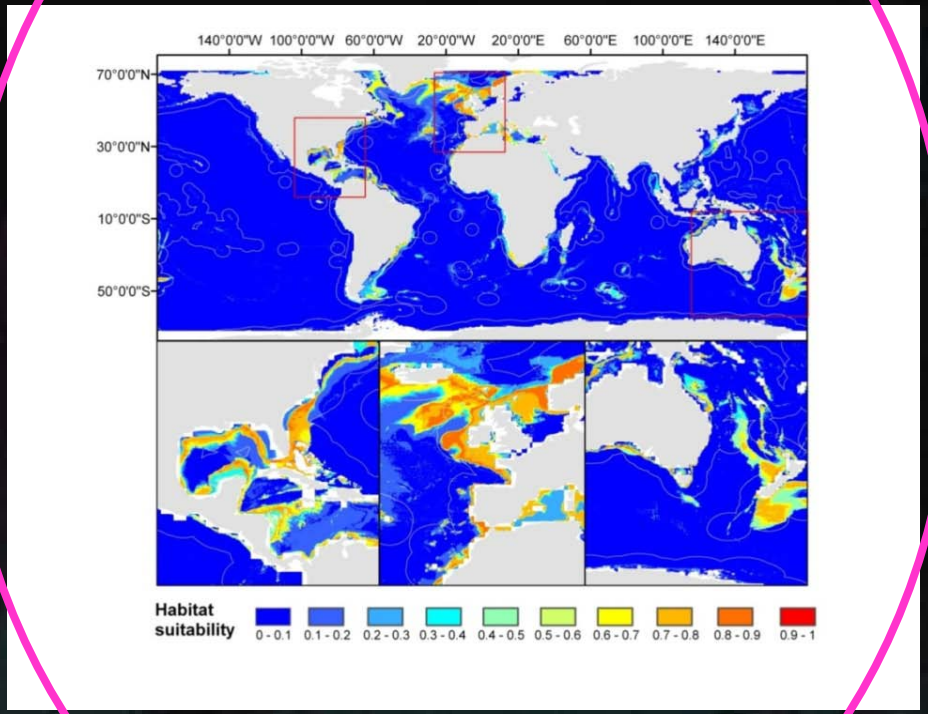
Importance for threatened, endangered or declining species



Pacific Leatherback sea turtle migration corridors

Credit: Andre Boustany, MGEL

Vulnerability, Fragility, sensitivity, slow recovery



Reef forming cold-water corals

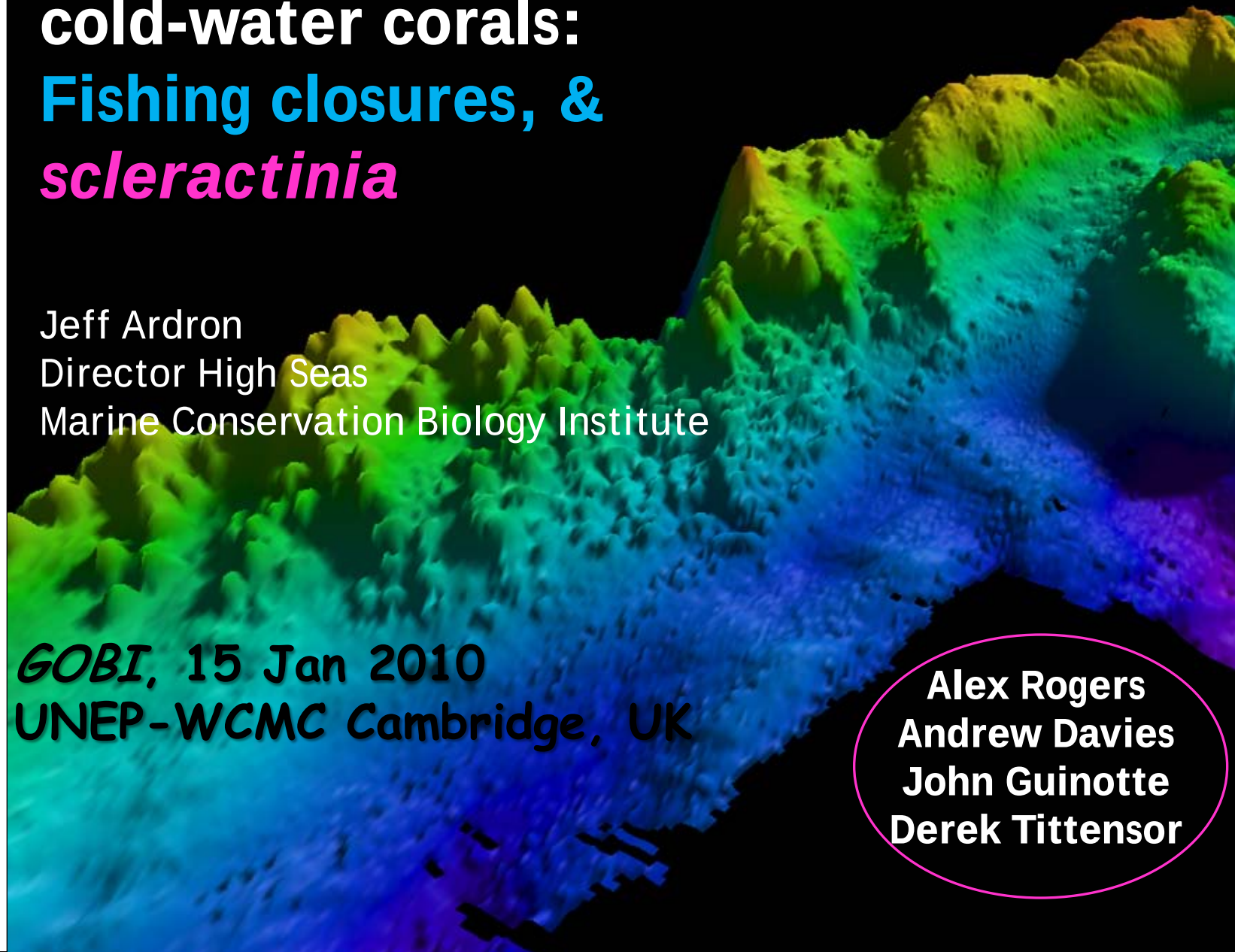
Credit: Andrew Davies, Bangor University; John Guinotte, Jeff Ardron, MCBI

UNGA Res. 64/72 (2009) §119 (b)

Conduct further marine scientific research and use the best scientific and technical information available to identify where vulnerable marine ecosystems are known to occur or are likely to occur and adopt conservation and management measures to prevent significant adverse impacts on such ecosystems consistent with the Guidelines, or close such areas to bottom fishing until conservation and management measures have been established, as called for in paragraph 83 (c) of its resolution 61/105;

Part 2: Predicting distributions of cold-water corals: Fishing closures, & *scleractinia*

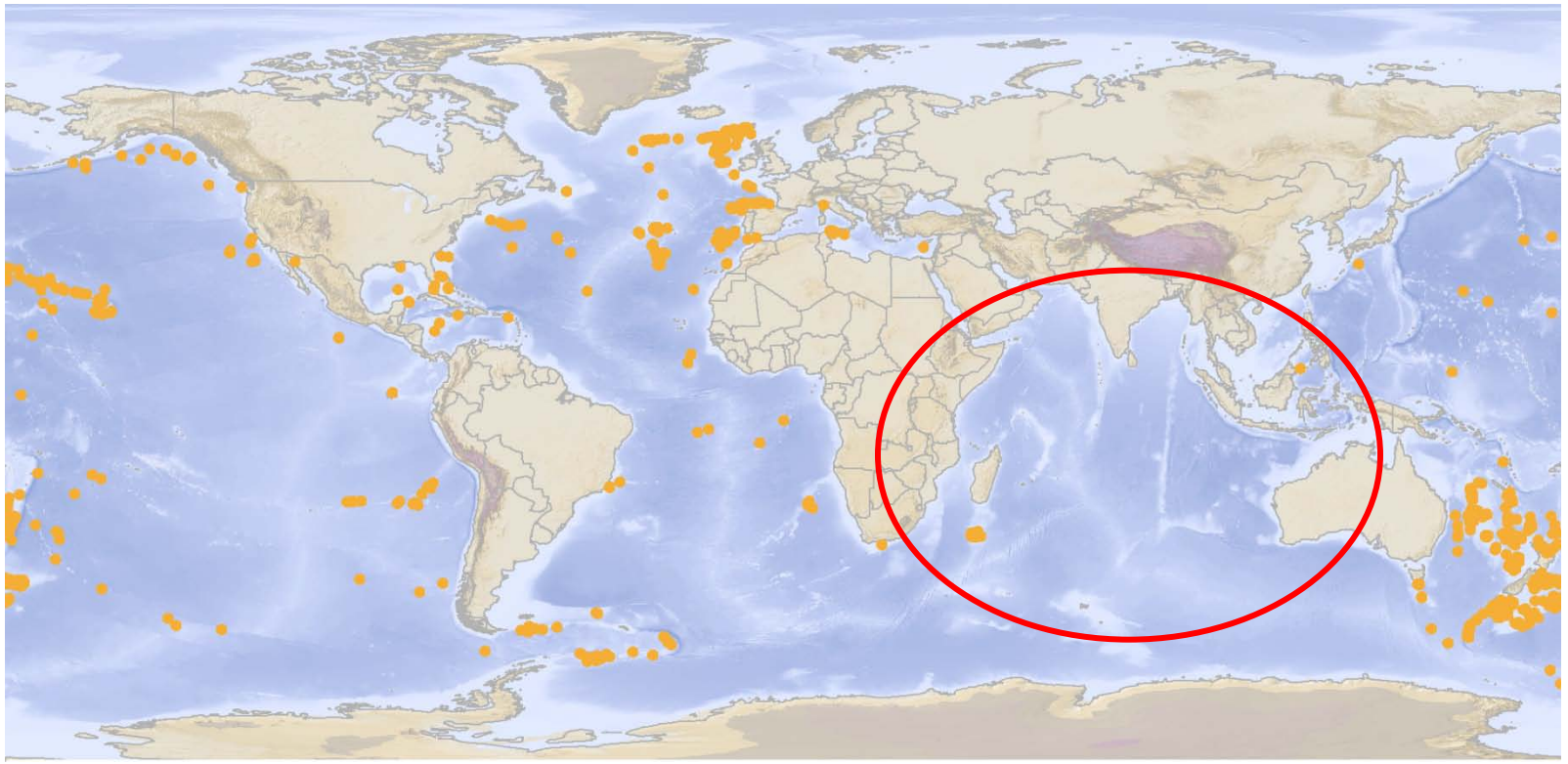
Jeff Ardron
Director High Seas
Marine Conservation Biology Institute



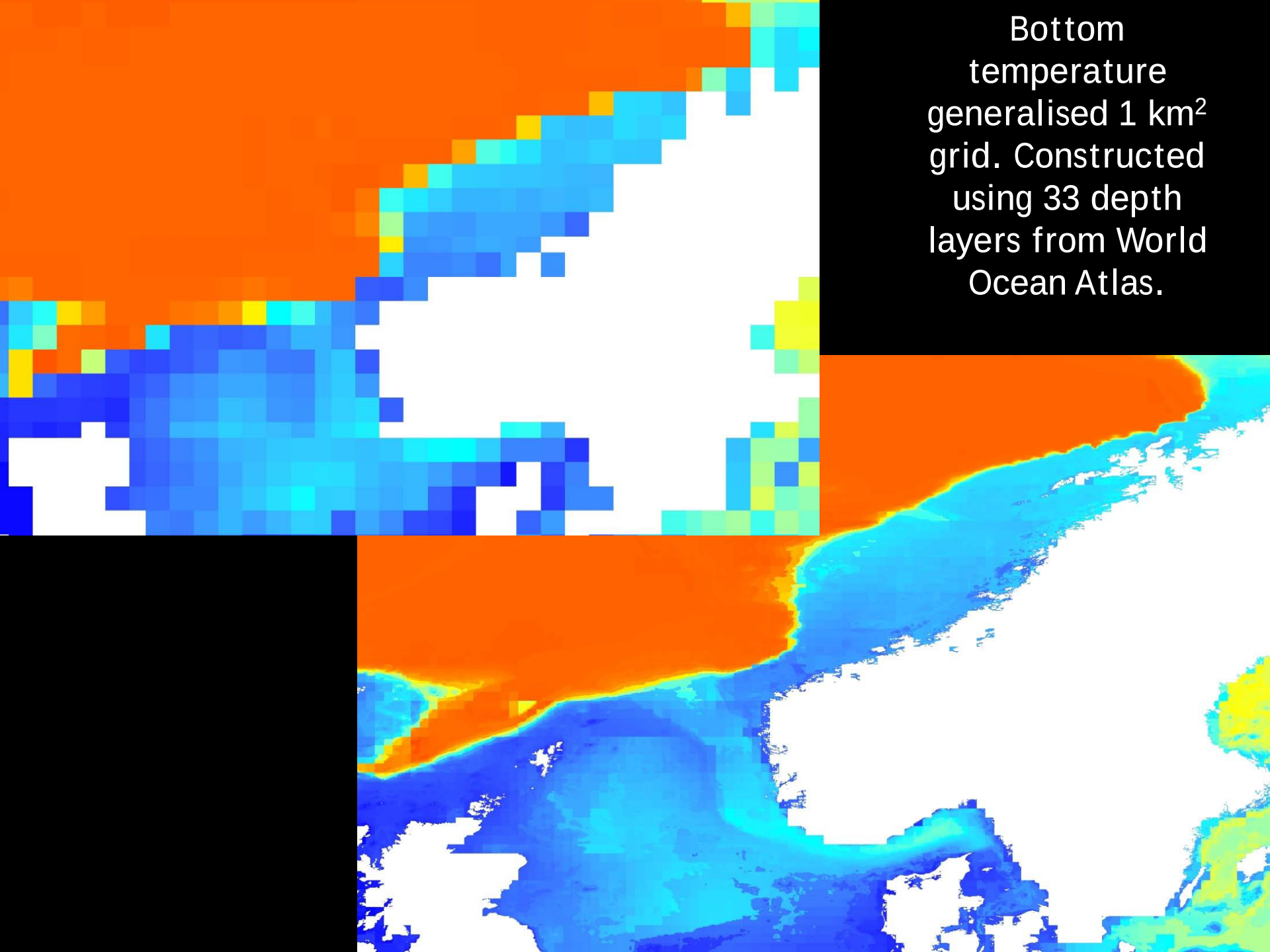
GOBI, 15 Jan 2010
UNEP-WCMC Cambridge, UK

Alex Rogers
Andrew Davies
John Guinotte
Derek Tittensor

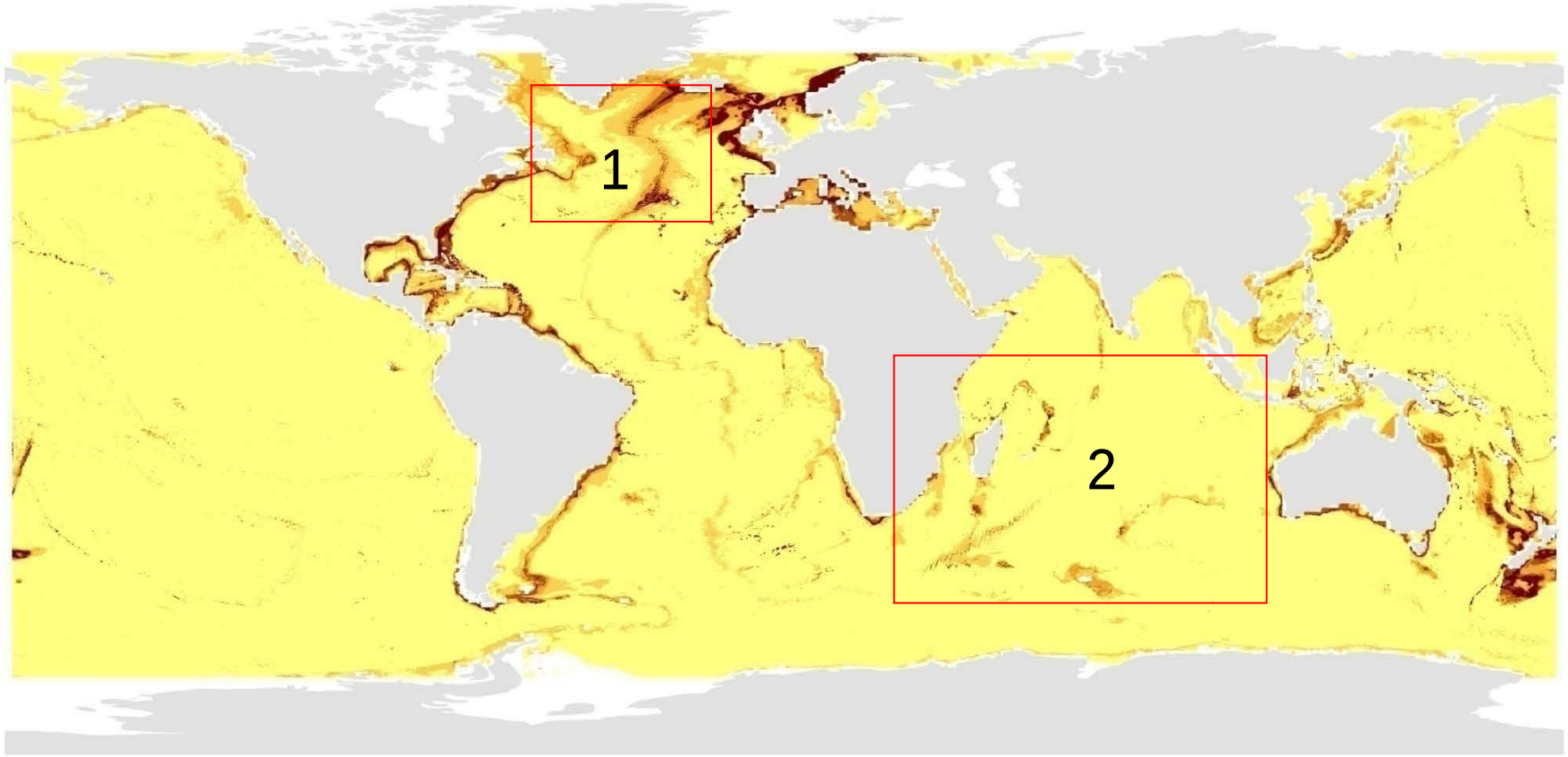
Database of all coral records



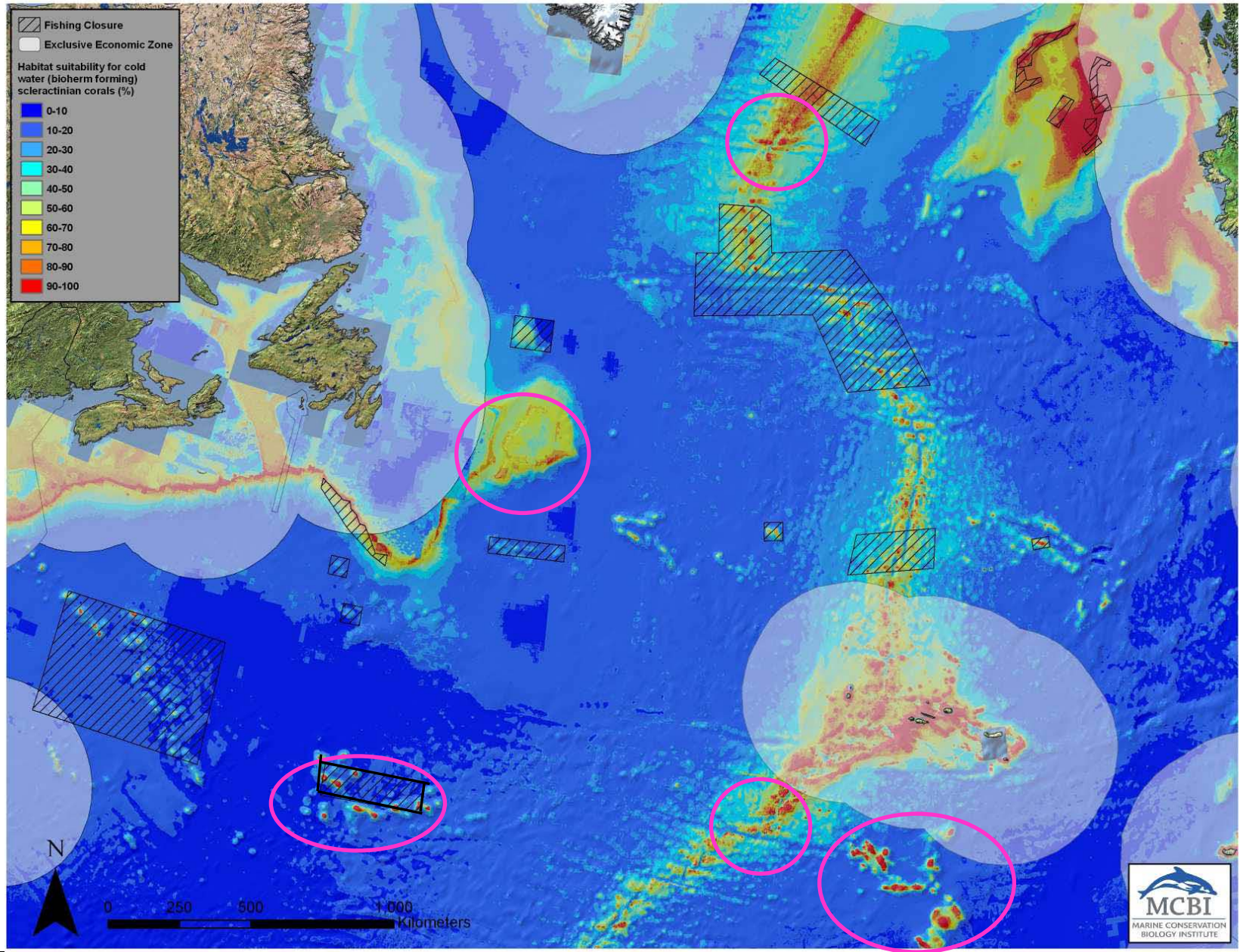
Rogers et al., 2007; Clark et al. (2006)


Bottom temperature generalised 1 km^2 grid. Constructed using 33 depth layers from World Ocean Atlas.

Predicted global distribution of stony corals



1. N Atlantic Closures



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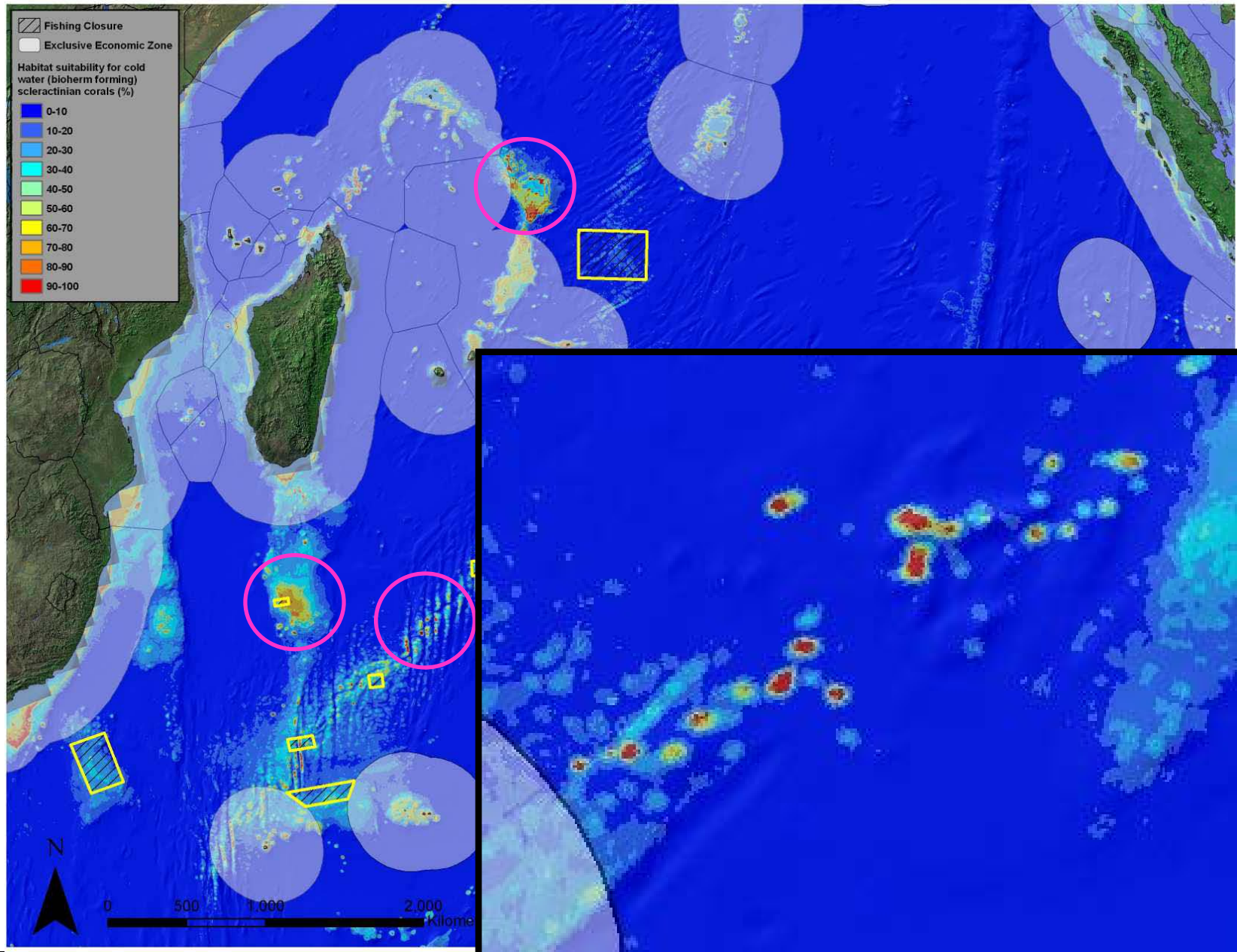
SCOTTISH ASSOCIATION for MARINE SCIENCE

2. S Indian Ocean Vol. Closures



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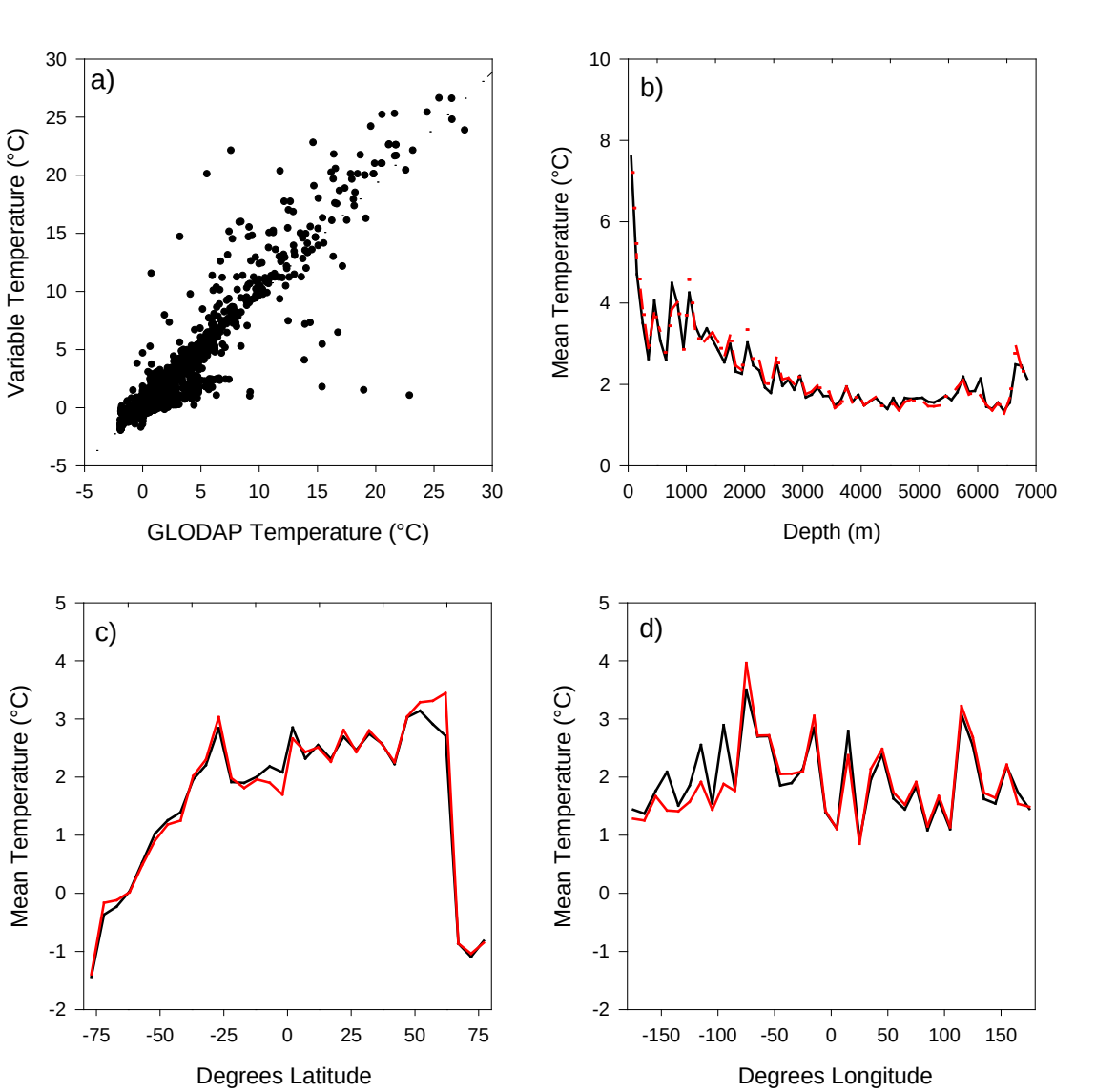
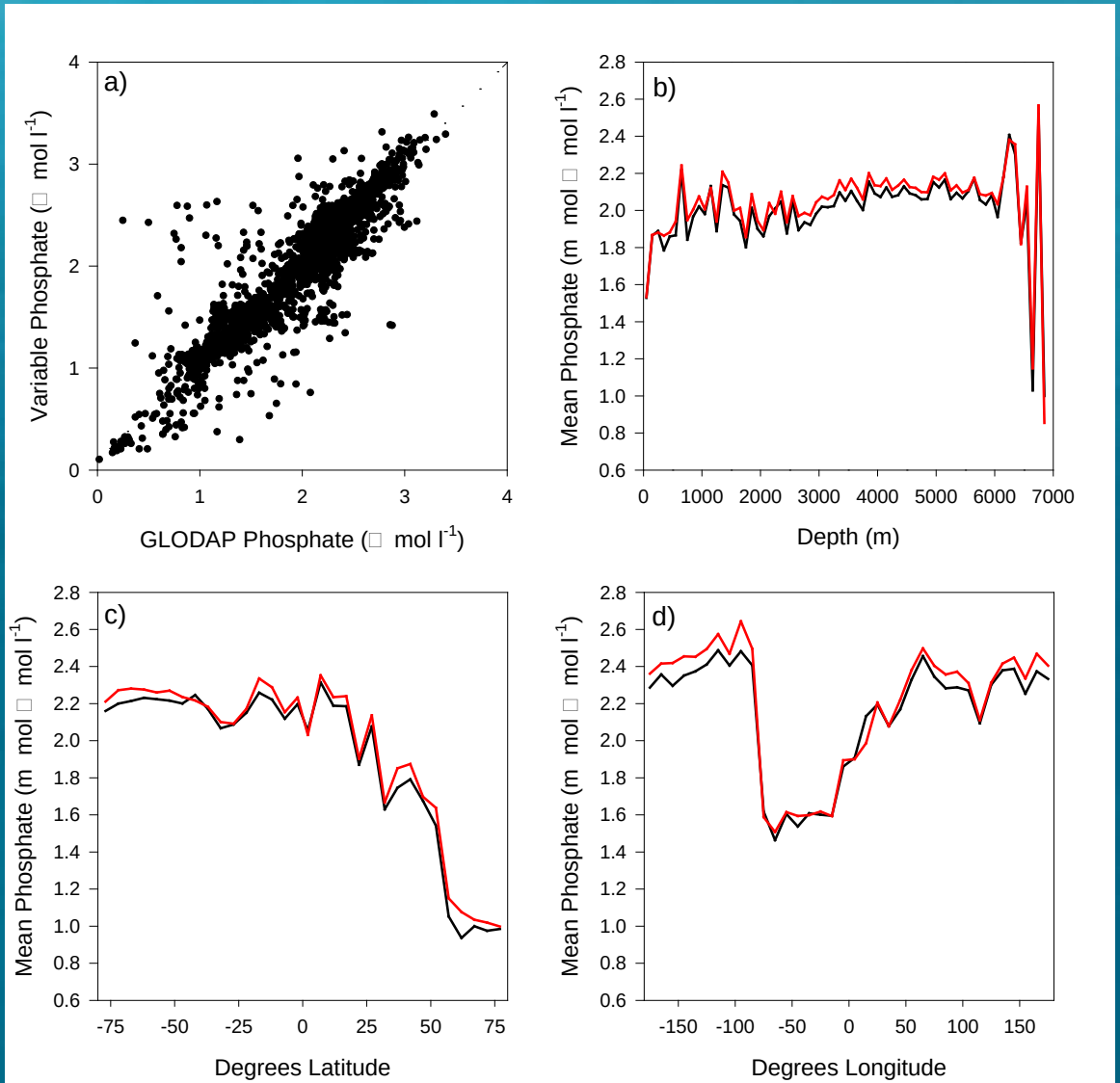
What are the major environmental drivers?

- Combination:
  - Carbonate chemistry.
  - Temperature.
  - Salinity.
  - Nutrients.
  - Dissolved O_2.
  - Topography.
  - Food supply.

Validation of environmental layers with GLODAP bottle data (Temperature)



Validation of environmental layers with GLODAP bottle data (Phosphate)



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Validation statistics

comparing the performance of 5 environmental variables created using the up-scaling approach compared with GLODAP bottle data (all statistics significant at $p = 0.001$))

Dataset	*n*	Mean diff (SE)	Regression	Correlation
Temperature	6972	0.002 (0.01)	0.854	0.924
Salinity	6891	0.02 (0.001)	0.835	0.914
Phosphate	6386	0.036 (0.003)	0.851	0.923
Nitrate	6598	0.52 (0.04)	0.833	0.913
Silicate	6994	7.434 (0.35)	0.677	0.823

Wrap-up Parts 1 & 2

- Human uses have intensified in offshore / high seas areas;
- High seas areas account for 64% of the oceans, almost half the surface of the planet…
- UN General Assembly and the Convention on Biological Diversity have both passed international resolutions to protect significant & vulnerable high seas areas;
- GOBI is the fledgling international scientific response;
- MCBI is leading on identifying unique areas ("Jewels") and predictive coral habitat modeling. (We are also looking at measures of benthic and pelagic complexity.)

Part 3:
(assuming there is still time...)

Accounting for limited knowledge & uncertainty

The nature of knowledge

...and the knowledge of nature

The Existential Poetry of D.H. Rumsfeld

The Unknown

As we know,
There are known knowns.
There are things we know we know.
We also know
There are known unknowns.
That is to say
We know there are some things
We do not know.
But there are also unknown unknowns,
The ones we don't know
We don't know.

—Feb. 12, 2002, Department of Defense news briefing

Recent works by the [former] secretary of defense.

Transcribed by Hart Seely

http://slate.msn.com/id/2081042/#ContinueArticle

What We Know We Know & What We Know We Don't Know…

e.g. from British Columbia

There are over 6,500 known spp of invertebrates, 400 spp of fish, 161 spp of birds, & 29 spp of marine mammals in BC…

Total: 7,087

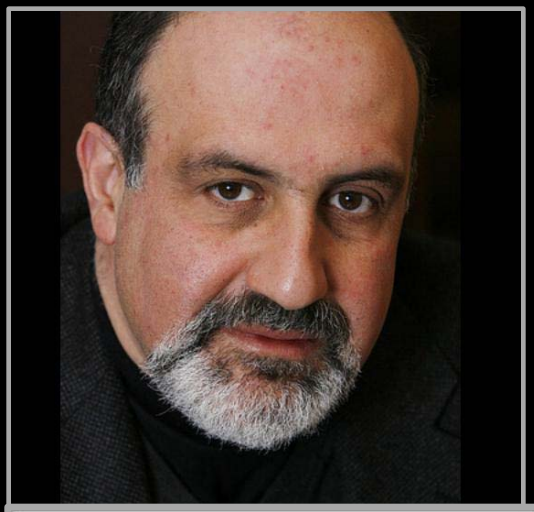
Less what we (sort of) know, say three or four dozen…

7,087 **– 48 = 7039**

0.07%

Governments of Canada and BC, 1998. Marine Protected Areas: A Strategy for Canada's Pacific Coast. Discussion Paper.

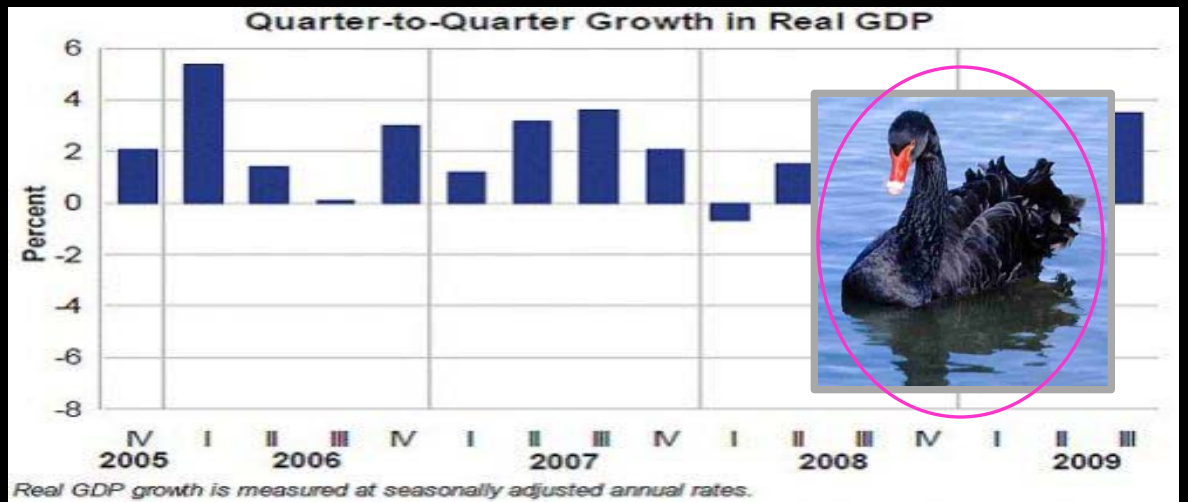
The Black Swans of Nassim Nicholas Taleb

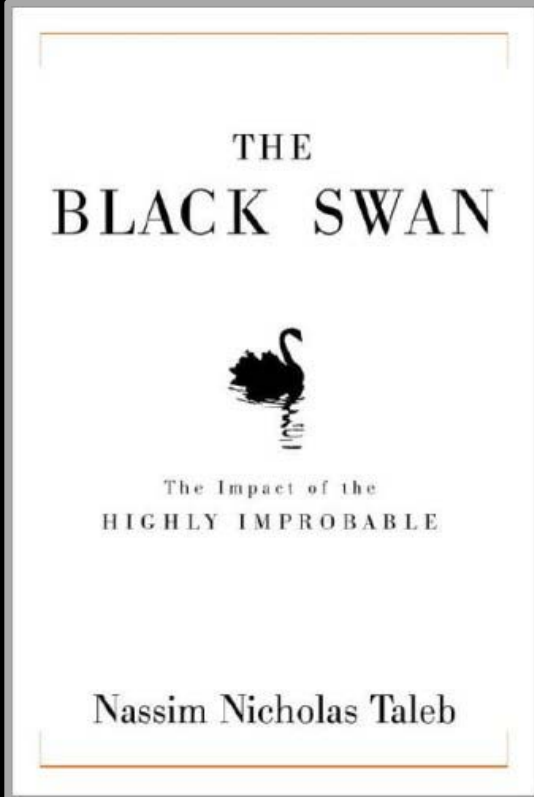


Favorite hobby

"…teasing people
who take themselves
& the quality of their knowledge
too seriously &
those who don't have the courage
to sometimes say:
I don't know...."

www.fooledbyrandomness.com/ (22 Mar 2010)





The road to success is paved with humility...

"I have no idea whether the markets are going to be up 20% or down 20% over the next year."

-Tye Bousada

Manager of the most successful Canadian mutual fund over the past 25 years

(Toronto Star, 24 March, 2007)

The Portfolio (EBM) Approach to planning

spreading the risk and increasing the likelihood of success by:

1. Protecting examples of representative habitats
2. Ensuring that duplicate examples of all major habitat types are protected
3. Applying varying degrees of protection, from fully protected reserves through to limited openings for high-risk activities
4. Using adaptive management
5. Recognizing intangible values
6. Maintaining capital (nat. resources)
7. Implementing robust networks of MPAs as insurance

***--The Ecosystem Approach: Demystifying the Concept and its Application in the Marine Environment*, Report by IUCN for the 7th Meeting of the UN open-ended Informal Consultative Process on Oceans and the Law of the Sea, 2006.**

Uncertainty =

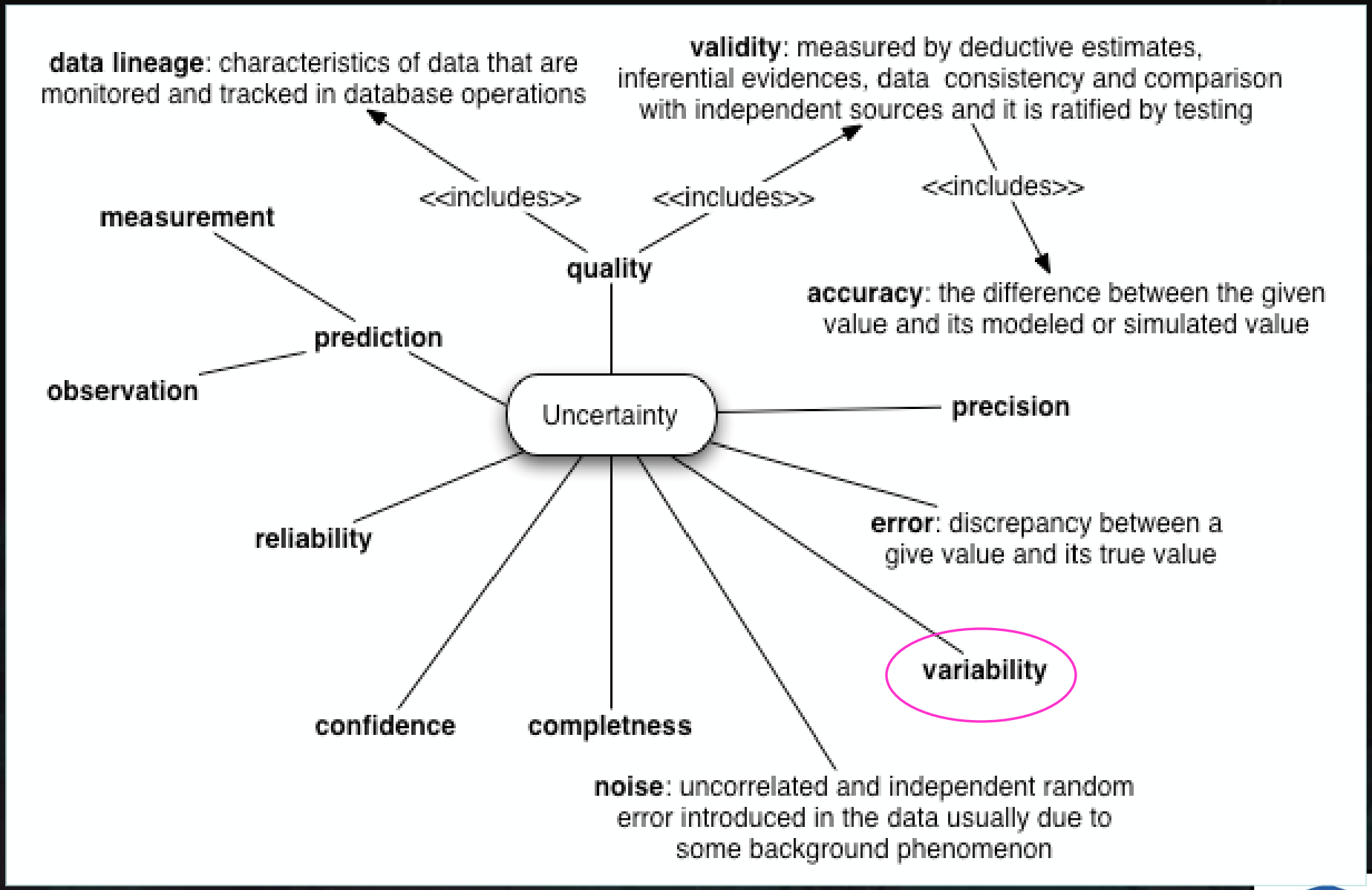
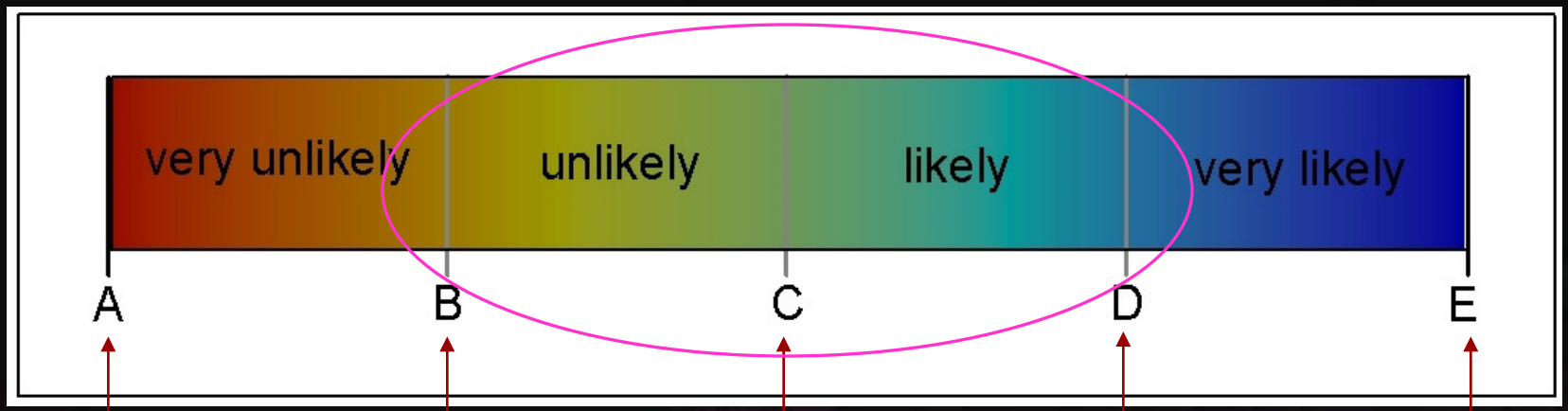


Figure: Fabien Girardin

Certainty: a combination of probability (that som Knowns will occur) & uncertainty in Unknowns ge



Unknown but "conceivable"

Enough known to make it "possible"

"...probable"

"most likely"

"Definite"

100%

model

knowledge

Aphorisms / Thoughts so far…

1. Know that knowledge is a continuum and that any decision that is knowledge-based is also ignorance-based…
2. Precaution should be proportional to uncertainty;
3. Better to be approximately right than exactly wrong! (Avoid over-fitting, and specific narrow solutions.)
4. "Luck favors the prepared…"
5. Cultivate serendipity by admitting you don't know all the answers and need to try different approaches…

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Adaptive MSP

(aMSP –the latest greatest buzzword!)

Definition: A structured, iterative, (usually) public process of analyzing and allocating the spatial and temporal distribution of human activities in marine areas, in the face of uncertainty, with an aim to reducing uncertainty over time via system monitoring to achieve ecological, economic, and social objectives.

Adapted from several definitions, to appear in our new UNEP publication

Adaptive MSP (aMSP) …cont'd

Elaboration: Characteristics of aMSP should include area-based, adaptive, systematic, strategic, ecosystem-based, integrated, and participatory. In taking a systematic approach, aMSP should be 1) data-driven; 2) goal-directed; 3) efficient; 4) explicit, transparent, repeatable; and, 5) flexible. It should begin with a concerted effort to integrate existing interdisciplinary experience and scientific information into dynamic models that attempt to make predictions about the impacts of alternative policies. Actions should be designed so that, even if they fail, they will provide useful information for future actions.

Adapted from several definitions, to appear in our new UNEP publication

Beware: Two types of error, two types of risk analyses, two types of users...

- Type 1 "false positives": resource users want to avoid these, because it means areas are being protected that really didn't have to be. Predictive modelling generally has a lot of "false positives."
- Type 2 "false negatives": conservationists want to avoid these, because it means valuable areas have been missed and are now (possibly) being damaged. Historic data (e.g. footprints) or patchy sampled data usually have lots of false negatives.

Thanks to Jake Rice for bringing this to my attention

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Conservation Planning with Uncertainty

1. Recognize those places that are already known to be special ("recognition heuristic" –low hanging fruit)
2. Anchor spatial planning around more persistent features, when possible.
3. Choose scales that are stable to perturbations (e.g. functional communities vs individual species level)
4. Take a portfolio approach (distribute risk, etc.)
5. Keep it simple. (Do not over-fit)
6. Plan in advance your management options to be open to adaptation and learning

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Sage advice striking off into the unknown

"Begin at the beginning and go on till you come to the end; then stop."

--Lewis Carroll (Rev. Charles Dodgson)

"You've got to be very careful if you don't know where you're going, because you might not get there…"

--Yogi Berra

My interpretation:

1. Just do it. (It won't get done otherwise…)
2. But carefully and keep your eyes open!

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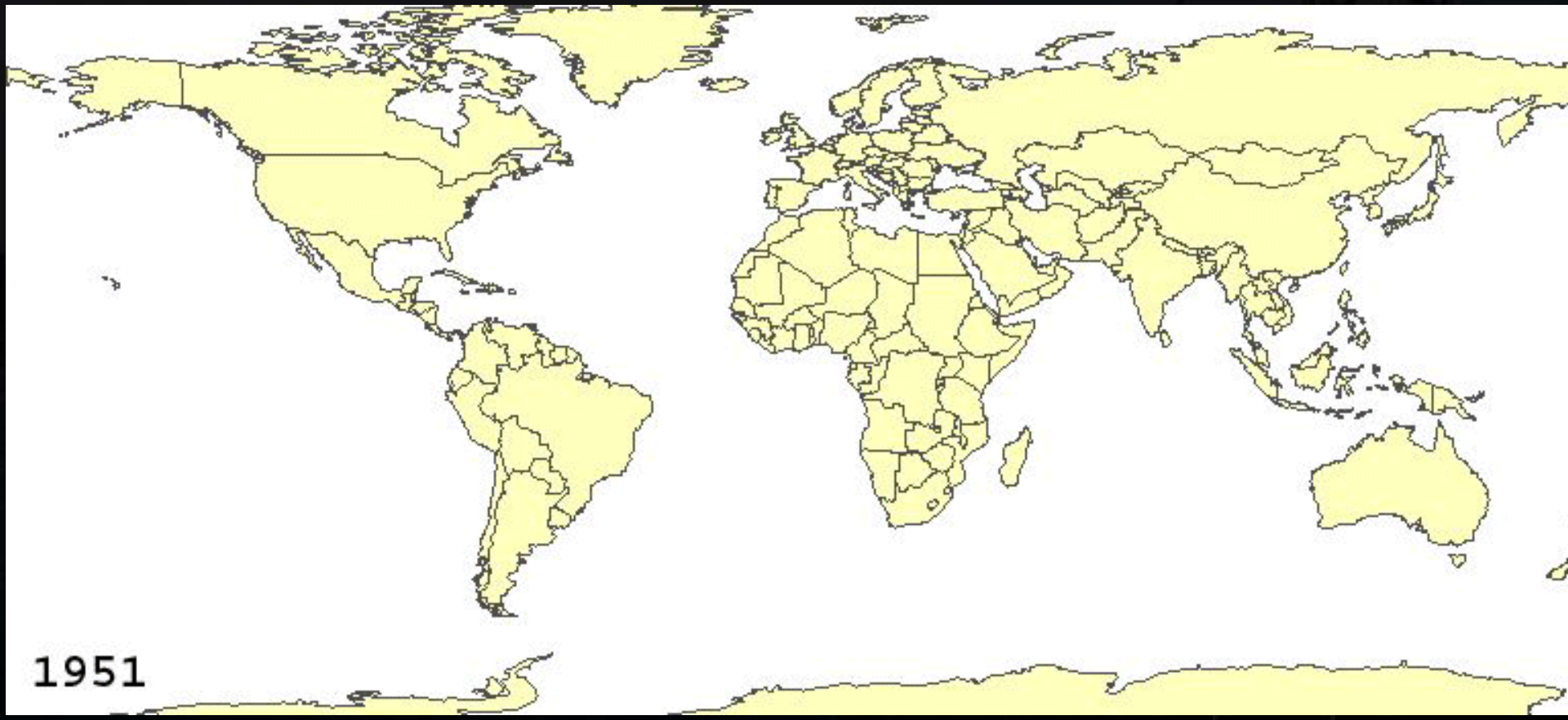
Acknowledgements: thanks to the many colleagues who have shared ideas and slides, esp. John Guinotte, Andrew Davies, and GOBI.

Jeff.Ardron@MCBI.org

Supplementary Information

The Spread of Fishing Activity…

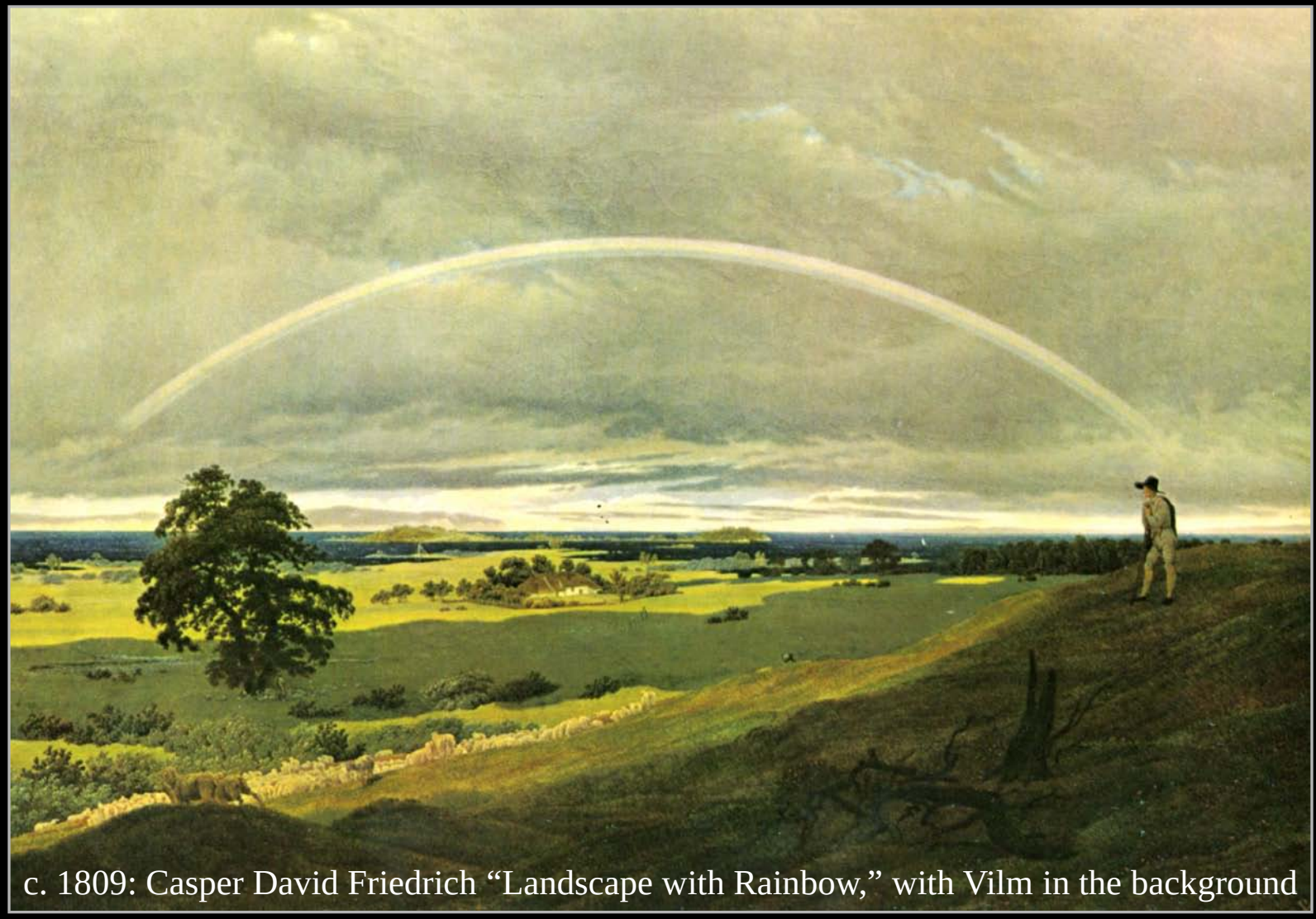


Calculated Max. Fish Harvest (“the good old days”)

- Pre-peak
- Harvest peak
- Post-peak

Source: Millennium Ecosystem Assessment and Seas Around Us Project

A French take on change:
Plus ça change, plus c'est la même chose...



c. 1809: Casper David Friedrich “Landscape with Rainbow,” with Vilm in the background

An American take on change:

For he that gets hurt
Will be he who has stalled
There's a battle outside
And it is ragin'.
It'll soon shake your windows
And rattle your walls
For the times they are a-changin'.

--Bob Dylan