



Can we use zooplankton diversity to fill the global indicator gap of the Aichi Biodiversity Target 10?



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Putting biodiversity at the heart of decision-making

World Conservation Monitoring Centre



UNEP

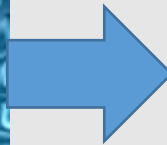


WCMC

Collating Knowledge

Assessing Biodiversity

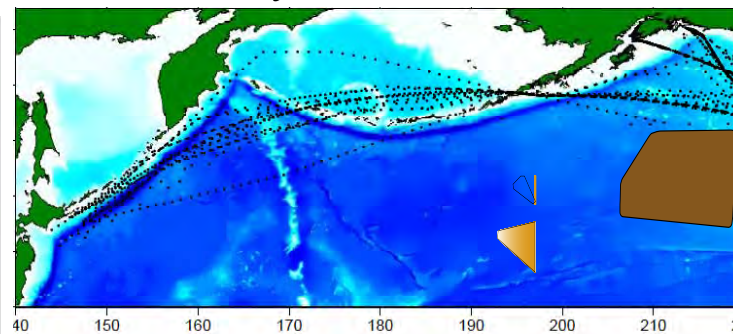
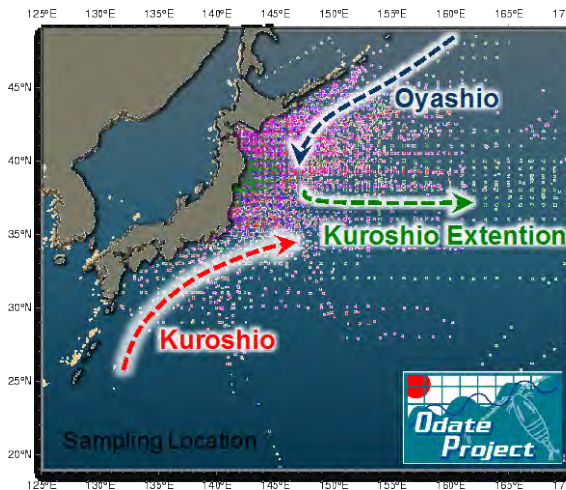
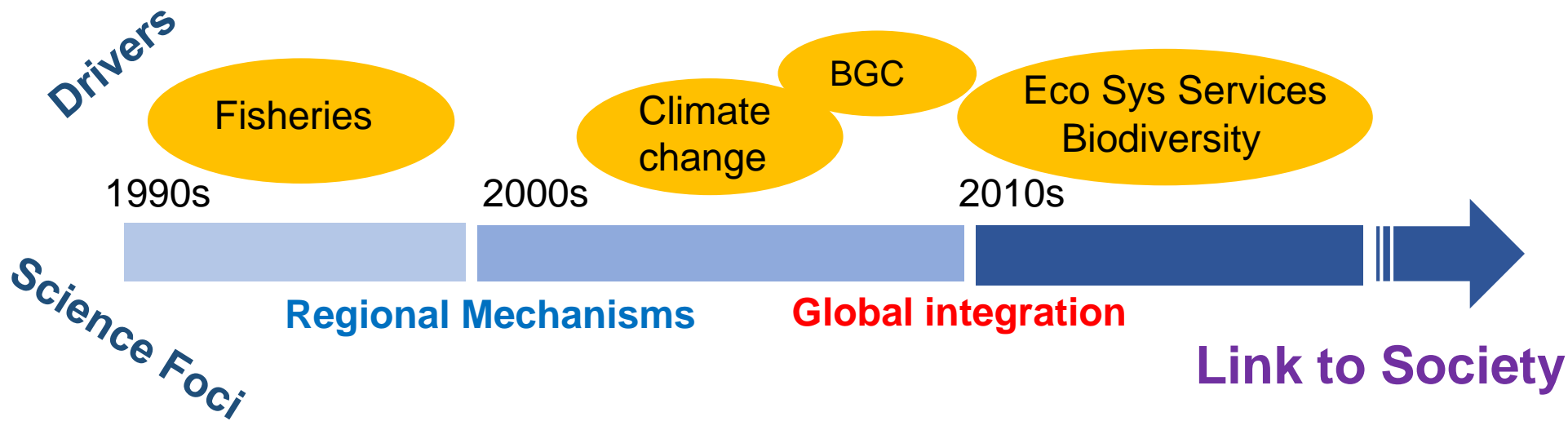
Developing tools



Valuing Natural Capital

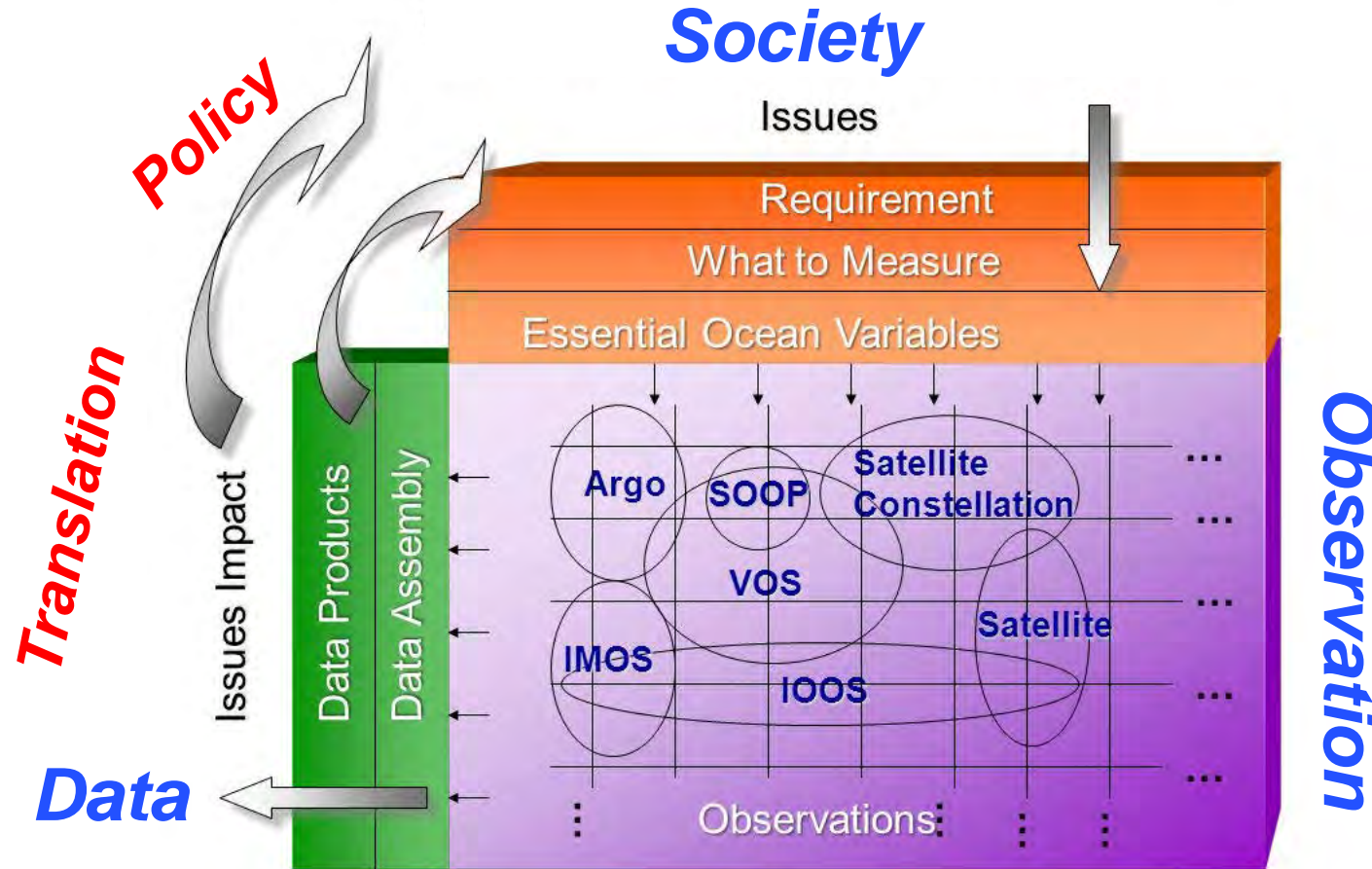
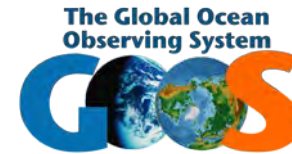
Mapping Hotspots and Priorities

25 yrs of PICES & Ecosystem Change Studies



Framework for Ocean Observing

EOV: Essential Ocean Variable



April 2011

(UNESCO 2012, doi: 10.5270/OceanObs09-FOO)

CLAIRASSE M. HART/HARVARD FOREST



It's time to get real about conservation

Nature 2016

How can scientists protect the Great Elephant Census in numbers through researchers for more and better many of each species there conserve them. This is non

Better data will not save an enormous number of individuals and national governments, organizations have been collecting data for decades, essentially

Of course, biodiversity data suggest priorities and to draw species. But biodiversity data conservation decision-making majority of cases, they are

decisions made for other reasons. The decisions last week by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) to tighten trade in endangered species of sharks, parrots and pangolins shows this. Fascination, charisma and plush toys captured the imagination of the delegates, and journalism, political pressure and social-media campaigns pushed the decisions.

This week's Global Scientific Meeting in South Africa's Kruger National Park of the International Long-term Ecological Research network (ILTER) demonstrates the problem. With its long and enviable track record in integrating social dynamics into the study of ecological systems and

Third, more scientists must get actively involved in the political process. Calling, e-mailing and writing to political leaders is a small but necessary first step. Showing up for seemingly endless political meetings is a larger but necessary follow-up. If we're not in the room, our voices won't be heard. Volunteering for local, regional, national or international groups directly involved in conservation decisions is a bigger commitment. But if not us, who? And running for elected office would logically follow. If not now, when?

Scientists studying ozone depletion and climate change have shown that getting involved directly in the decision-making process can give scientists a place at the global table and a voice to help effect political change. Scientists who both study biodiversity and want to see other species persist and thrive must follow their example. ■

**BETTER DATA
WILL
NOT SAVE
ELEPHANTS,
RHINOS OR
ANY OTHER
SPECIES.**

spiders or snakes, or positive ones to pandas, pangolins or baby seals. Decisions about which species to save — and which to triage to extinction — are based on raw emotion, the views of many different stakeholders and myriad political calculations. As the CITES process has demonstrated, data can be marshalled to support conservation decisions with broad-based support from a range of parties. But such consensus are increasingly hard to come by, the resulting CITES decisions still do not provide airtight protection, and as conflicts rage around the world and rapid economic growth continues to be prioritized over conservation in both developing and developed countries, biodiversity will continue to decline.

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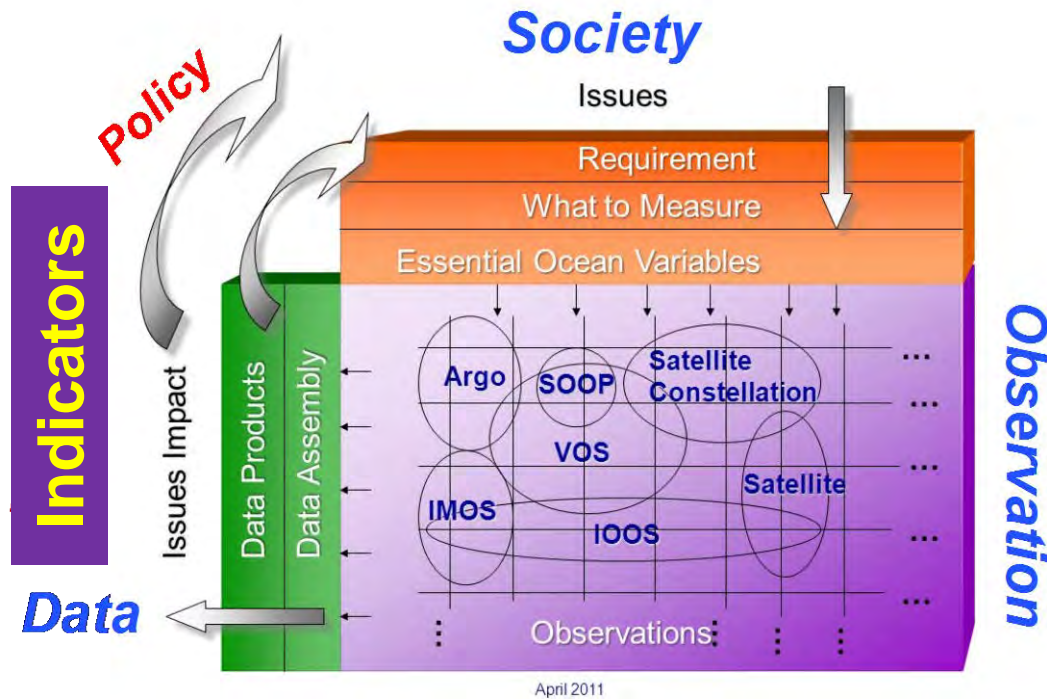
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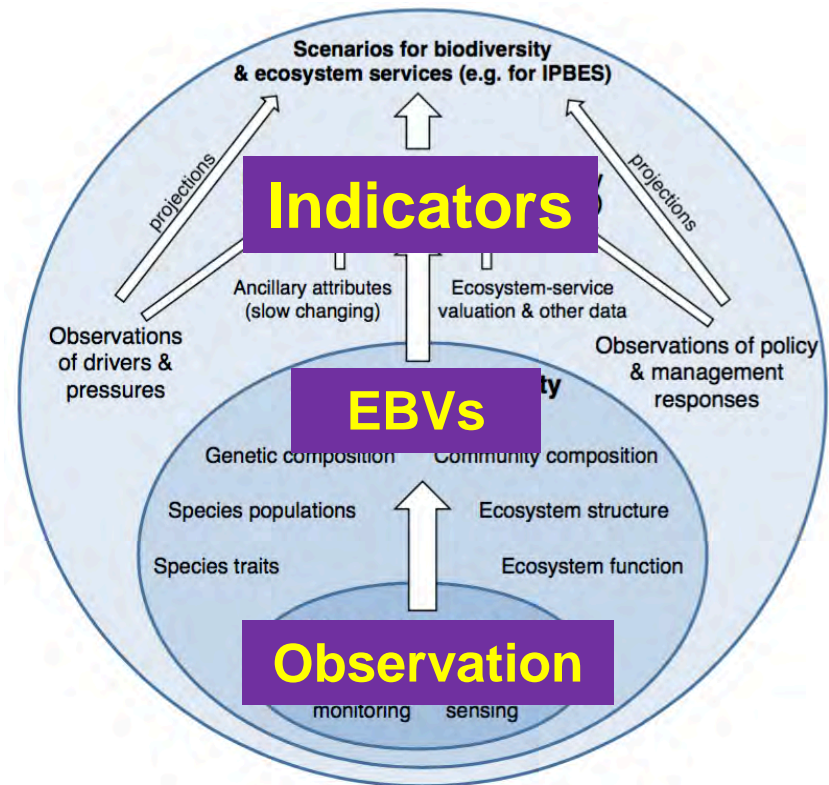
Indicators: Translation of Scientific Outcome

Framework for Ocean Observing

EOV: Essential Ocean Variable



EBV: Essential Biodiversity Variables



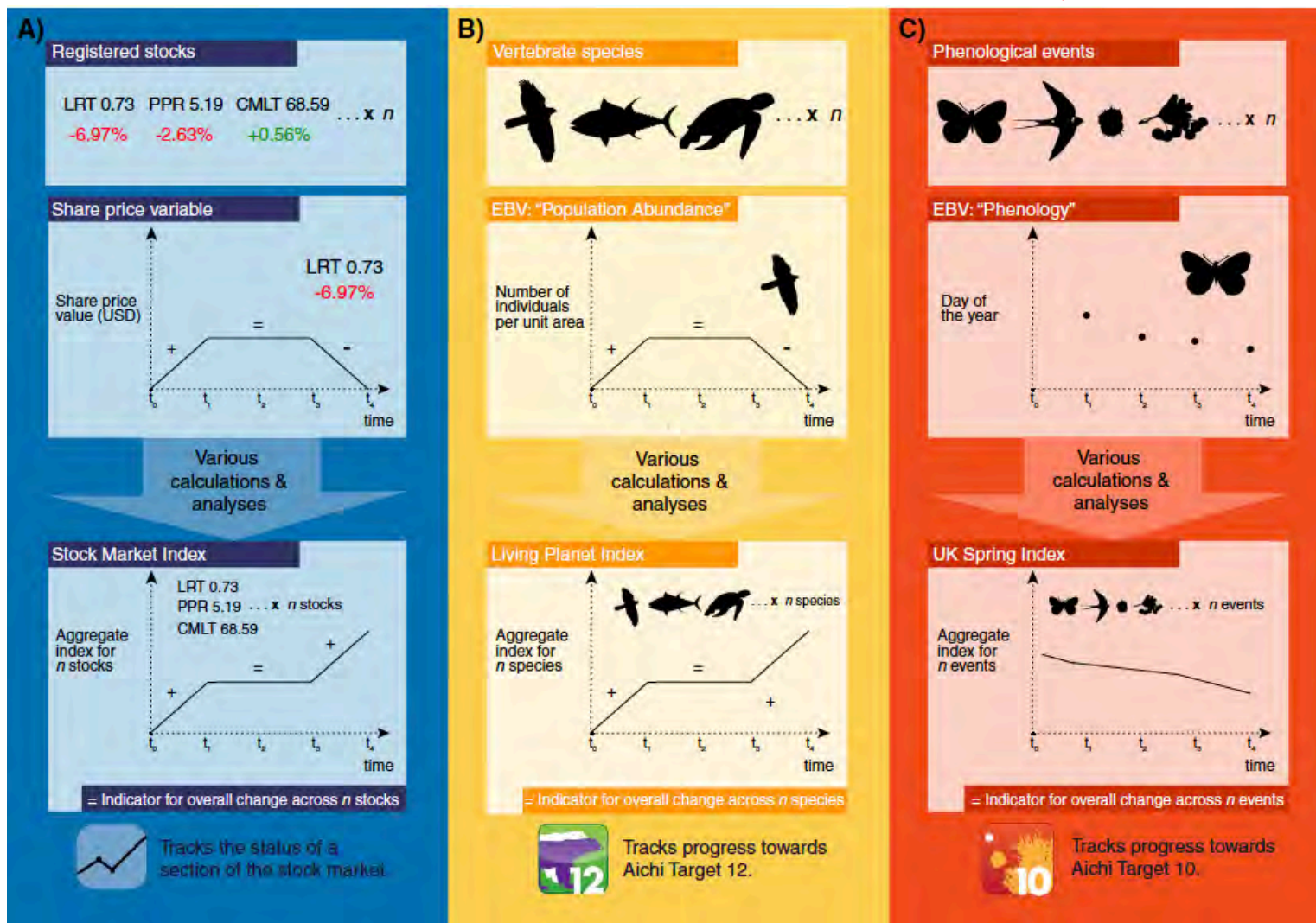
(Pereira et al., Science, 2013)

Analogy between Stock market Index and Living Planet Index

Issue

EOV
/EBV

Index



(Brummitt et al 2016, Biological Conservation)

Academic Articles on Marine Biodiversity Indicators published since 2010

The image shows a Google Scholar search results page. At the top, the Google logo is on the left, and the search bar contains the text 'Biodiversity indicators marine OR ocean'. To the right of the search bar is a magnifying glass icon. Below the search bar, the word 'Scholar' is written in red. The search results are displayed in a list format. The first result is titled 'Global biodiversity: indicators of recent declines' by SHM Butchart, M Walpole, B Collen, and A Van Strien, published in 2010 on science.sciencemag.org. The second result is 'The trophic fingerprint of marine fisheries' by TA Branch, R Watson, EA Fulton, and S Jennings, published in Nature in 2010. The third result is 'An index to assess the health and benefits of the global ocean' by BS Halpern, C Longo, D Hardy, and KL McLeod, published in Nature in 2012. The fourth result is 'Functional traits as indicators of biodiversity response to land use changes across ecosystems and organisms' by M Vandewalle, F De Bello, MP Berg, and T Bolger, published in Biodiversity and Conservation in 2010 by Springer. The fifth result is 'What criteria should be used to select biodiversity indicators?' by U Heink and I Kowarik, published in Biodiversity and Conservation in 2010 by Springer. On the left side of the page, there are filters for 'Articles', 'Case law', and 'My library'. There are also filters for 'Any time', 'Since 2016', 'Since 2015', 'Since 2012', and 'Custom range...'. A search box with '2010' and a 'Search' button is present. At the bottom, there are options to 'Sort by relevance', 'Sort by date', 'include patents', 'include citations', and 'Create alert'.

Google

Biodiversity indicators marine OR ocean

Scholar

About 21,800 results (0.08 sec) **About 21,800 results**

Articles

Case law

My library

Any time

Since 2016

Since 2015

Since 2012

Custom range...

2010 —

Search

Sort by relevance

Sort by date

include patents

include citations

Create alert

Global biodiversity: indicators of recent declines
SHM Butchart, M Walpole, B Collen, A Van Strien... - ..., 2010 - science.sciencemag.org
... Table 1 Summary of global **biodiversity indicator** trends. ... 2 Aggregated indices of (A) the state of **biodiversity** based on nine **indicators** of species' population trends, habitat extent and condition, and community composition; (B) pressures on **biodiversity** based on five ...
Cited by 1943 Related articles All 37 versions Web of Science: 1065 Cite Save More

The trophic fingerprint of marine fisheries
TA Branch, R Watson, EA Fulton, S Jennings... - Nature, 2010 - nature.com
... **Biodiversity indicators** provide a vital window on the state of the planet, guiding policy development and management 1, 2 . The most widely adopted **marine indicator** is mean trophic level (MTL) from catches, intended to detect shifts from high-trophic-level predators to low ...
Cited by 251 Related articles All 24 versions Web of Science: 134 Cite Save More

An index to assess the health and benefits of the global ocean
BS Halpern, C Longo, D Hardy, KL McLeod... - Nature, 2012 - nature.com
... and implemented a systematic approach for measuring overall condition of **marine** ecosystems that ... into a synthetic measure using a concise set of **indicators** facilitates communication ... other goals scored higher (>75), including 'carbon storage', 'clean waters' and '**biodiversity**'. ...
Cited by 306 Related articles All 14 versions Web of Science: 193 Cite Save More

Functional traits as indicators of biodiversity response to land use changes across ecosystems and organisms
M Vandewalle, F De Bello, MP Berg, T Bolger... - **Biodiversity** and ..., 2010 - Springer
... fragmented habitats. Ecol Lett 3:449–456; Streamlining European 2010 **Biodiversity Indicators** (SEBI) (2010) http://**biodiversity**-chm.eea.europa.eu/information/**indicator**/F1090245995/F1101800700/1090246068; Teder T ...
Cited by 172 Related articles All 19 versions Web of Science: 103 Cite Save More

What criteria should be used to select biodiversity indicators?
U Heink, I Kowarik - **Biodiversity** and conservation, 2010 - Springer
... Wildl Soc Bull 24(4):738–749. Duelli P, Obrist MK (2003) **Biodiversity indicators**: the choice of values and measures. Agric Ecosyst Environ 98(1–3):87–98CrossRef. Dulvy NK, Jennings S, Rogers SI et al (2006) Threat and decline in fishes: an **indicator** of **marine biodiversity**. ...
Cited by 49 Related articles All 12 versions Web of Science: 20 Cite Save More

Good Global Indicators are:

- Well align to specific foci
- Scientifically credible
- Easy to understand (for non-scientist)
- Indicate present state and temporal trend
- Ideally Global

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"He's right, when you look at it that way,
it's not so bad!"

MIND THE GAP!

CAN YOU HELP US TO FILL THE REMAINING GAPS IN THE GLOBAL INDICATOR FRAMEWORK FOR THE STRATEGIC PLAN FOR BIODIVERSITY 2011-2020?



List of Aichi Target components for which no specific indicators have been identified*:

 Trends in public engagement with biodiversity	 Trends in identification and prioritization of IAS	 Trends in areas of particular importance for ecosystem services conserved
 Trends in extent to which biodiversity and ecosystem service values are incorporated into reporting systems	Trends in the distribution and populations of IAS	 Trends in genetic diversity of socio-economically as well as culturally valuable species
 Trends in extent to which biodiversity and ecosystem service values are incorporated into organizational accounting and reporting	Trends in impacts of IAS on ecosystems	 Trends in restoration of ecosystems that provide essential services
 Trends in fragmentation of forest and other natural habitats	 Trends in responses to reduce pressures on coral reefs	 Trends in ecosystem resilience
 Trends in proportion of depleted, target and bycatch species with recovery plans	Trends in extent and condition of other vulnerable ecosystems impacted by climate change or ocean acidification	 Trends in the practice of traditional occupations (decision X/43)
 Trends in proportion of production of aquaculture under sustainable practices	Trends in pressures on other vulnerable ecosystems impacted by climate change or ocean acidification	Trends in which traditional knowledge and practices are respected through their full integration, safeguards and the full and effective participation of indigenous and local communities in the national implementation of the Strategic Plan
Trends in extinction risk and populations of forest-specialist species in production forest	Trends in responses to reduce pressures on other vulnerable ecosystems impacted by climate change or ocean acidification	

*A full list of the Aichi Biodiversity Targets is available online: <https://www.cbd.int/sp/targets/>



Quick guide to the Aichi Biodiversity Targets

Pressures on vulnerable ecosystems reduced

By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning

Element 10.1

Multiple anthropogenic pressures on **coral reefs** are minimized, so as to maintain their integrity and functioning

Element 10.2

Multiple anthropogenic pressures on **other vulnerable ecosystems** impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning

Indicator type

PRESSURE **X**

STATE 

RESPONSE **X**

Indicator

- Living Planet Index of reef-dependent spp.
- Red List Index of reef-building coral spp.

Potential Indicator

- Global coral health (NOAA Coral Reef Watch)
- Global coral reef cover (U Queensland)
- Number of countries reporting coral bleaching (ReefBase)

PRESSURE **X**

STATE **X**

RESPONSE **X**

Cumulative human impact on marine ecosystem (Halpern et al. 2008)



Online Survey

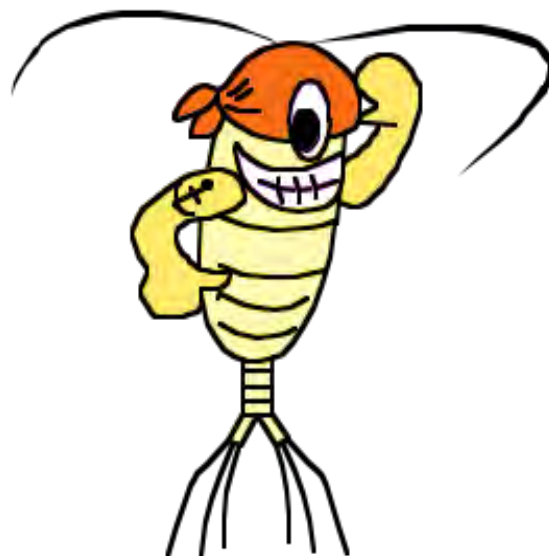


MIND THE GAP!

CAN YOU HELP US TO FILL THE REMAINING GAPS IN THE GLOBAL INDICATOR FRAMEWORK FOR THE STRATEGIC PLAN FOR BIODIVERSITY 2011-2020?



Strength of Zooplankton Data against BIP Criteria



Strengths

- Advantages
- Capabilities
- Resources, Assets, People
- Marketing - reach, distribution, awareness

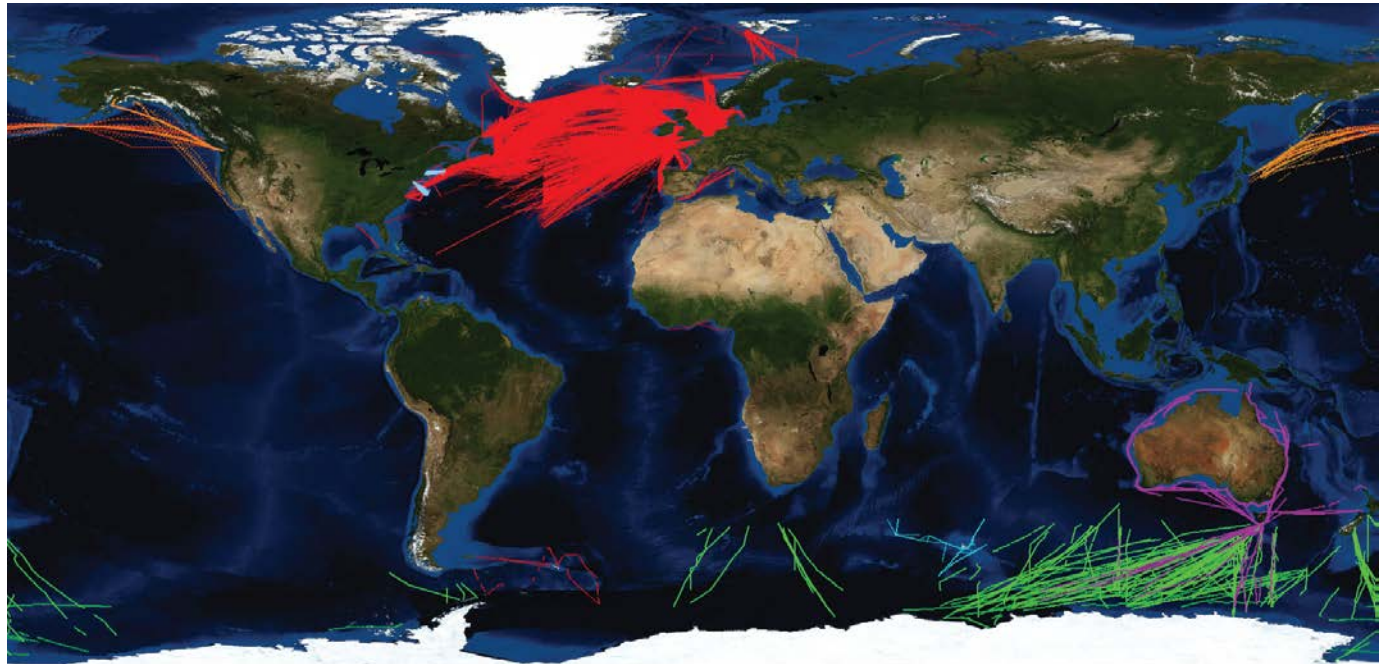




Strengths

Advantages
Capabilities
Resources, Assets, People
Marketing - reach, distribution, awareness

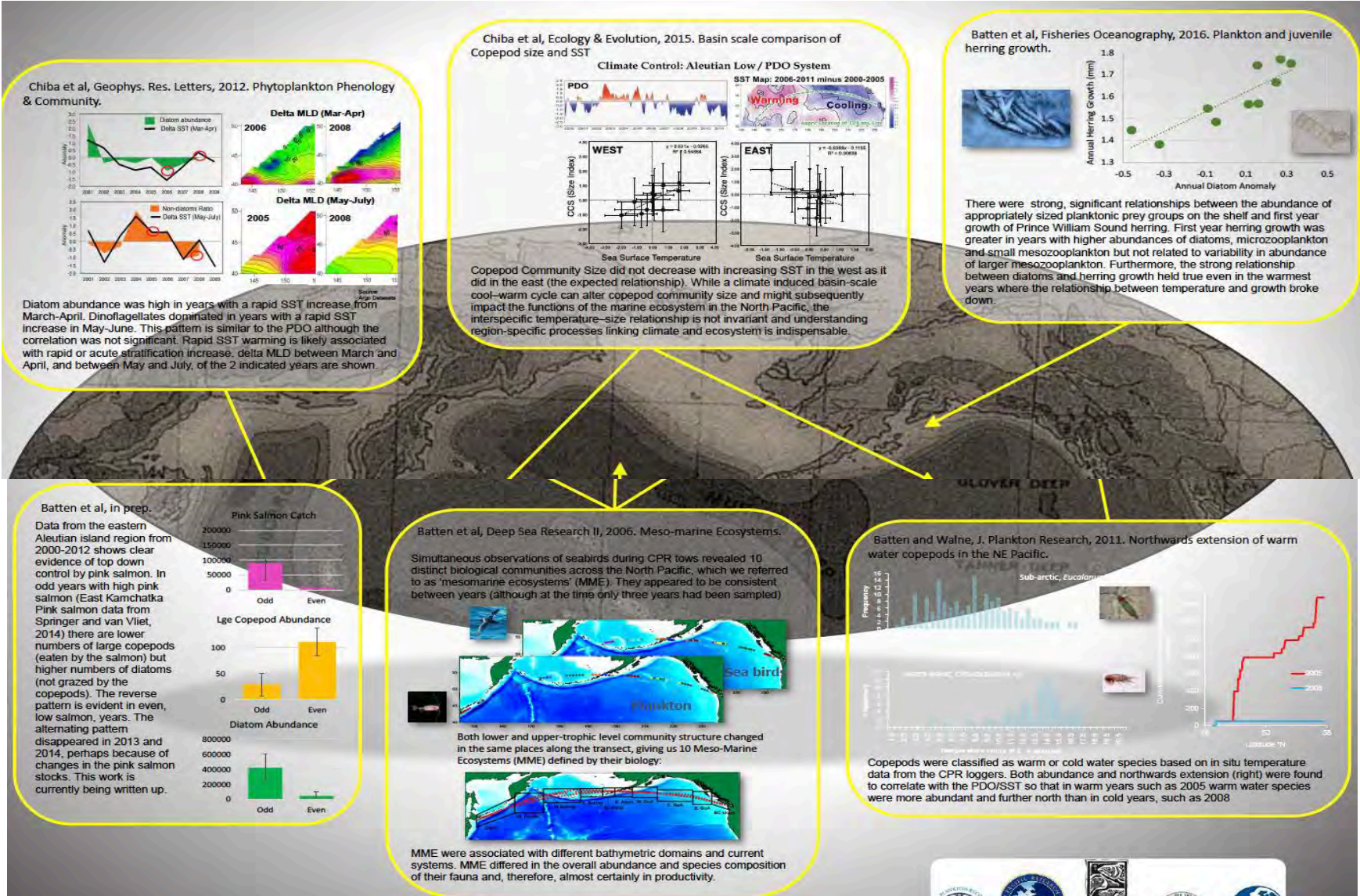
**Good Temporal and Spatial Coverage
(quasi-global, many time-series > 10 yrs)
CPR: Standardized observation and analytical methods**



Scientifically Credible

S1 Poster

Highlights from 16 years of the North Pacific CPR program, a PICES MONITOR project. S. Batten, S. Chiba, T. Yoshiki, H. Sugisaki



Chiba et al, Geophys. Res. Letters, 2012. Phytoplankton Phenology & Community.

Diatom abundance was high in years with a rapid SST increase from March-April. Dinoflagellates dominated in years with a rapid SST increase in May-June. This pattern is similar to the PDO although the correlation was not significant. Rapid SST warming is likely associated with rapid or acute stratification increase, delta MLD between March and April, and between May and July, of the 2 indicated years are shown.

Chiba et al, Ecology & Evolution, 2015. Basin scale comparison of Copepod size and SST

Climate Control: Aleutian Low / PDO System

Copepod Community Size did not decrease with increasing SST in the west as it did in the east (the expected relationship). While a climate induced basin-scale cool-warm cycle can alter copepod community size and might subsequently impact the functions of the marine ecosystem in the North Pacific, the interspecific temperature-size relationship is not invariant and understanding region-specific processes linking climate and ecosystem is indispensable.

Batten et al, Fisheries Oceanography, 2016. Plankton and juvenile herring growth.

There were strong, significant relationships between the abundance of appropriately sized planktonic prey groups on the shelf and first year growth of Prince William Sound herring. First year herring growth was greater in years with higher abundances of diatoms, microzooplankton and small mesozooplankton but not related to variability in abundance of larger mesozooplankton. Furthermore, the strong relationship between diatoms and herring growth held true even in the warmest years where the relationship between temperature and growth broke down.

Batten et al, in prep.

Data from the eastern Aleutian island region from 2000-2012 shows clear evidence of top down control by pink salmon. In odd years with high pink salmon (East Kamchatka Pink salmon data from Springer and van Vliet, 2014) there are lower numbers of large copepods (eaten by the salmon) but higher numbers of diatoms (not grazed by the copepods). The reverse pattern is evident in even, low salmon, years. The alternating pattern disappeared in 2013 and 2014, perhaps because of changes in the pink salmon stocks. This work is currently being written up.

Batten et al, Deep Sea Research II, 2006. Meso-marine Ecosystems.

Simultaneous observations of seabirds during CPR tows revealed 10 distinct biological communities across the North Pacific, which we referred to as 'mesomarine ecosystems' (MME). They appeared to be consistent between years (although at the time only three years had been sampled)

Both lower and upper-trophic level community structure changed in the same places along the transect, giving us 10 Meso-Marine Ecosystems (MME) defined by their biology:

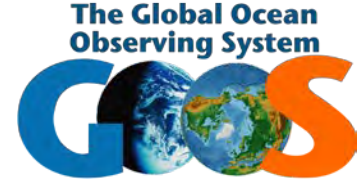
MME were associated with different bathymetric domains and current systems. MME differed in the overall abundance and species composition of their fauna and, therefore, almost certainly in productivity.

Batten and Walne, J. Plankton Research, 2011. Northwards extension of warm water copepods in the NE Pacific.

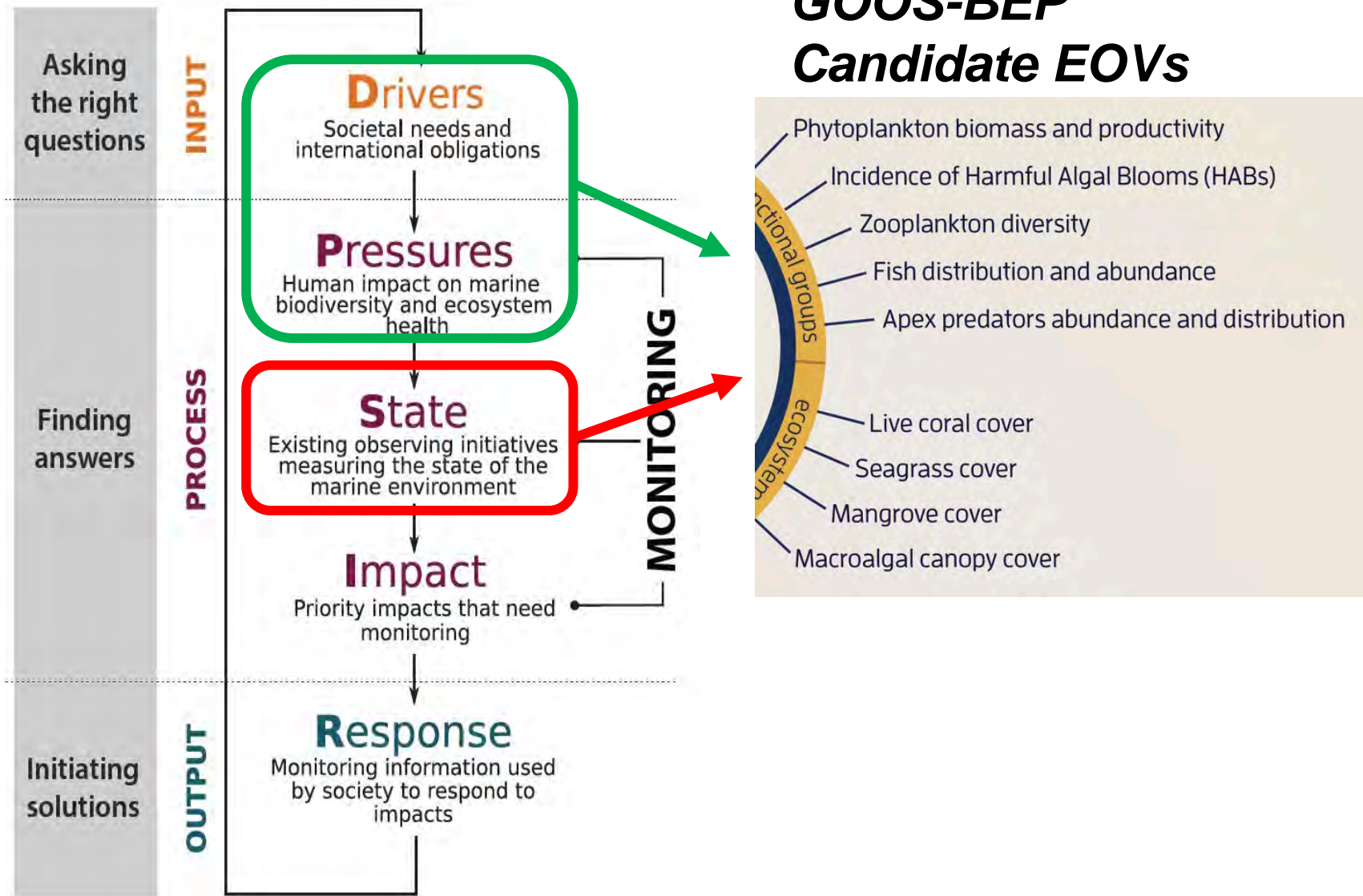
Copepods were classified as warm or cold water species based on in situ temperature data from the CPR loggers. Both abundance and northwards extension (right) were found to correlate with the PDO/SST so that in warm years such as 2005 warm water species were more abundant and further north than in cold years, such as 2008



Priority Setting for GOOS EOVs

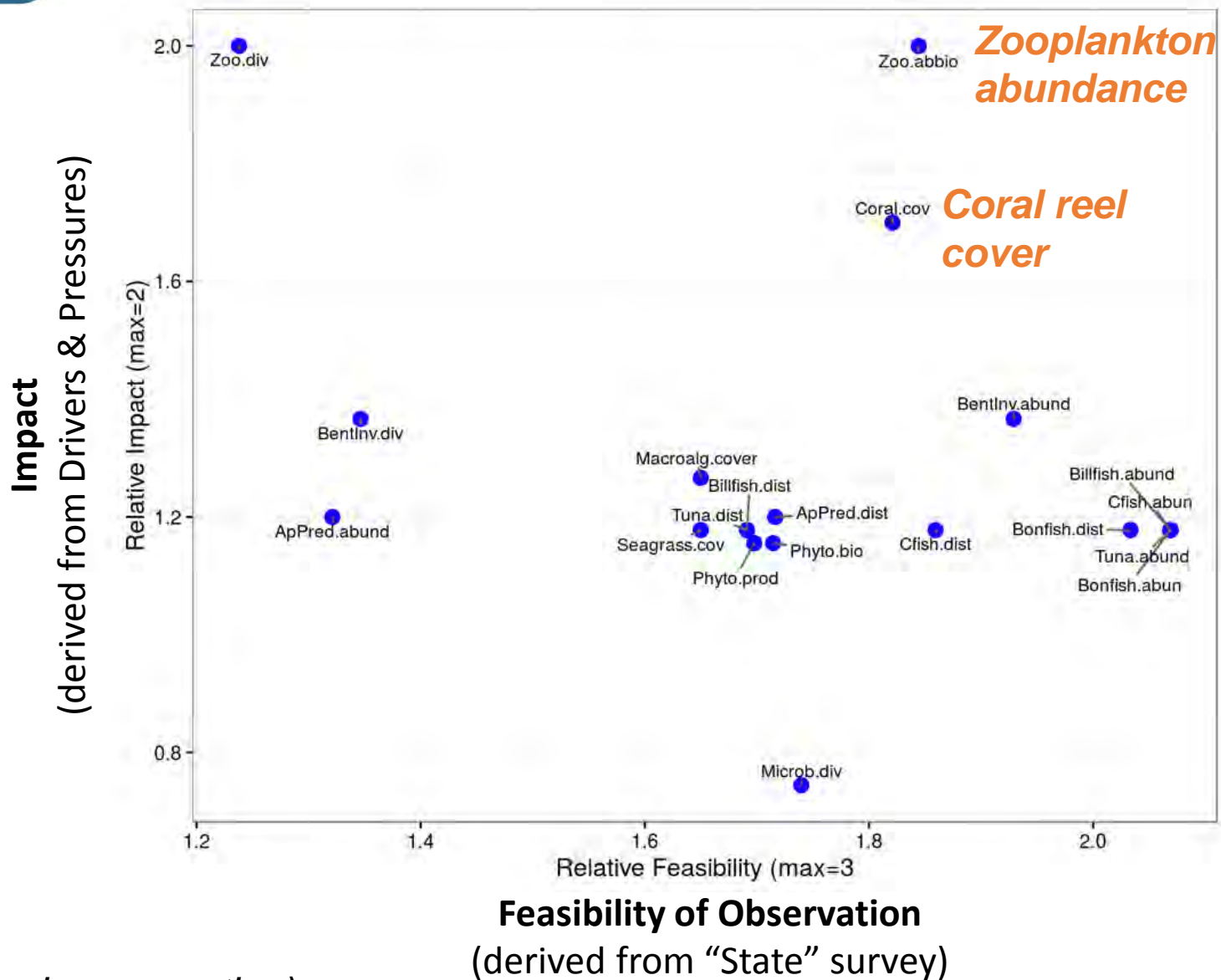
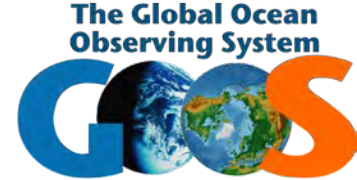


GOOS-BEP Candidate EOVs





Priority Setting for GOOS EOVs: Impact vs Feasibility



(Paper in preparation)



High score against BIP Indicator Criteria

Table 1 Zooplankton Diversity Indicators vs. BIP Global Indicator Criteria. The Criteria is based on Tittensor et al. 2014).

Zooplankton Diversity Indicators		Total Abundance	Species Richness	Size Index	Community Structure (Principal Component)	Abundance of target species/taxa	Morphological & physiological condition of shelled plankton
What to indicate (on current status and long-term trend)		Biological Productivity, Food supply for fish, birds & mammals.	Biodiversity, Ecosystem health	Food quality for fish, birds & mammals	Food quantity for fish, birds & mammals, Biogeographical shift, etc.	Productivity of top predator, deterioration of environment, etc.	Impacts of Ocean Acidification
BIP Global Indicator Criteria	Relevance/Alignment (Low – Mid – High)	High	High	High	High	High	High
	Scientific Credibility "Published?" (Low – Mid – High)	High	High	High	High	High	Low – Middle (method not published yet)
	Temporal Coverage: end data point 2010~	Yes	Yes	Yes	Yes	Yes	Potentially Yes
	Temporal Coverage: at least 5 data points	Yes	Yes	Yes	Yes	Yes	Potentially Yes
	Geographic Coverage "Global ideally"	Quasi - global	Quasi - global	Quasi - global	Quasi - global	Quasi – global or Regional	Quasi - global
	BIP Category ABC	?	?	?	?	?	?

Online Survey Summary, September 16, 2016

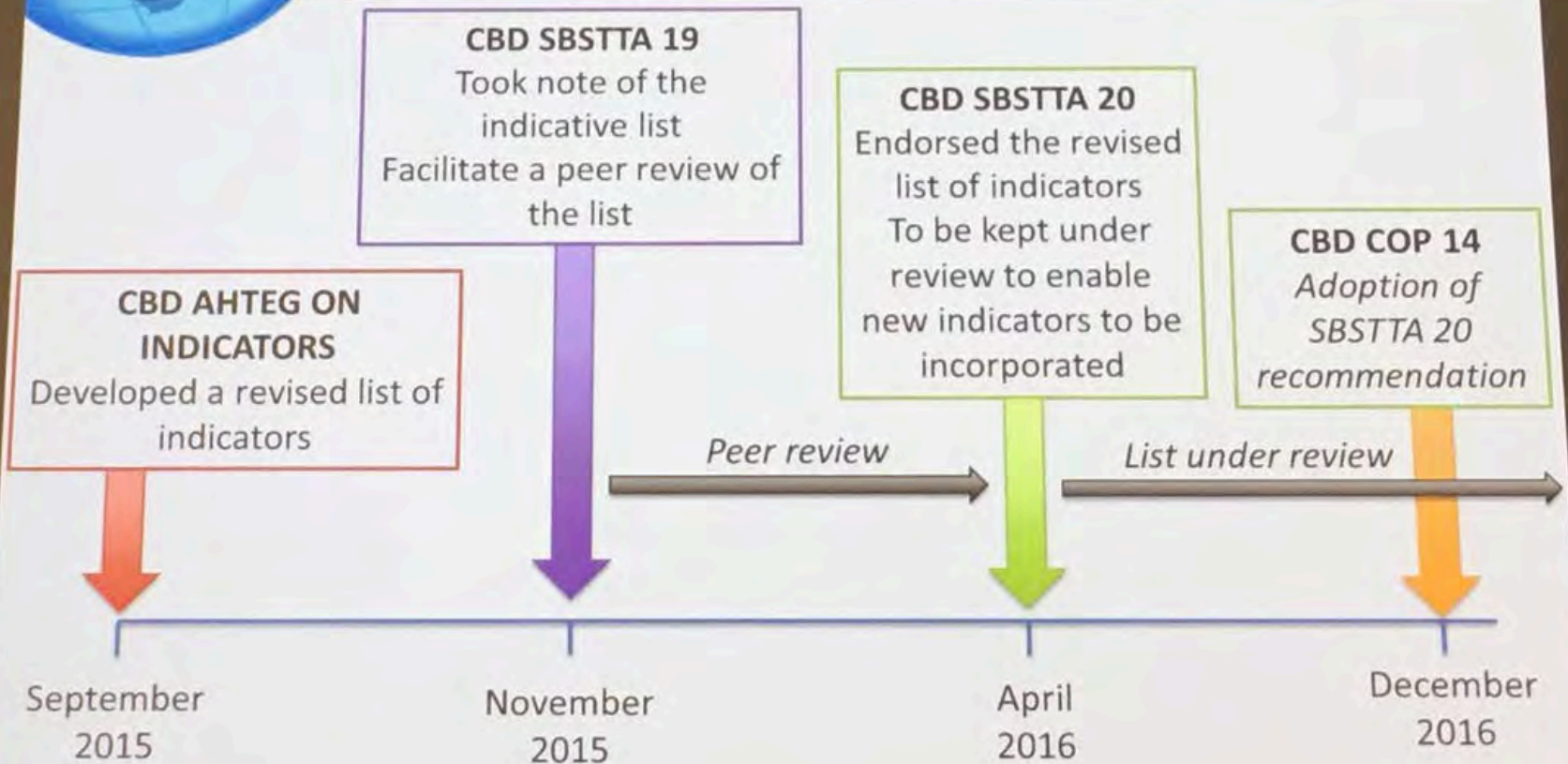
Aichi Target	Generic indicator	Suggested indicators through the online consultation	Operational (o) or under development (d) or idea (I)	Funding required for global indicator (Y/N)	Easy to update? Y/N)	Alignment to element (H/M/L)	Spatial coverage (H/M/L)	Indicator category
10	Trends in extent and condition of other vulnerable ecosystems impacted by climate change or ocean acidification	Mortality, bleaching and necrosis events – UNEP MAP	O (sub-global)	Y	?	H	M (21 Mediterranean countries)	Sub-global indicator of potential future interest for dissemination
		Phenology of reproductive events of selected marine species (fishes, marine turtles, seabirds, flowering of <i>P. oceanica</i>) – UNEP MAP	O (Sub-global)	Y	?	H	M (21 Mediterranean countries)	Sub-global indicator of potential future interest for dissemination
		Episodic Marine Species Outbreaks (blooms) – UNEP MAP	O (Sub-global)	Y	?	H	M (21 Mediterranean countries)	Sub-global indicator of potential future interest for dissemination
		Zooplankton diversity (1. total abundance/biomass, 2. size structure, 3. abundance of key species, 4. species richness, etc.) - Global Alliance of Continuous Plankton Survey (GACS) a	O	N => Y, to set the protocol to implement	? => Y once the protocol is set	H	H	Ready for global use (yet still need to set the protocol to implement)
		Coral Reef Watch (http://coralreefwatch.noaa.gov/satellite/index.php)	D	?	?	H	H	Global indicator under active development
		Elevational shifts in mountain plant/vegetation and animal species – Walter <u>Jetz</u>	I	Y	?	H	H	Idea with future potential
		Live Coral cover – David <u>Obura</u>	D	?	?	?	?	?

Partnership with BIP

The institutions producing indicators that meet the criteria will be invited to join the BIP



Evolution of the CBD indicator list



Next Steps

1. Develop the tentative indicator ideas to fully empirical ones

Zooplankton Diversity Indicators	Total Abundance	Species Richness	Size Index	Community Structure (Principal Component)	Abundance of target species/taxa	Morphological & physiological condition of shelled plankton
What to indicate (on current status and long-term trend)	Biological Productivity, Food supply for fish, birds & mammals.	Biodiversity, Ecosystem health	Food quality for fish, birds & mammals	Food quantity for fish, birds & mammals, Biogeographical shift, etc.	Productivity of top predator, deterioration of environment, etc.	Impacts of Ocean Acidification

2. Establish operational protocols to regularly report indicator values among GACS (and zooplankton observation network?) to BIP and more.

Need Funding! ... as always...



Benefits of being BIP Partner :Future Opportunities

Support for the implementation of the **Strategic Plan for Biodiversity 2011-2020 and more...**

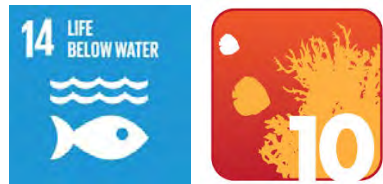
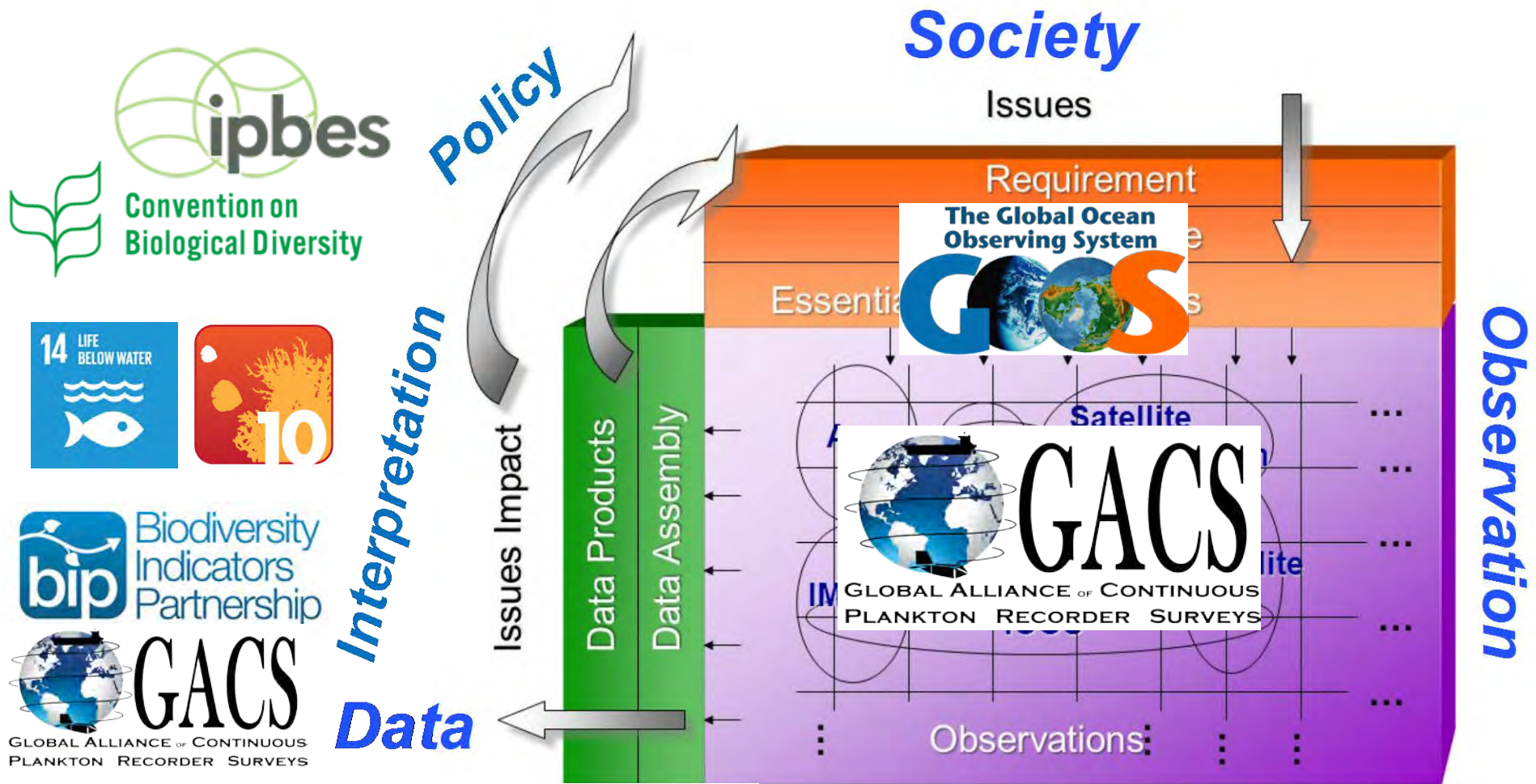


Support in the **production of multilingual indicator communication materials** (subject to resources), which can be used by Partners to highlight their indicators and the role of their indicators in supporting global mandated processes.

Participation in BIP Technical Meetings and help to shape the future of the BIP. Technical meetings provide an opportunity for indicator partners to network and come together to identify opportunities for collaborative work and fundraising.

Opportunity via the BIP to have indicator(s) **published in future editions of the Global Biodiversity Outlook, the flagship publication of the CBD**, and to be brought to the attention of other relevant processes and initiatives, such as **IPBES.**

Framework for Ocean Observing



SCO 2012, doi: 10.5270/OceanObs09-FOO)



And...

Strengthen communication bw/ communities of **conservation biology** and **oceanography**



MIND THE GAP!

Online Survey for Potential Global Indicators (July 2016)
(<https://www.surveymonkey.co.uk/r/GQ8PH9Y>)

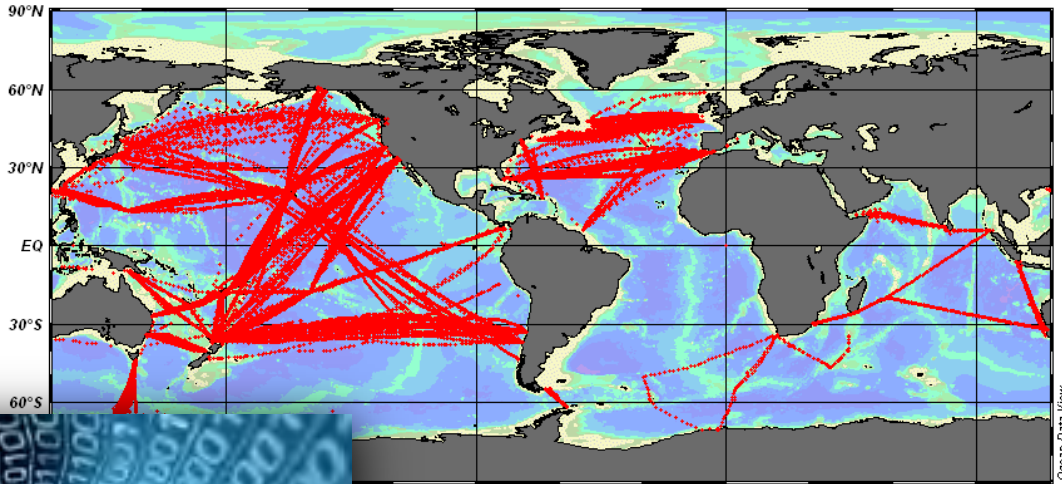
	Trends in responses to reduce pressures on coral reefs
	Trends in extent and condition of other vulnerable ecosystems impacted by climate change or ocean acidification
	Trends in pressures on other vulnerable ecosystems impacted by climate change or ocean acidification
	Trends in responses to reduce pressures on other vulnerable ecosystems impacted by climate change or ocean acidification

→ **State Indicator:
Zooplankton Global Indicators
(CPR plus), proposed**

→ **Pressure Indicator
e.g. OA Global Indicator?**



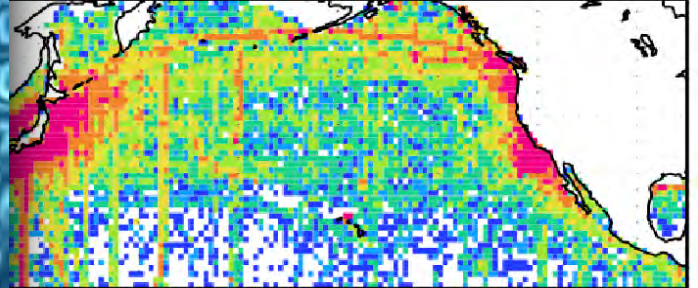
eWOC UOT - High Density Lines



Ocean Data View

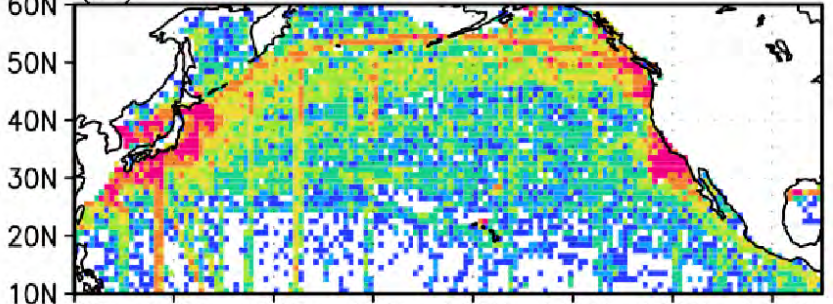
https://www.nodc.noaa.gov/woce/woce_v3/ocedata/2/ewoce/data/woce-uot/index.html

Phosphate



120E 140E 160E 180 160W 140W 120W 100W

(b) Nitrate

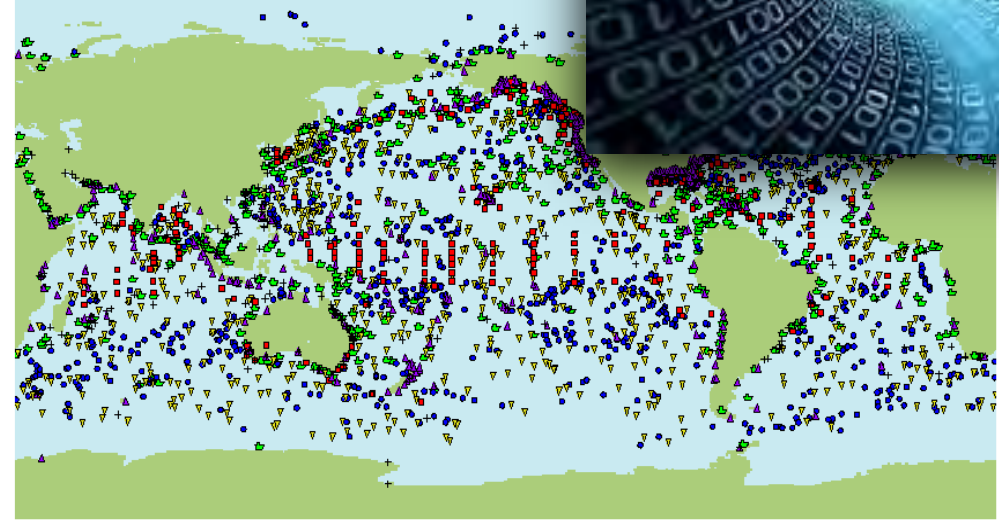


60N 50N 40N 30N 20N 10N 120E 140E 160E 180 160W 140W 120W 100W



<http://portal.goa-on.org/Explorer>

Date: 15-Oct-2012 00:00:00 to 17-Oct-2012 23:59:59 Platforms



Suppressing ship observations for most recent 48 hours
<https://ioos.noaa.gov/community/global/>



25

Happy
Anniversary