Biodiversity Observations for Decision-Making: From Data to Decision

Mike Gill

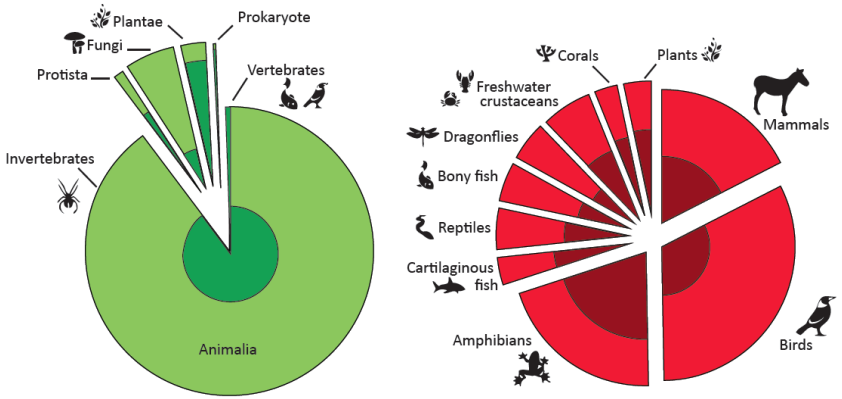
GEO BON Co-Chair

NatureServe Director of Biodiversity Indicators Program

Expert Meeting on SEEA Indicators for SDGs and Post-2020 Agenda for Biodiversity
Cambridge, UK

Biodiversity Data: Many Deficiencies

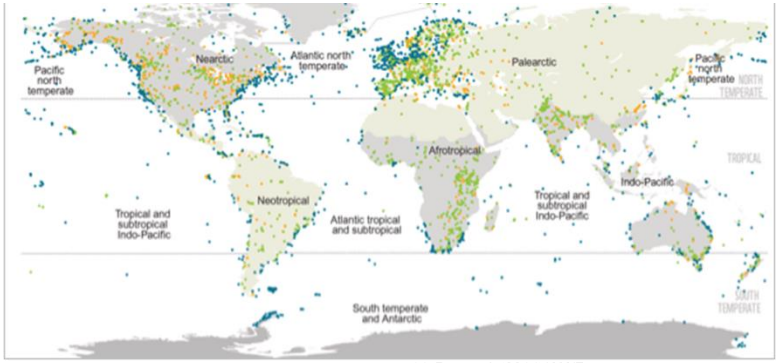
Taxonomic Bias



Pereira, H.M. et al (2012) *Annual Review of the Environment and Resources*.

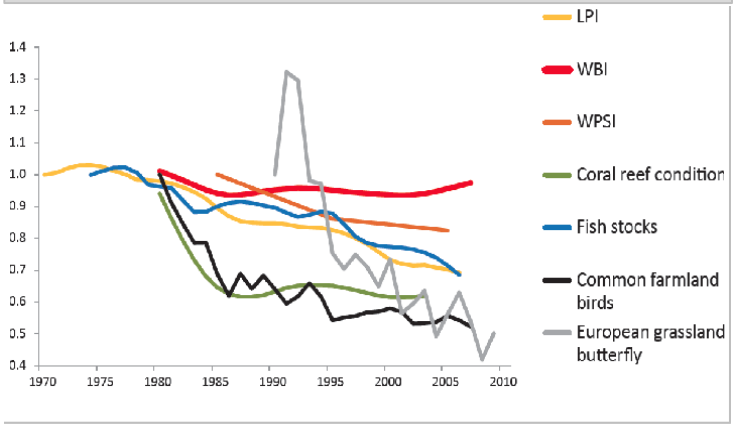
Impact & personal bias

Spatial dimension



McRae et al. (2014) WWF

Temporal dimension



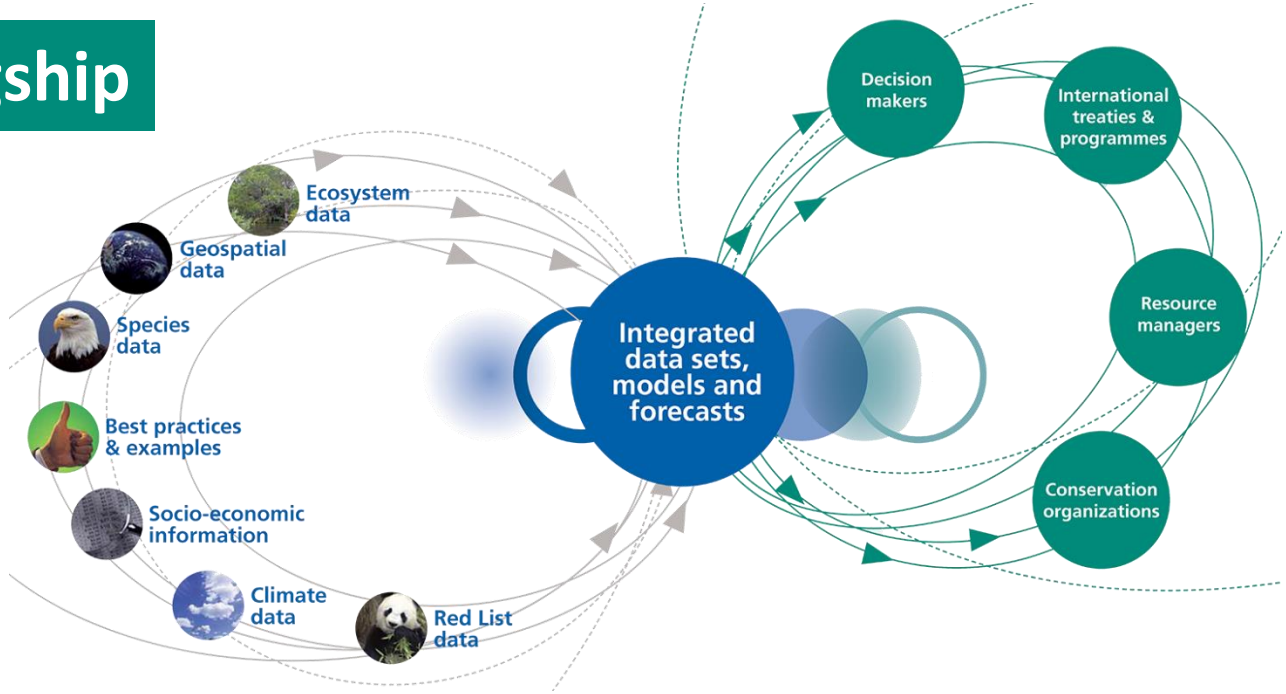
Pereira, H.M. et al (2012) *Annual Review of the Env. & Resources*.

What is GEO BON?

Mission

Improve the **acquisition**, **coordination** and **delivery** of biodiversity observations and related services to users including decision makers and the scientific community.

GEO Flagship



Vision

A **global biodiversity observation network** that contributes to effective **management policies** for the world's biodiversity and ecosystem services.

What is **GEO?**

A Global, Coordinated, Comprehensive and Sustained System of Observing Systems

Countries have borders. Earth Observations don't.

EARTH OBSERVATIONS FOR THE SUSTAINABLE DEVELOPMENT GOALS

GEO GROUP ON EARTH OBSERVATIONS

Target Contribute to progress on the Target, not necessarily the Indicator									Goal	Indicator Direct measure or indirect support to the Indicator					
							1.4	1.5	1 No poverty	1.4.2					
						2.3	2.4	2.c	2 Zero hunger	2.4.1					
					3.3	3.4	3.9	3.d	3 Good health and well-being	3.9.1					
									4 Quality education						
								5.a	5 Gender equality	5.a.1					
		6.1	6.3	6.4	6.5	6.6	6.a	6.b	6 Clean water and sanitation	6.3.1	6.3.2	6.4.2	6.5.1	6.6.1	
					7.2	7.3	7.a	7.b	7 Affordable and clean energy	7.1.1					
								8.4	8 Decent work and economic growth						
					9.1	9.4	9.5	9.a	9 Industry, innovation and infrastructure	9.1.1	9.4.1				
						10.6	10.7	10.a	10 Reduced inequalities						
	11.1	11.3	11.4	11.5	11.6	11.7	11.b	11.c	11 Sustainable cities and communities	11.1.1	11.2.1	11.3.1	11.6.2	11.7.1	
				12.2	12.4	12.8	12.a	12.b	12 Responsible consumption and production	12.a.1					
					13.1	13.2	13.3	13.b	13 Climate action	13.1.1					
		14.1	14.2	14.3	14.4	14.6	14.7	14.a	14 Life below water	14.3.1	14.4.1	14.5.1			
	15.1	15.2	15.3	15.4	15.5	15.7	15.8	15.9	15 Life on land	15.1.1	15.2.1	15.3.1	15.4.1	15.4.2	
								16.8	16 Peace, justice and strong institutions						
17.2	17.3	17.6	17.7	17.8	17.9	17.16	17.17	17.18	17 Partnerships for the goals	17.6.1	17.18.1				

Earth Observations in Service of the 2030 Agenda

Purpose:

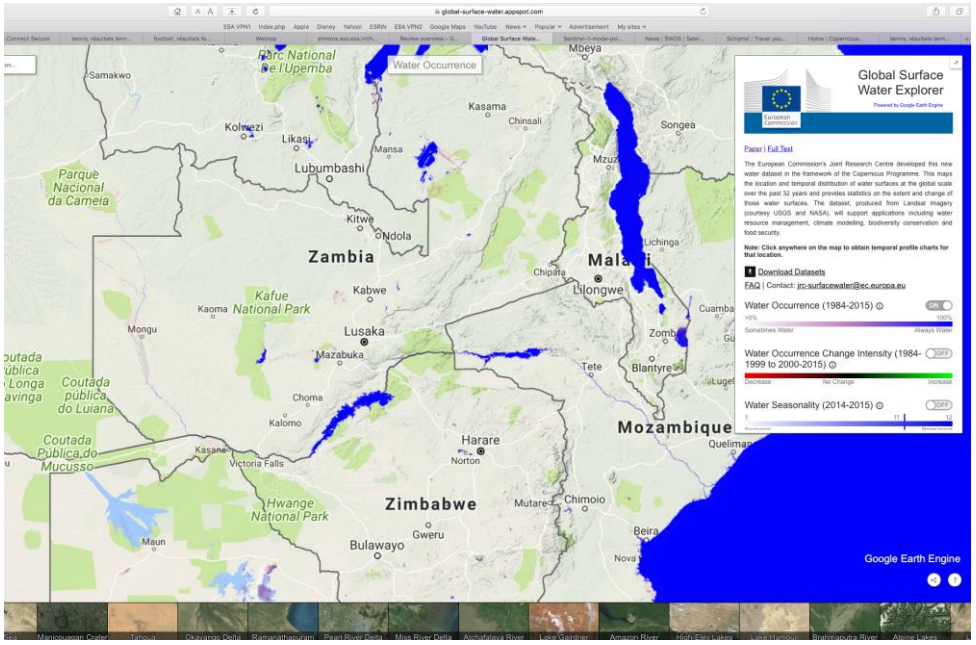
Organize and extend the potential of Earth observations and geospatial information within GEO to advance the *2030 Agenda* and enable societal benefits through achievement of the SDGs.

Key Emphasis:

Collaborations with global statistical community, NSOs, line ministries, custodian agencies. Also, communication role in a federated approach to GEO community.

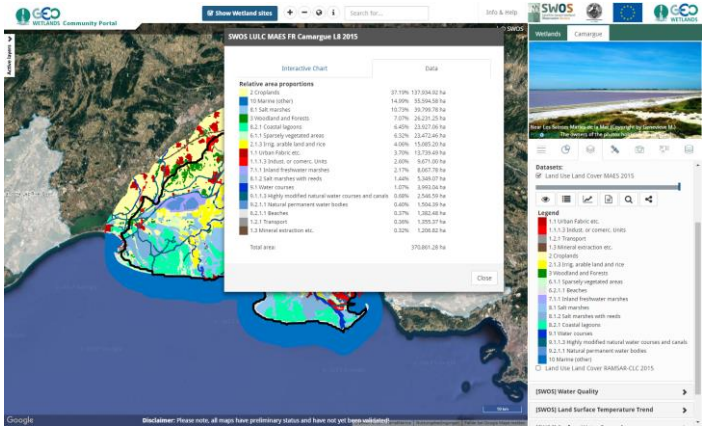
Earth observations for water-related ecosystem monitoring

High quality Global Data Set on spatial extent of inland water bodies (1984-2015, full Landsat archive, 30m, Joint Research Center supported by Google Earth Engine)

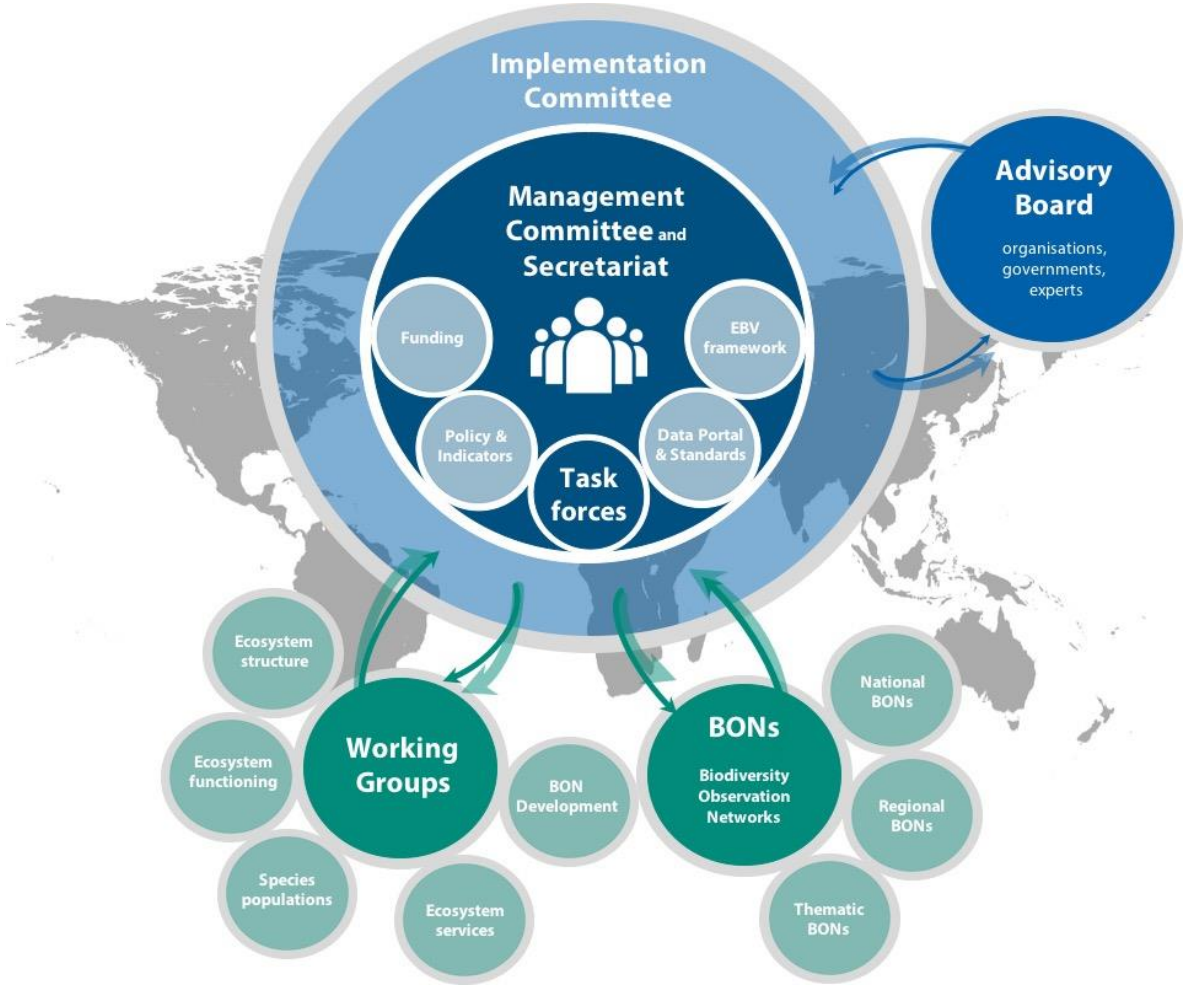


Water-related Community Portal

- Wetland-related datasets freely available
- EO best case practices & guidelines
- Portal customization for SDG 6 monitoring & reporting



GEO BON Governance and Core Focus



Developing a standard and flexible framework for biodiversity observations

Supporting the development of Biodiversity Observation Networks

Producing policy relevant outputs

Our Network of BONs: The 'Engines' of GEO BON

Contribute to the **collection** and **analysis** of **harmonised biodiversity observations**, the development of integrated and interoperable **biodiversity monitoring programs**, the development of **data standards** and the **testing and development** of GEO BON **outputs.**

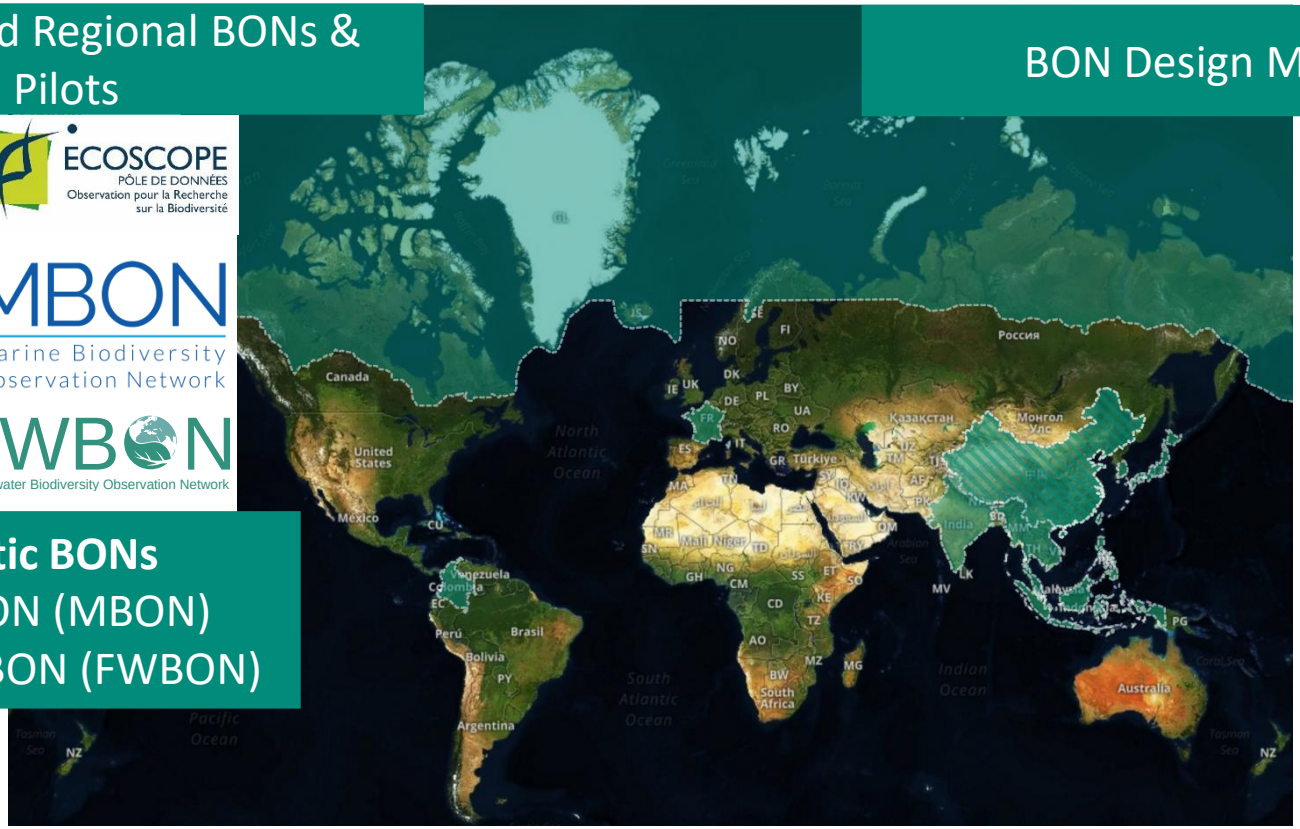
National and Regional BONs & Pilots

BON Design Manual

ECOSCOPE
PÔLE DE DONNÉES
Observation pour la Recherche sur la Biodiversité

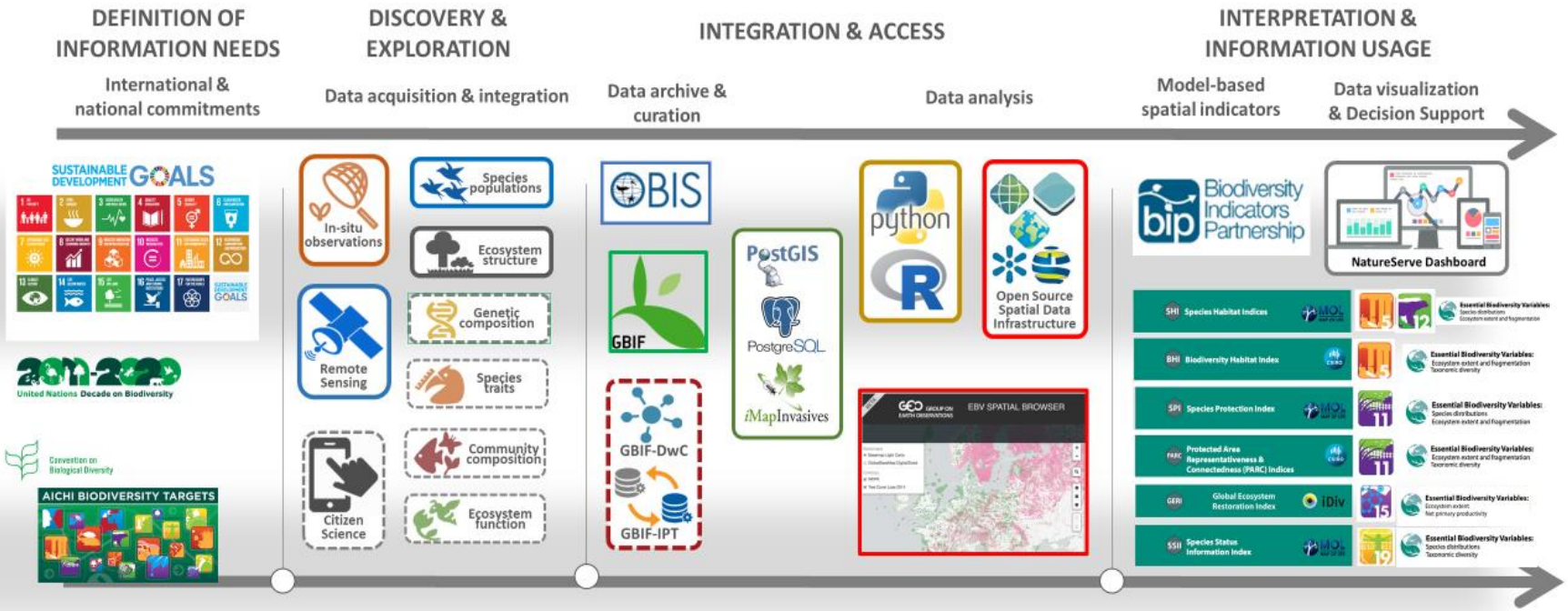
MBON
Marine Biodiversity Observation Network

FWBON
Freshwater Biodiversity Observation Network



Thematic BONs
Marine BON (MBON)
Freshwater BON (FWBON)

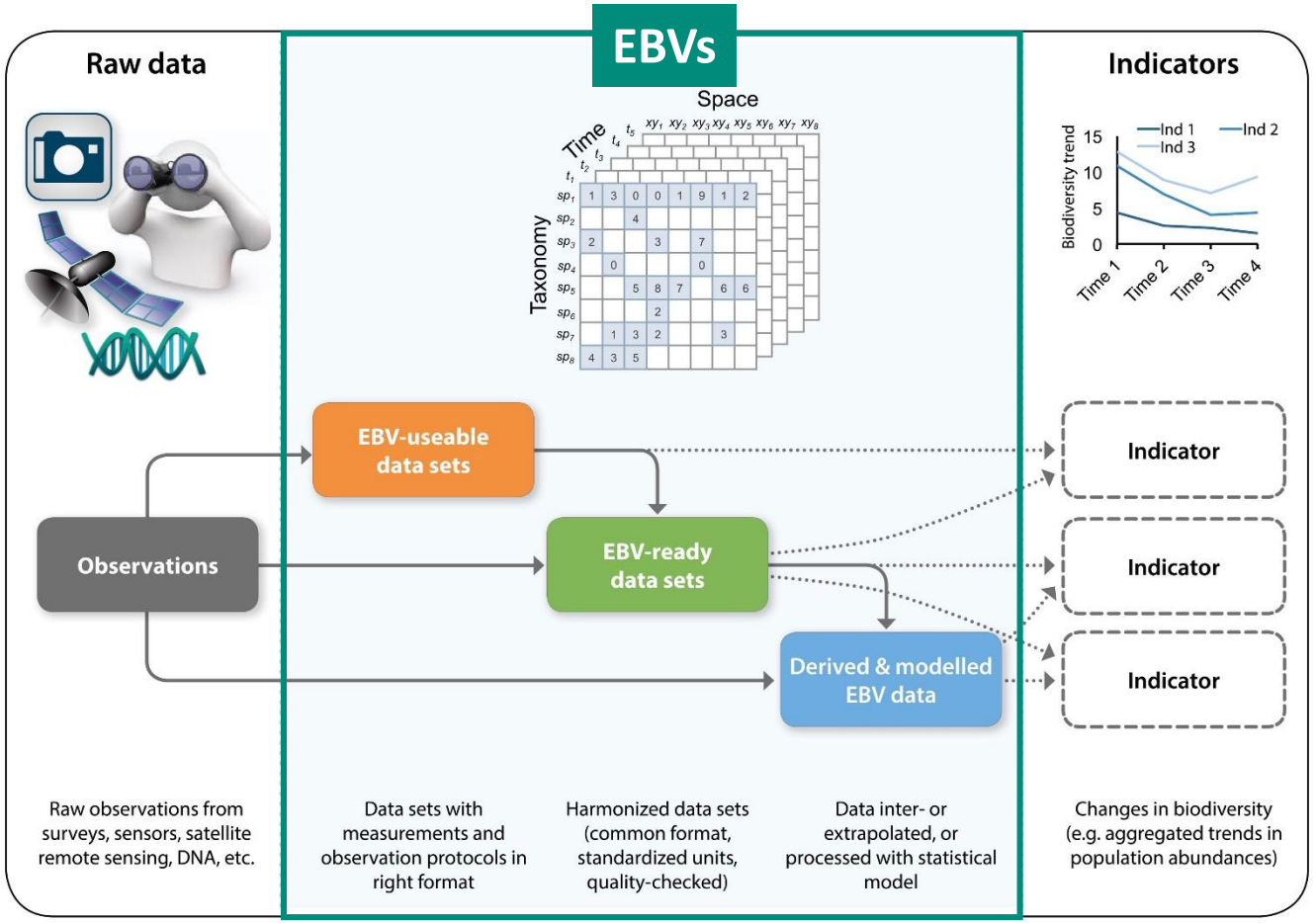
Biodiversity Observation and Information Systems: From Data to Decision



BON IN A BOX

Standard and Flexible Framework for Biodiversity Observations: the Essential Biodiversity Variables

EBVs: Minimum set of measurements, complementary to one another, that can capture major dimensions of biodiversity change.



Users

National Governments

CBD

ipbes Science and Policy for People and Nature

SUSTAINABLE DEVELOPMENT GOALS

Kissling et al., (2017) Biological Reviews

EBVs for Remote Sensing

TRACKING BIODIVERSITY

Ten variables

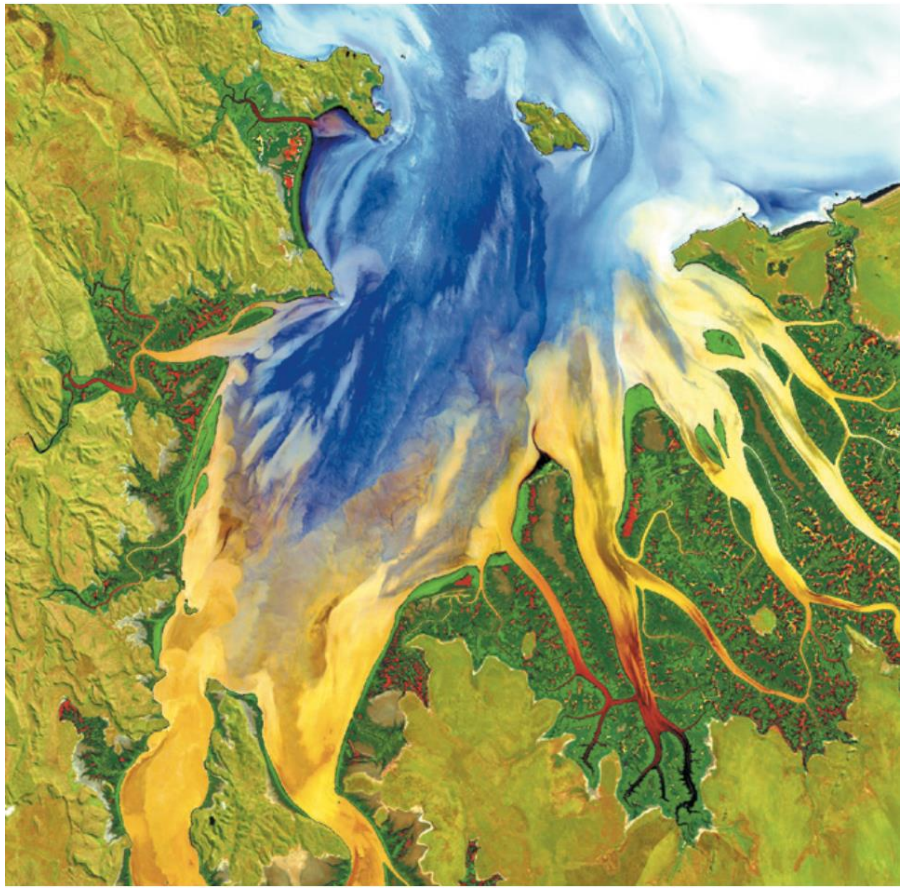
Proposed variables for satellite monitoring of progress towards the Aichi Biodiversity Targets.

Species populations
- Species occurrence

Species traits
- Plant traits (such as specific leaf area and leaf nitrogen content)

Ecosystem structure
- Ecosystem distribution
- Fragmentation and hetrogeneity
- Land cover
- Vegetation height

Ecosystem function
- Fire occurrence
- Vegetation phenology (variability)
- Primary productivity and leaf area index
- Inundation



Skidmore, A. et al (2015) *Nature*

EBVs and the SDGs

MBON
Marine Biodiversity Observation Network

Indicator 14.5.1.
Coverage of protected areas in relation to marine areas

Target 14.2
Prototype product to integrate EO, OBIS data, local surveys

Candidate EBV classes

2.4 2.5	Ecosystem structure Ecosystem function Genetic composition
3.D	Species populations
6.3 6.6	Ecosystem function Species Populations Ecosystem Structure
11.3	Ecosystem Structure
14.4 14.5	Species Populations Ecosystem Structure
15.1, 15.2, 15.3, 15.4, 15.5, 15.7, 15.8, 15.c	Ecosystem Structure Species Populations Ecosystem Function

GEO BON

Policy relevant outputs

Convention on Biological Diversity

SUSTAINABLE DEVELOPMENT GOALS

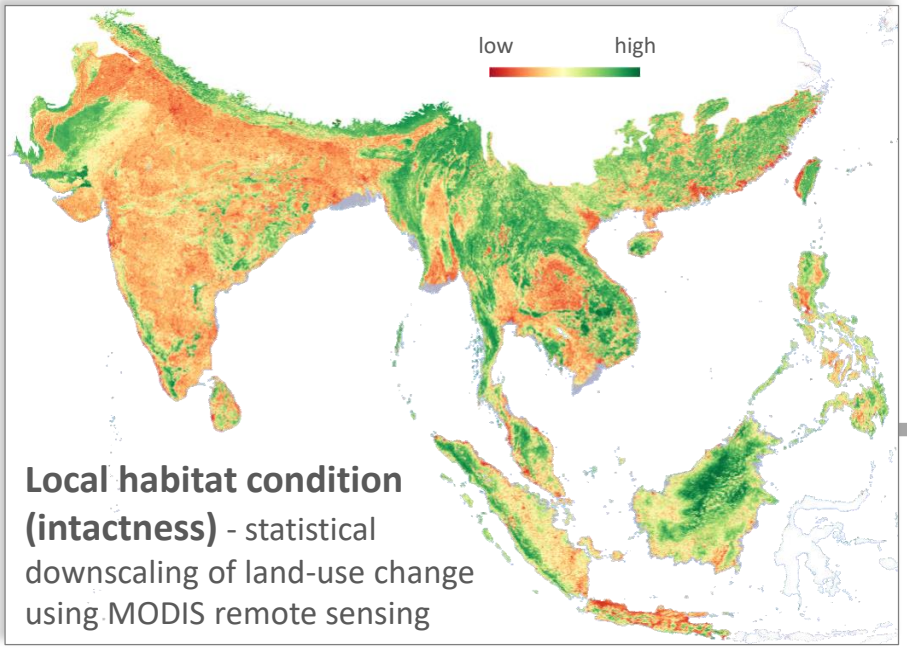
GEO BON

Global Biodiversity Change Indicators

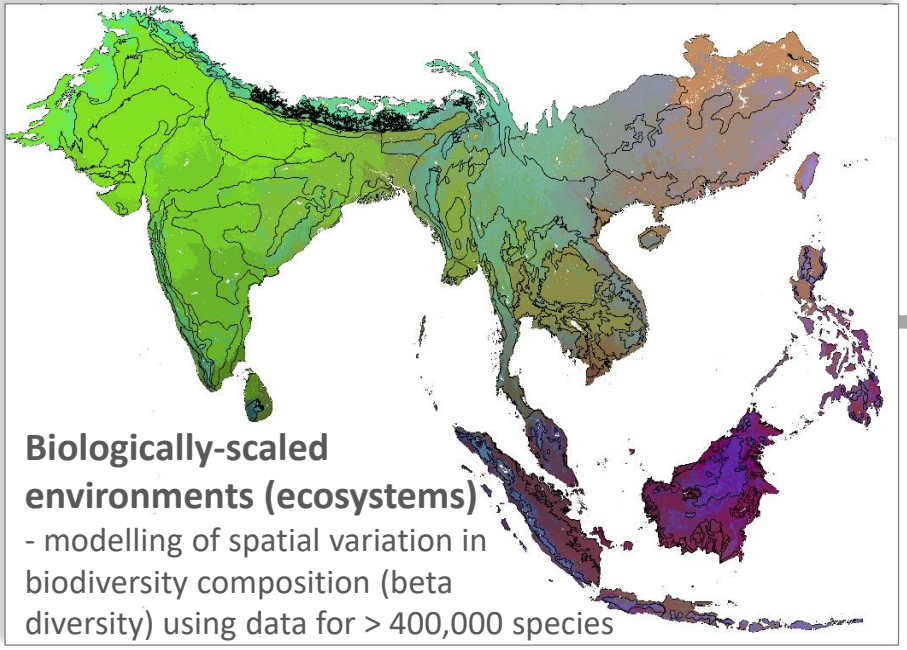
Model-based integration of remote-sensing & in situ observations that enables dynamic updates and transparency at low cost

Predicts MOL MAP OF LIFE UNEP WCMC iDiv

Biodiversity Habitat Index (BHI) – Aichi Target 5

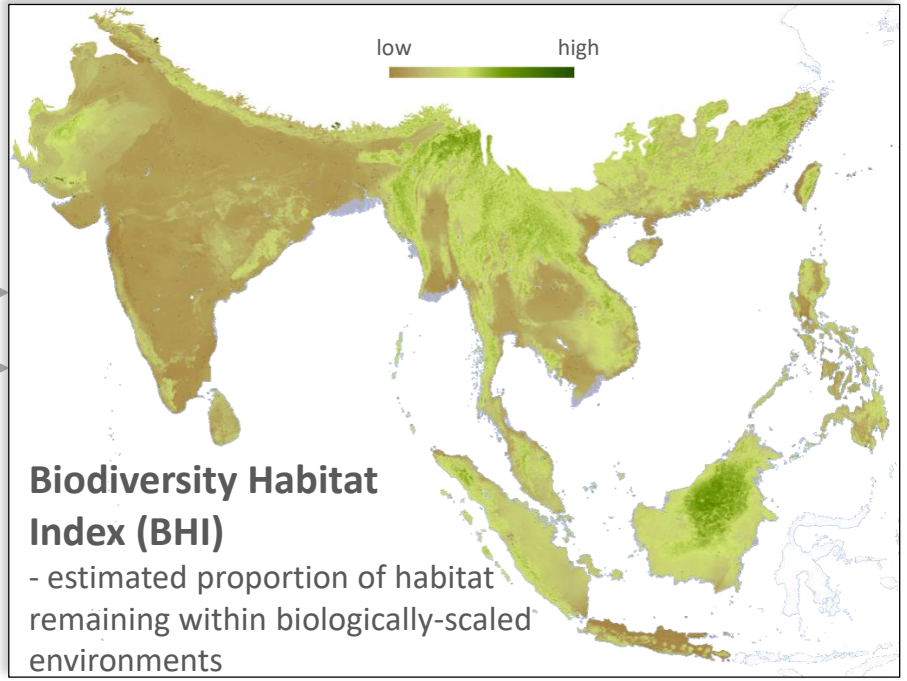


Local habitat condition (intactness) - statistical downscaling of land-use change using MODIS remote sensing



Biologically-scaled environments (ecosystems) - modelling of spatial variation in biodiversity composition (beta diversity) using data for > 400,000 species

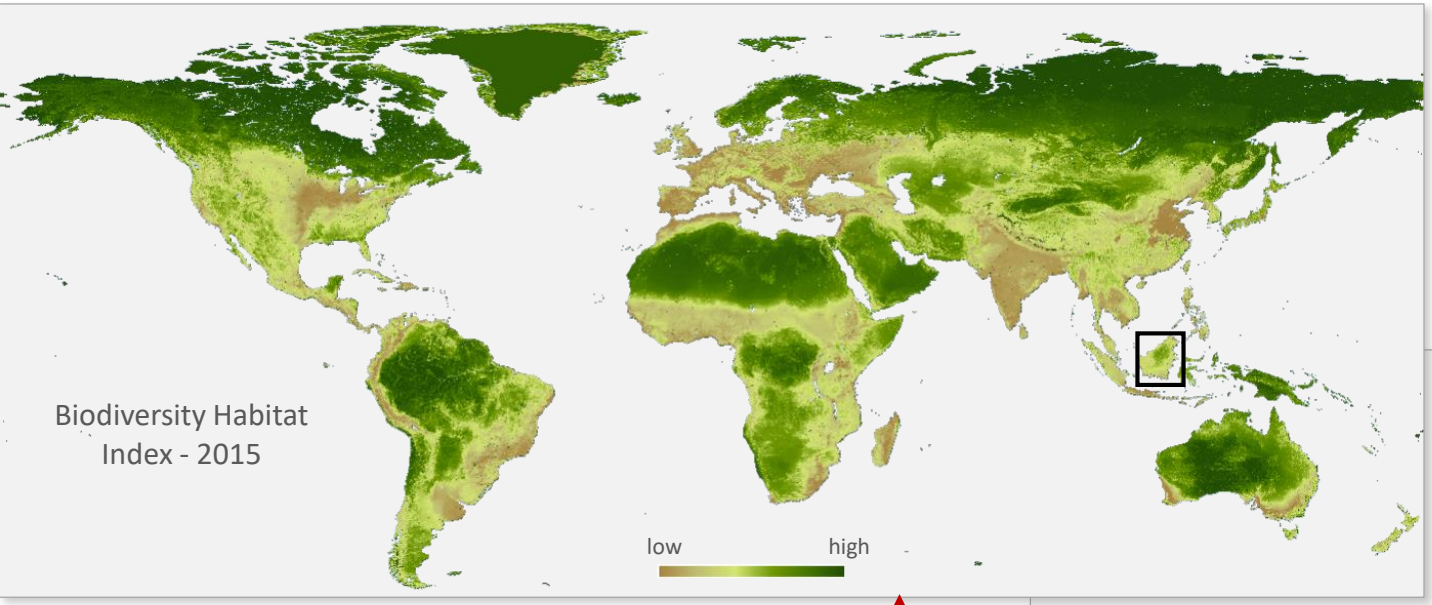
- **Combines remotely monitored habitat condition with modelled spatial variation in biodiversity composition**
- **Derived at 1km grid resolution across the entire land surface of the planet**

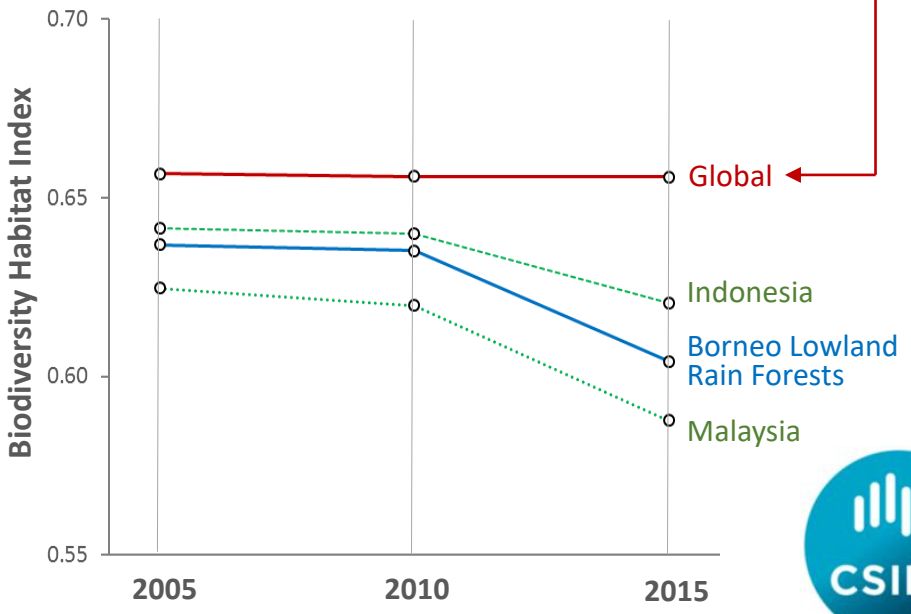


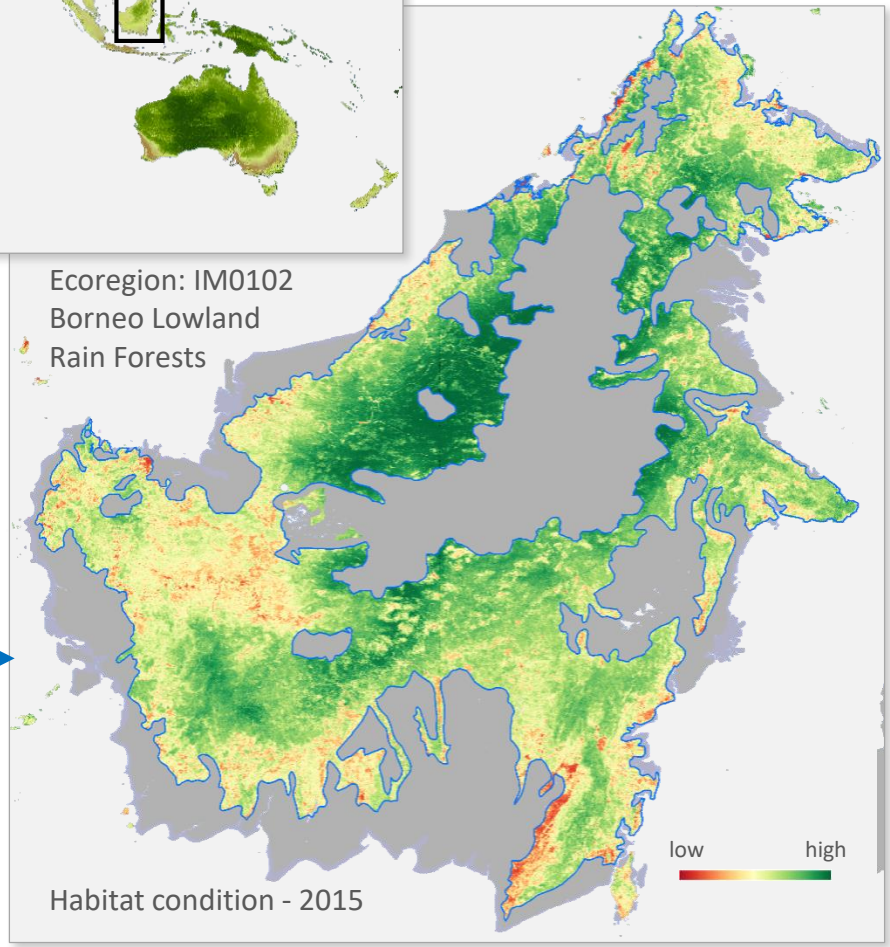
Biodiversity Habitat Index (BHI)
- estimated proportion of habitat remaining within biologically-scaled environments

CSIRO · GEO BON · bip Biodiversity Indicators Partnership · GBIF · MOL Map of Life · Predicts

The BHI is recalculated, using remote-sensing inputs from different years, to report change in habitat retention across all biologically-scaled environments occurring within any given spatial unit (e.g. country, ecoregion, the entire planet)

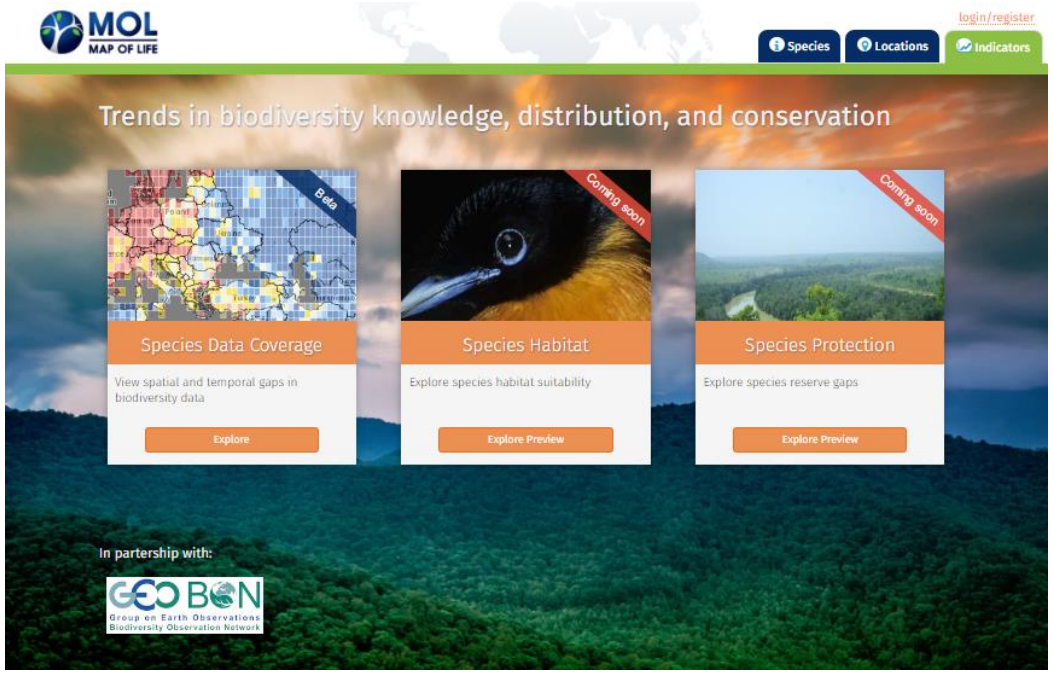






Indicators

https://mol.org/indicators



Species Status Information Index (Aichi Target 19)
Species Protection Index (Aichi Target 11)
Species Habitat Index (Aichi Targets 5 & 12)

Part of the 28 IPBES Core Indicators

GEO BON

ipbes

Species Protection Index

MOL MAP OF LIFE

Species Info | Map a Species | Species Lists by Location | About MOL | News | Help

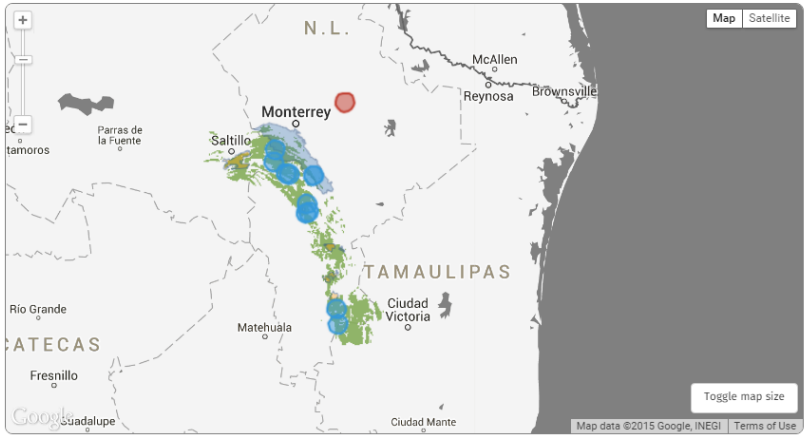
Overview | Habitat Distribution | Habitat Change | Reserve Coverage | Info

Select a species | Pick random | Birds

Vejar's Fir
Abies vejarii

Learn more | Update

Records outside suitable range | Records in suitable range | Suitable range | Strict Parks | All Parks



Habitat Associations ON OFF

Elevation ON OFF
1900 - 3400 meters

Tree cover: ON OFF
10 - 100%

Landcover ON OFF

Woodlands: Forests | Woody Savannas
Cultivated: Cropland | Cropland Mosaics
Shrublands: Open | Closed
Barren | Urban: Barren | Urban
Herbaceous: Savannas | Grasslands
Water: Wetlands | Water Bodies

Geographic distribution

Range size	6,549 km² Suitable	23,170 km² Total
Map improvement	52 % (35 % - 55 %)	12 Validation points

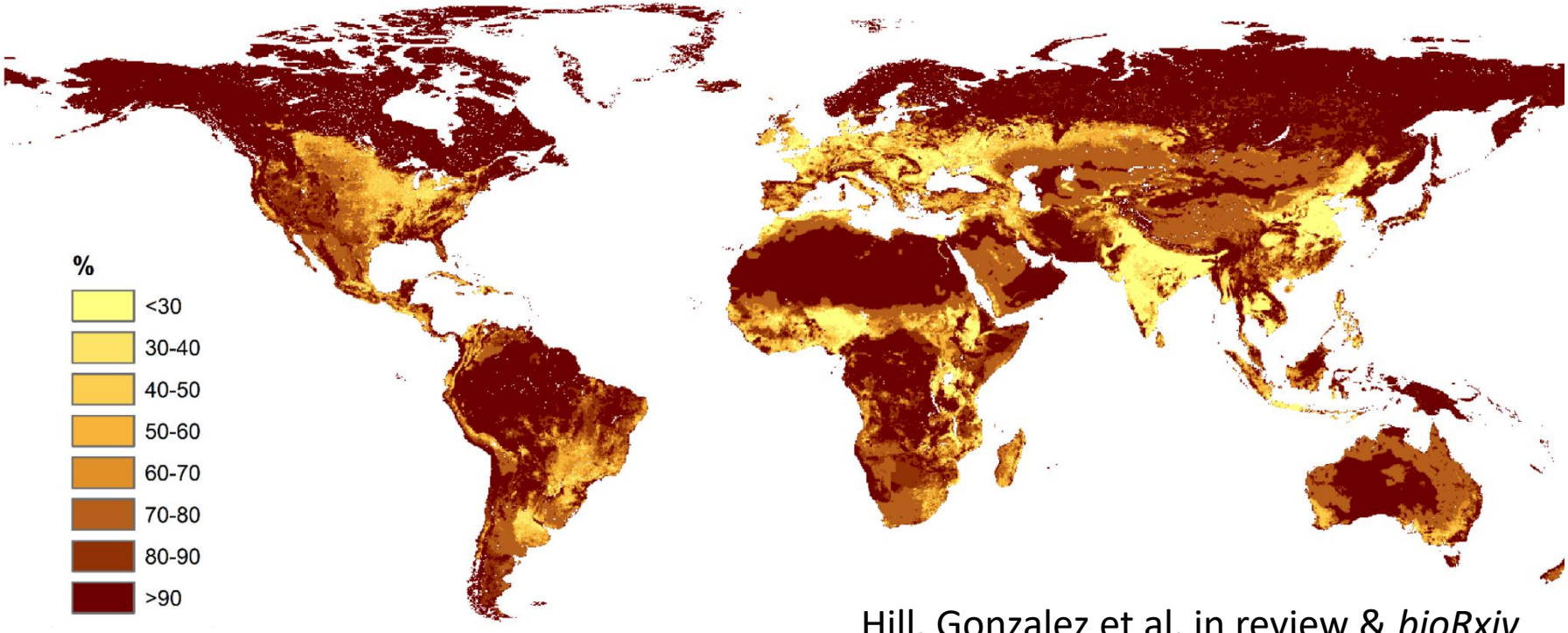
Maximum protected area coverage within suitable habitat.

	Any size	Larger than 10 km²
Strict Parks	1	1
All parks	10	7
All parks area	1,166 km²	1,154 km²
Target area	4,540.6 km²	
Target realized	25.7%	

Minimum reserve size:

Pollock et al, Nature 2017

Biodiversity Intactness Index (Aichi Targets 12 & 14) = estimated average fraction remaining of abundance of original species



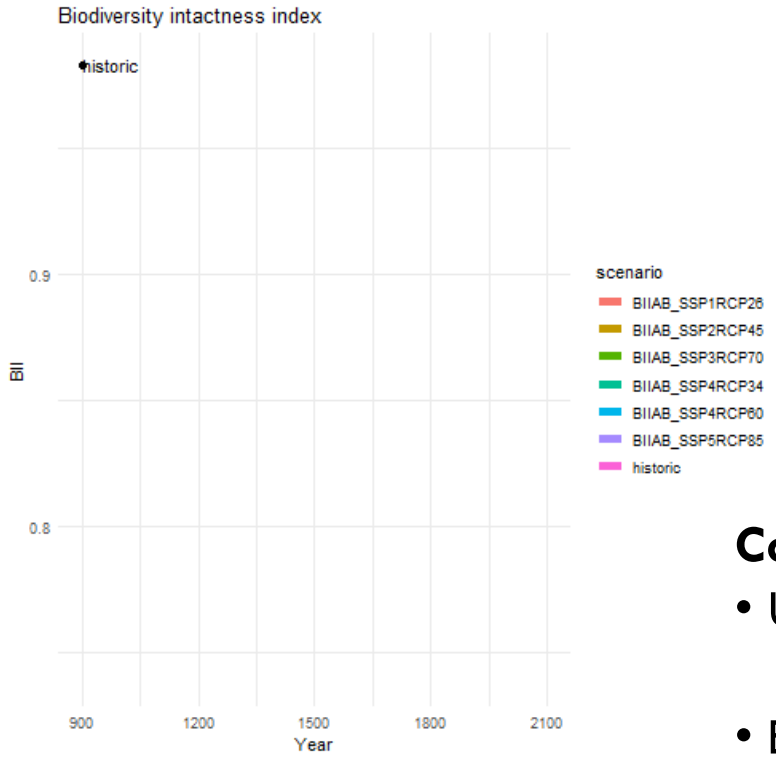
Hill, Gonzalez et al. in review & *bioRxiv*

- BII proposed by Scholes & Biggs (2005 *Nature*) as indicator of **community composition**
- Implemented by PREDICTS in 2016 (*Science*), but data and analyses have since improved:
  - Better differentiation of land uses; better use of data on roads and human population
  - New map (above) rectifies most of the perceived weaknesses of the 2016 map
- Adopted as 'core' indicator by IPBES; available on BIP dashboard

Recent and upcoming developments to BII

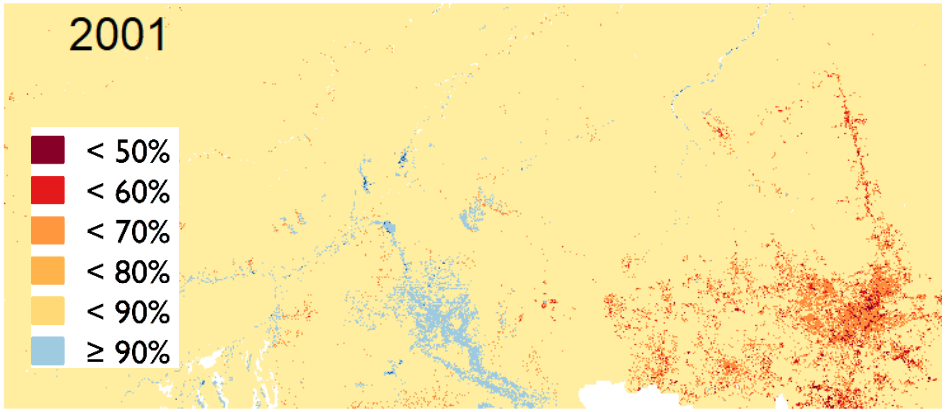
Hindcasts & (using SSPs) projections

Hill, Gonzalez et al. in review & *bioRxiv*



Annual BII at high spatial resolution (1km)

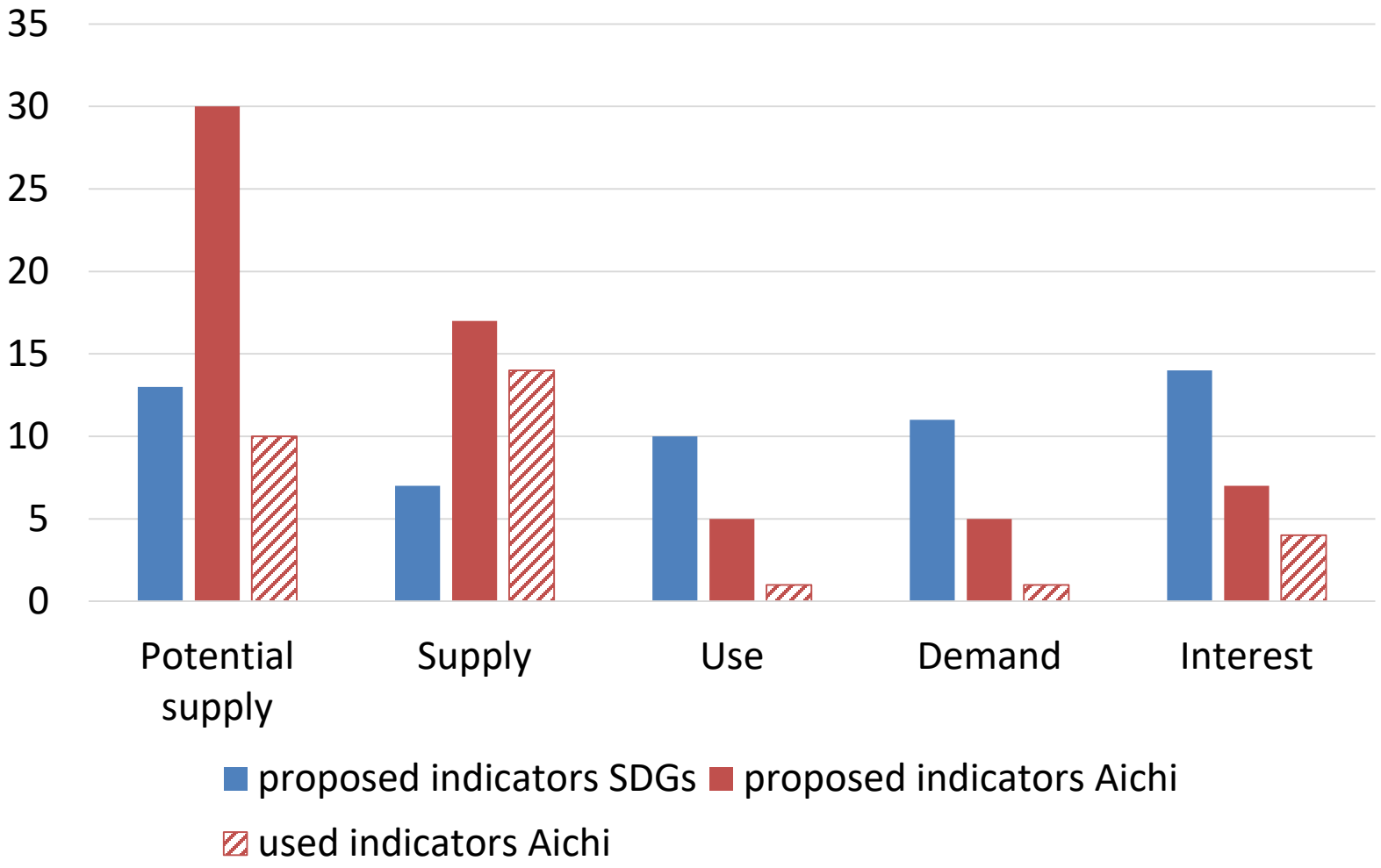
De Palma et al. in review & *bioRxiv*



Coming up:

- Use newly-available plantation forest mask
  - Improve estimates in S E Asia especially
- Explicit modelling of lagged responses
  - Necessary data already collated
- Integrating more drivers
  - Collaboration with *GLOBIO*

Result: comparing proposed with used indicators



GEO/GEO BON and the UN SEEA: Exploring Links

- **National Observation Network Design**: potential links between GEO BON Observation Design Process and the Experimental Ecosystem Accounting approach
- **EBVs Data Sources**: aligning data collection efforts as inputs
- **EBV Modelled Indicators**: as input or output indicators
- **EO for SDGs:** aligning this initiative to serve the SEEA

Thank-you!

GROUP ON EARTH OBSERVATIONS | GEO BON