Genetic/Phylogenetic Diversity
GEO BON working group “WG1”

In parallel with GEO BON goals for ecosystems and species, this WG will facilitate the global observation and monitoring of genetic and phylogenetic diversity, using a combination of remote sensing and in situ approaches.

Co-chairs – Dan Faith and Tet Yahara

GEO BON Implementation Plan Meeting
22-25 February 2010
Asilomar Conference Grounds, Pacific Grove, California

Genetic/Phylogenetic Diversity
GEO BON working group “WG1”

Co-chairs – Dan Faith and Tet Yahara

Also attending this meeting –

Adeniran Akanni

Greg Caporaso

Tiago Egger Moellwald Duque Estrada

Felix Forest

Richard Frankham

Jorn Scharlemann

(Becky Kao)

(Ben Collen)

Fukuoka meeting a few weeks ago

how do we monitor genetic/phylogenetic diversity?

big challenges

- . UNEP note "…there is as yet no commonly agreed set of monitoring and assessment procedures or parameters that can be used to measure either how much biodiversity there is, nor how much is being lost at genetic, species or ecosystem levels" (UNEP/CBD/COP/7/INF/22),

- UNEP also notes that "Coverage of the components of biological diversity (especially genetic diversity) needs to be improved."

how do we monitor genetic/phylogenetic diversity?

big challenges

Laikre (2009):

"Existing national plans for implementation of the CBD genetic diversity goal clearly are insufficient. Less than half of the reviewed countries have included explicitly the goal of conserving genetic variation of wild animals and plants, and only 20% recognize the need for monitoring this level of variation."

how do we monitor genetic/phylogenetic diversity?

big challenges

Yahara et al (in review)

“much of the focus to date has been largely restricted to links from genetic diversity to ecosystem services – for example, genetic diversity of crop plants. ..., there is a danger of neglecting other genetic diversity that also supports human well-being..”

Genetic/Phylogenetic Diversity working group

Three broad strategies for observations/analyses at the level of genetic and phylogenetic diversity will be addressed

See section 2.3 of the GEO BON Concept Document

Two basic perspectives on monitoring

one view – build up a time series of observations, for selected taxa in selected places

alternative view – create models of biodiversity as a "lens" to interpret time series of changes in land condition detected by remote sensing (see WG7)

biodiversity calculations then can indicate loss of diversity when localities are degraded

(as indicated by remote sensing)

Three strategies for monitoring genetic / phylogenetic diversity

Repeated observations, over time, of:

1) specific genetic / phylogenetic components of interest, in selected target species.

2) other biodiversity components (e.g. range extents for a representative set of species), integrated with models that link these observations to genetic diversity.

3) changes in land/water condition (e.g. using remote sensing), integrated with spatial genetic variation models as the “lens” to infer corresponding changes at the genetic/phylogenetic levels.

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Some obvious target species

The loss of genetic diversity of crop and other human-use species.

e.g., Shand (1997) estimate-

“approximately 75 per cent of the genetic diversity of crops has been lost since the turn of the last century.”

FAO, others

...For any target species can draw on DNA sequencing methods to observe over place, over time

AP-BON, COE (Center of Excellence of Asian Conservation Ecology) activities, including

“Actions of Genetic Diversity Assessment” (AGenDA) (Tet Yahara and colleagues)

“quantify genetic and phylogenetic diversity within and among areas at our Asian supersites, and will link to land use changes using satellite images and ground truth observations. By using these data with appropriate models, we will be able to quantify ongoing loss of genetic and phylogenetic diversities in Asia.”

we can do the same thing for a whole set of representative or "surrogate" species

Sampled Red List Index

- Random sample of species from a broad range of taxonomic groups
- Inferences based on geographic range sizes of individual species

Use same framework for a "sampled genetic diversity index"

Based on intensive sequence data for those species.....

Target or surrogate species may also provide information about phylogenetic diversity (PD)

can draw on phylogeny data bases – Tree of Life etc.

Plus molecular based trees in DNA Barcode of Life etc

www.edgeofexistence.org

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Discover the world's most extraordinary threatened species - frogs that give birth through their skin and

EDGE Blogs

Saiga population assessment in western Mongolia

4th Feb 09

While we have all been enjoying the unusual amounts of snow in the UK, one of our EDGE Fellows, Buuvei, has been braving much more severe winter conditions t... Read

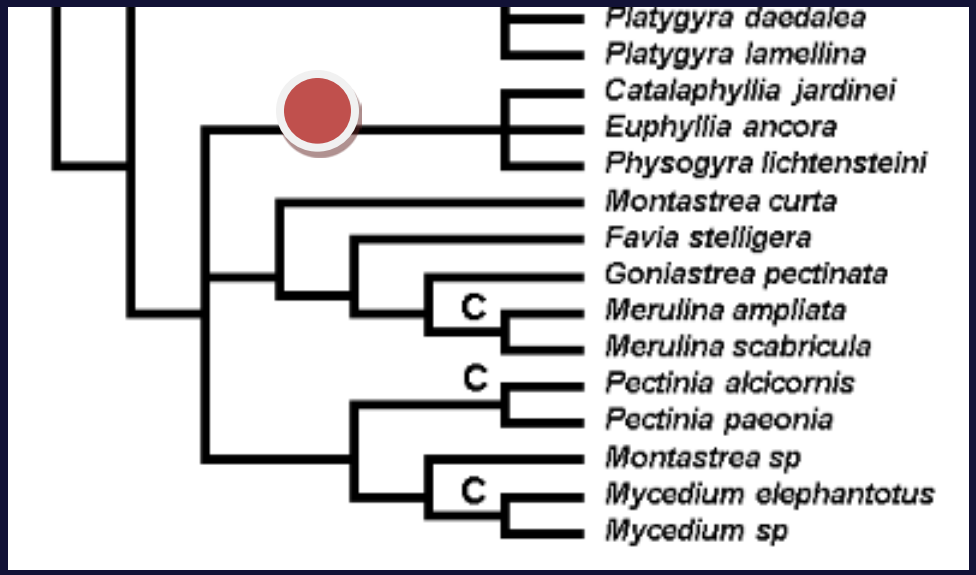
Zakhyn-Us Hay Crisis - update

23rd Jan 09

News just in from John Hare of the Wild Camel Protection Foundation that hay has been delivered to the captive breeding centre at Zakhyn-Us – just! John... Read

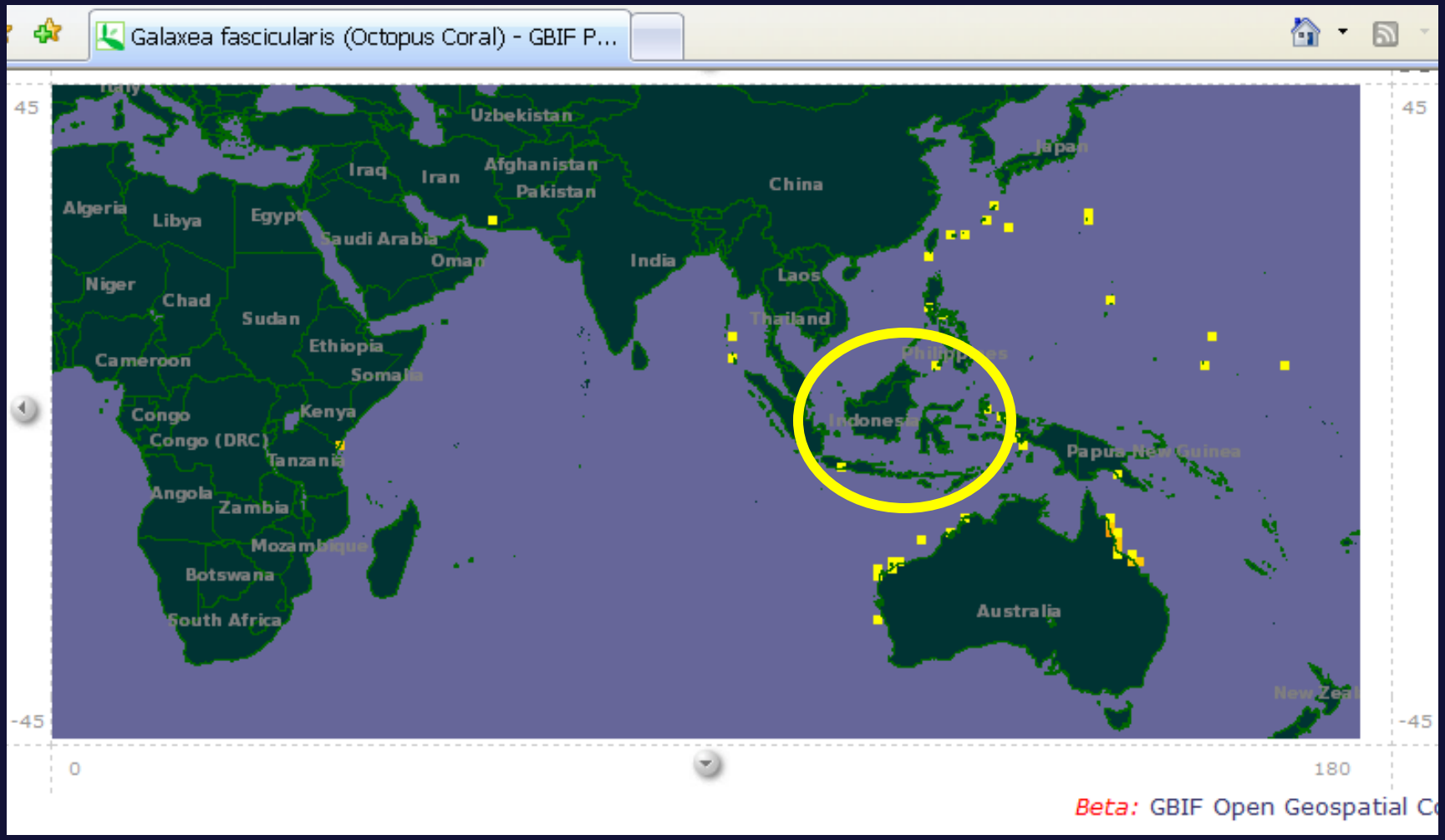
Loss of the world's corals

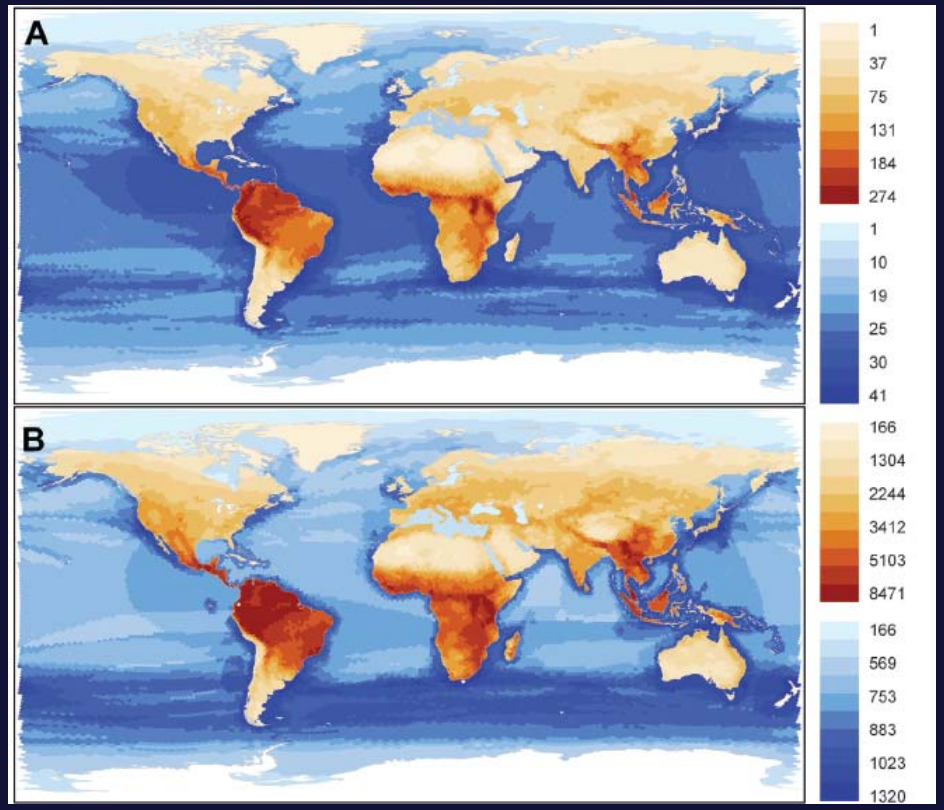
- Number of threatened species –
- "the proportion of corals (57.8%) exceeds that of all terrestrial animal groups assessed to date.."



many examples where entire clades (existing families and genera) fall into IUCN threatened classes

GBIF, OBIS. and other distribution data suggest that if we could somehow conserve corals, even in just one well-targeted part of the coral triangle, we could avoid worst case PD losses





Total phylogenetic diversity in a grid cell looks the same as total species diversity

Not so interested in total PD – we want gains and losses

Deliver a variety of phylogenetic maps based on recently developed indices – initially through FISHBASE etc.

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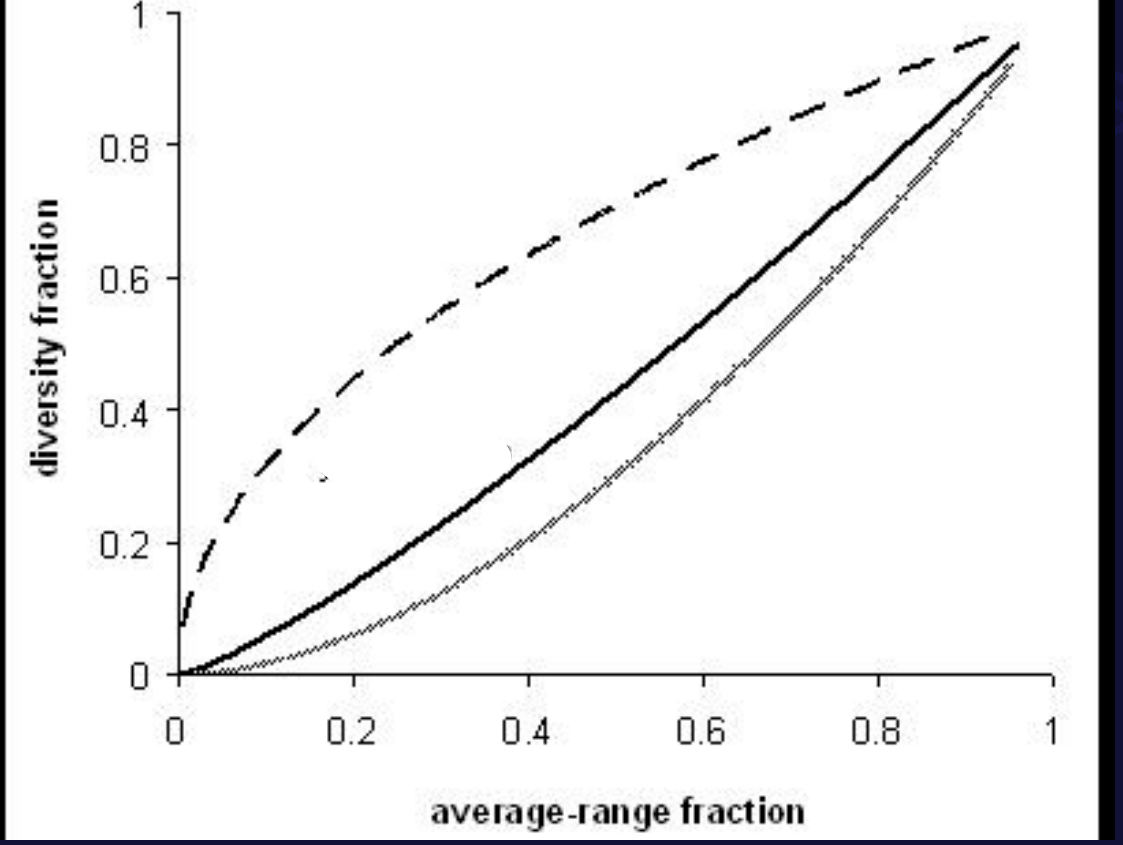

a “sampled genetic diversity index”

Genetic diversity loss related to loss of range extent

we can build on monitoring of change in range extent for representative sets of species by using these changes to estimate loss of genetic diversity

Again build on e.g. Sampled Red List Index, GLOBIO

Living Planet Index (LPI)

- “The Living Planet Index (LPI) is calculated using time-series data on more than 6,400 populations of over 2,000 species of mammal, bird, reptile, amphibian and fish from all around the globe. The changes in the population of each species are aggregated and shown relative to 1970, which is given a value of 1.0. The LPI can be thought of as a biological analogue of a stock market index that tracks the value of a set of stocks and shares traded on an exchange.”

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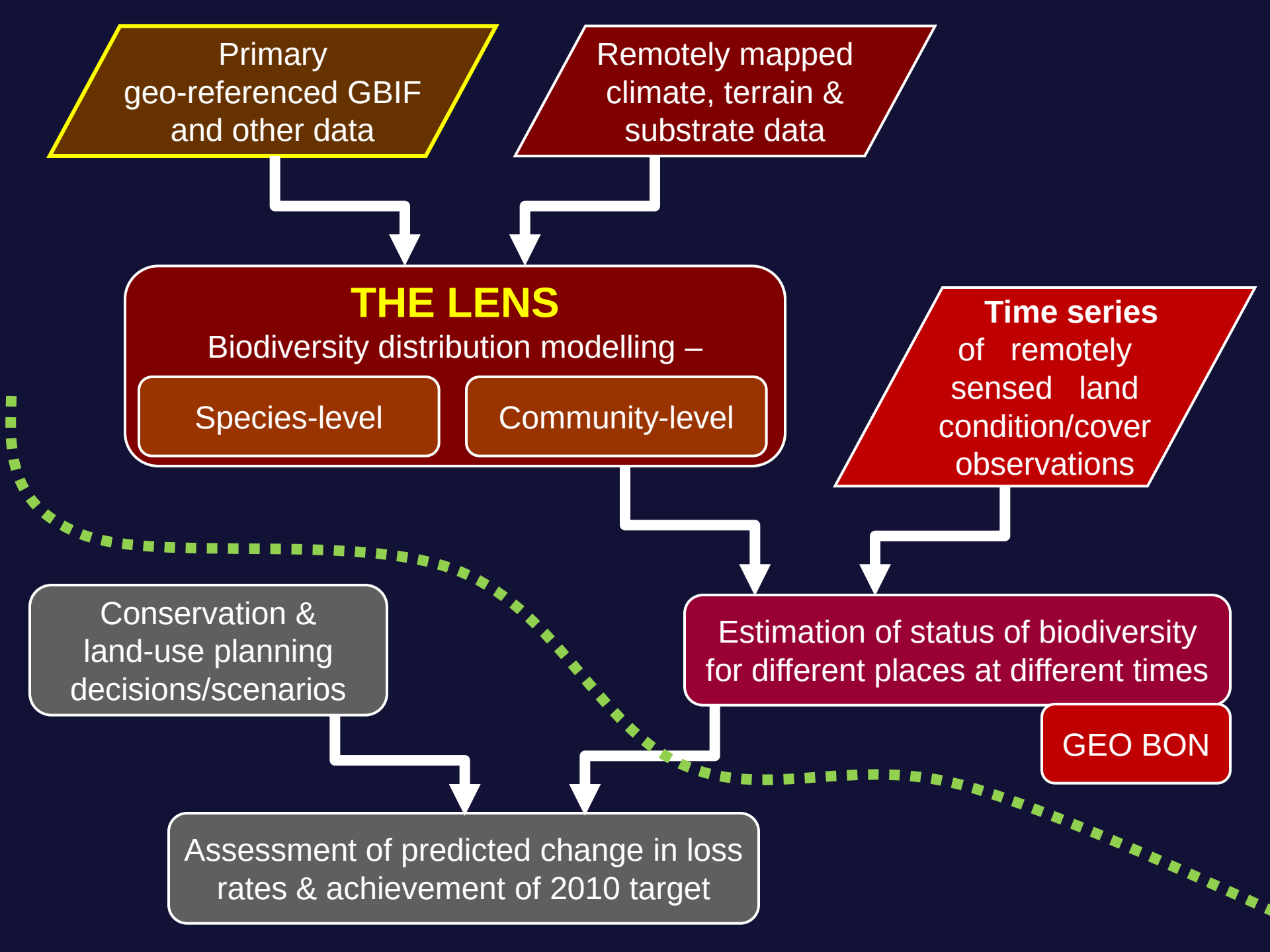
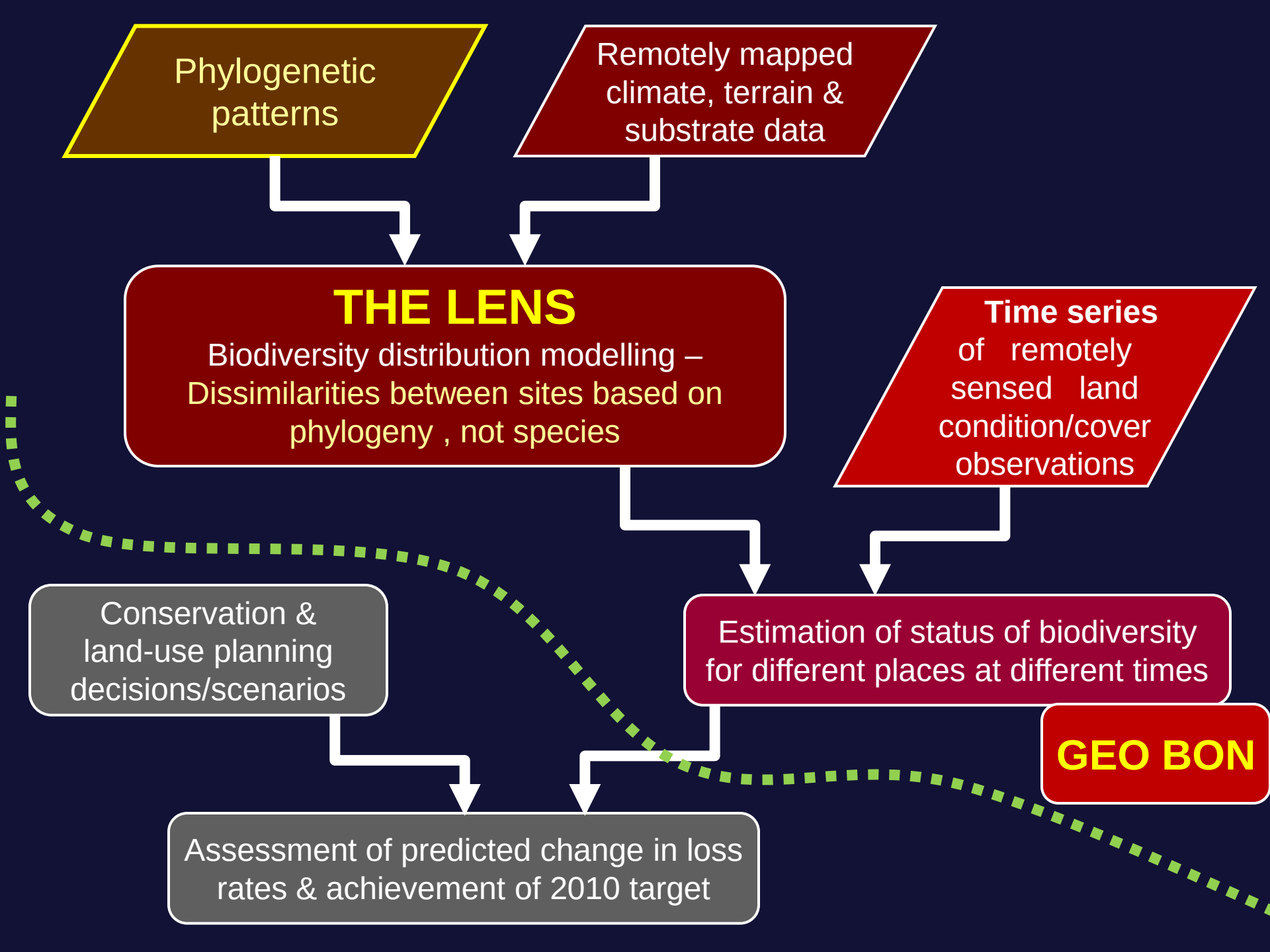
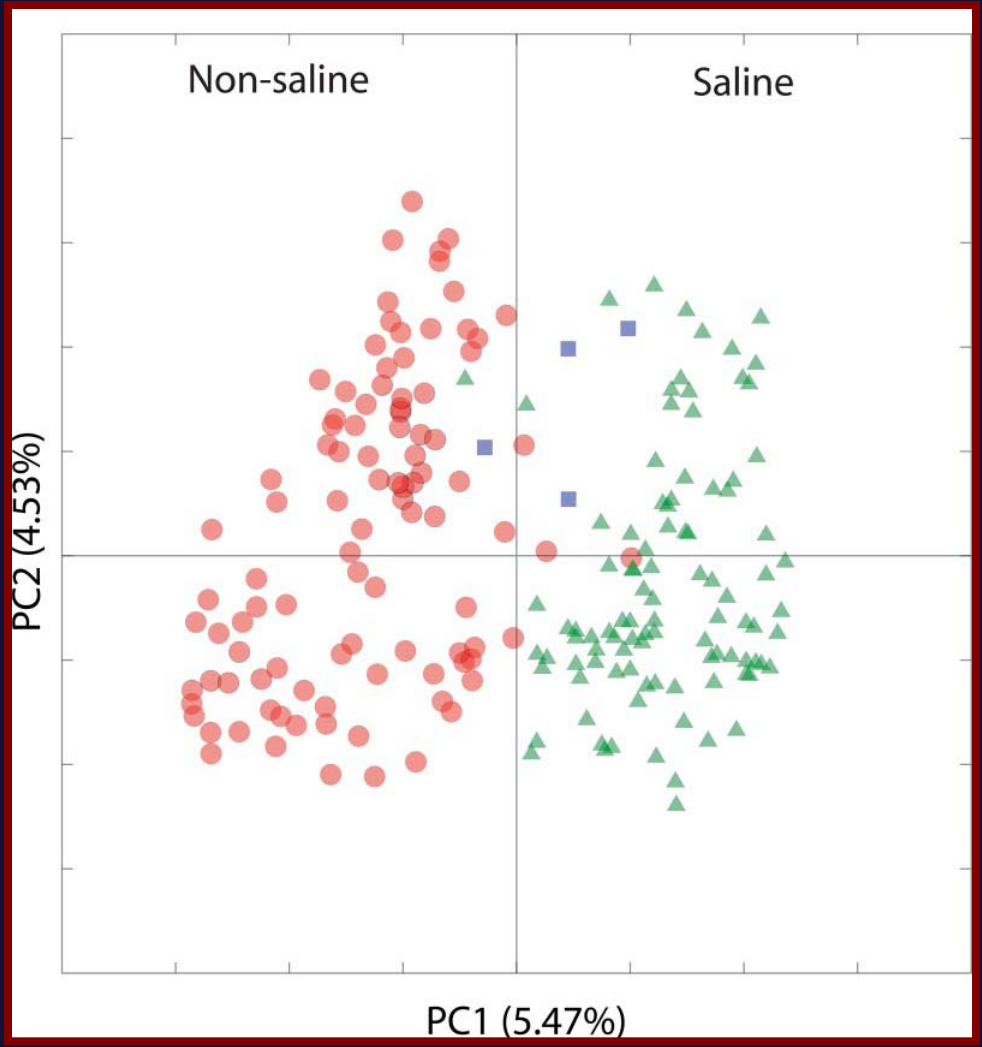

Primary geo-referenced GBIF and other data
Remotely mapped climate, terrain & substrate data
THE LENS
Biodiversity distribution modelling –
Species-level
Community-level
Time series of remotely sensed land condition/cover observations
Conservation & land-use planning decisions/scenarios
Estimation of status of biodiversity for different places at different times
GEO BON
Assessment of predicted change in loss rates & achievement of 2010 target

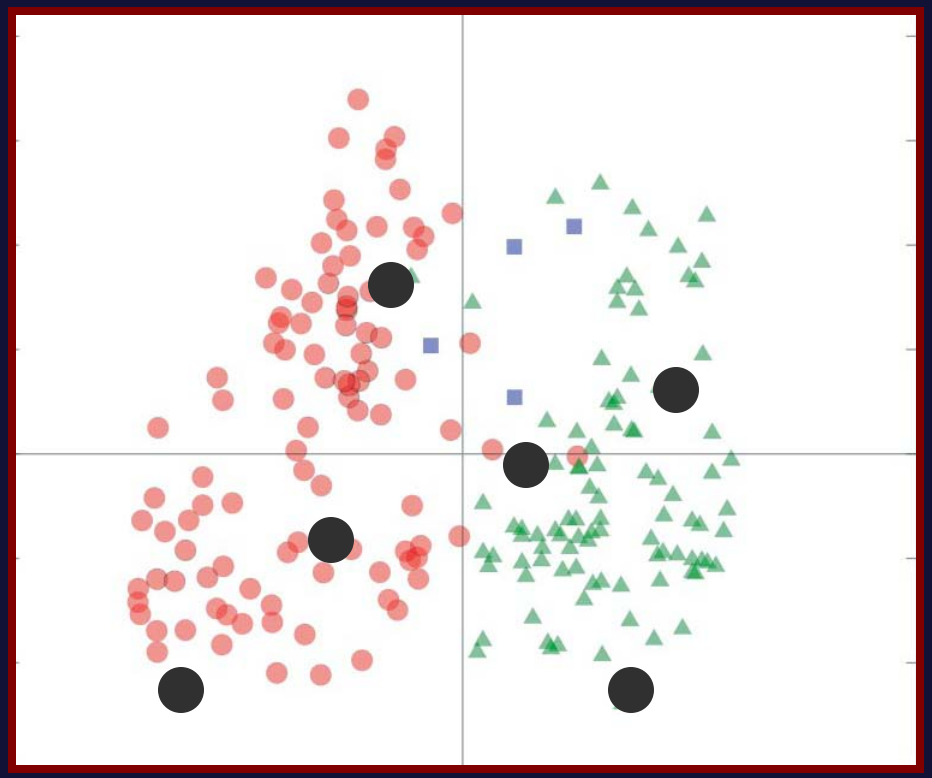

Phylogenetic patterns
Remotely mapped climate, terrain & substrate data
THE LENS
Biodiversity distribution modelling – Dissimilarities between sites based on phylogeny , not species
Time series of remotely sensed land condition/cover observations
Conservation & land-use planning decisions/scenarios
Estimation of status of biodiversity for different places at different times
GEO BON
Assessment of predicted change in loss rates & achievement of 2010 target

Genetic and phylogenetic dissimilarities among localities –
we can model these using environmental distances and so create a biodiversity “lens” with good geographic coverage

Lozupone and Knight
PD dissimilarity and global bacteria samples



- major environmental determinant of microbial community composition is salinity



phylogenetic information can be integrated into a “lens” for interpreting remotely sensed changes in land condition

- e.g., assess the biodiversity represented by any given set of protected areas

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The near future for WG1

- Each listed activity has a catch-phrase to assist reference in discussions.
- Activity 1.1 (“2010 early meetings”)
- Activity 1.2 (“position papers”)
- Activity 1.3 (“engage partners”)
- Activity 1.4 (“Japan Center of Excellence”)
- Activity 1.5 (“links to the lens approach”)
- Activity 1.6 (“range/abundance/genetics models”)
- Activity 1.7 (“phylogenetic diversity índices”)
- Activity 1.8 (“barcoding/genomics databases”)

Tasks for this meeting

Streamlining: Omit concepts, justification, and most background material

Partners: Who will do the proposed work?

Coordination and integration: Are other WGs proposing similar ideas? Are other organizations doing similar things?

Operational focus: GEO BON's goal is to provide operational products and services (ie, operational deliverables). The document should stay focused on these.