BIOS^2 Summer School 2024

Biodiversity Modelling

Notes document

Day 01 - Biodiversity changes and the Global biodiversity framework

International negotiation

- Things to keep in mind:
    - Communication
    - Verification - is there a way to know the metric is valid/trustworthy?
    - Transparency
    - Direct vs indirect indicators
    - Accessibility
    - Target vs trend goals

Annie Chaloux - Gouvernance mondiale de la biodiversité

1. Points historiques

-> année charnière pour la BD = 1992

Avant ça, deux mouvances : préservationnisme (cf def, conduisant à l'exclusion de peuples autochtones des zones protégées) et conservationnisme (protection des sp utiles à l'homme & utilisation raisonnée des ressources)

- Création UICN (Union Internationale de la Conservation de la Nature) en 1948 - dev de la liste rouge / liée à la fin de la seconde guerre mondiale et industrialisation croissante

- Engagements internationaux importants - Ramsar (conv sur les milieux humides 1971) & CITES (1973)

- 1992 - **Sommet de la terre de Rio** - création de plusieurs conv. en deux semaines et notamment sur la désertification, le réchauffement climatique et la diversité biologique - la situation géopolitique faisait qu'il y avait un grand espoir de collaborations (si convention poas signée, découle sur des déclarations d'intention)

==> Convention sur la diversité biologique (**CDB**) : conservation de la biodiversité, partage juste et equitable découlant de l'exploitation de la div génétique

- 1993 - entrée en vigueur de la CDB (étapes = signature, ratification et finalement entrée en vigueur)

- 1994 - COP1 à Nassau (COP sur la biodiv au deux ans, au 1 an pour chang. clim.)

- 2002 - sommet mondiale sur le dev durable (Johannesburg) : dev durable = idée d'assurer un dev qui permet aux générations actuelles et futures de répondre à leurs besoins - Prend la suite des mouvements de conservationnisme et préservationnisme

- 2010 - définition des objectifs d'AICHI

- depuis 2010 - création de l'IPBES (équivalent du GIEC, qui lui a été mis en place beaucoup plus rapidement et qui explique aussi pourquoi COP annuelle et pas juste aux deux ans) - experts qui regroupent la connaissance scientifique pour faire une synthèse - présence importante du corps politique

- entente Kunming-Montréal car COP15 effectuée deux temps à cause du COVID (une partie en remote organisé par la présidence chinoise et une partie en présence à Montréal)

2. Organisation

Les différentes structures:

- cadre principal - CBD, qui organise les (rôle à préciser)

- COPs (rôle ?)

- le secrétariat - aide le gvnt à mettre en oeuvre les plans d'action, organisation, super négociateur (nommé par les membres de la COPs)

- les protocoles et autres traités

Les acteurs de la gouvernance mondiale:

- les Parties (les états) - prennent les décisions sur les questions de biodiv

- les autres parties-prenantes - observateurs comme ong environnementales, des entreprises, groupes autochtones, de femmes, d'agriculteurs, de jeunes, ... - peuvent prendre la parole mais ne peuvent pas voter - Rôle d'influenceurs inportant !

- IPBES - entité qui fournit l'information utile basée sur la science pour les prises de décision

Le déroulements :

Processus qui se déroulent sur deux ans environ

- préparation des sessions de négociations

- la COP - sur deux semaines, plénière, groupes de travail avec séances de négociations (formels et informels), interventions des Parties et des observateurs

- Adoption des décisions en plénière

La présidence de la COP est un représentant du pays qui reçoit - super extra important et très très difficilertante du corps politique

Report analysis activity

Living planet report Canada

- They have really nice data-viz!
- More of a policy/advertising than an in-depth scientific report

Biodiversity in Canada

- The main message is not clear; we don't know what to do with that information
- There's no explanation about the data wrangling
- It lacks context about the threats to species
- It states that Canada does not have an overarching biodiversity legislation at the federal level
- There's no data analysis in the report, just general claims

State of the Great Lakes

- They go through the indicators quickly and have an status for each lake, with information about how reliable each indicator is
- It's multidimensional! They cover different indicators, not only for biodiversity, but also social indicators.

Canadian Biodiversity: ecosystem status and trends

- A lot of information, very comprehensive
- Aimed at the decision-makers
- Not a lot of recommendations
- It's based on a data synthesis, not new analysis

Atlas des oiseaux nicheurs du Québec méridional

- Aimed at birders
- The sampling biased their conclusion
- They use the observation, but they don't go beyond that - there is not data analysis

The status of Human footprint in Alberta

- Very nice report, clearly aimed at non-scientists
- 20 different layers that they use to compute their indexes
- They include political aspects as they present their data in different municipal / political scales
- They have a naive way of assessing biodiversity preservation as they don't have direct measures of biodiversity
- It's mostly a land use map, not a biodiversity analysis

What would be the ideal table of content for a biodiversity report?

Global Biodiversity Framework

- Failure to achieve Aichi's targets is mainly due to the goals not being measurable
    - Monitoring and reporting was not prioritized
    - Financing gaps reinforced existing imbalances
- There are 4 big goals and 23 targets
    - Goal A: maintain genetic diversity
    - Goal B: Nature's contribution to people
    - Goal C: Protecting traditional knowledge
    - Goal D: Closing the biodiversity finance gap
- Targets are related to reducing threats to biodiversity, meeting people's needs through sustainable use and benefit-sharing, and tools and solutions for implementation and mainstreaming
    - https://www.cbd.int/gbf/targets
- Financing + targets + monitoring
- GBF indicators:
    - **Headline indicators**: capture the global scope of the objectives and targets used for planning and monitoring progress.
    - **Component indicators**: optional indicators which add to the headline indicators to cover elements of the objectives and targets.
    - **Complementary indicators**: are for thematic or in-depth analysis of each goal and target.
    - Indicators must be capable of detecting relevant trends.
- Criteria to enter the GBF list of indicators:
    - data and metadata related to the indicator are publicly available
    - The method should be published / gone through a peer review process
    - Data sources and indicators are compiled and regularly updated at least every year every 5 years, if possible
    - A mechanism is in place to monitor indicators methodology and/or data production
- Stevenson, S. L., Watermeyer, K., Ferrier, S., Fulton, E. A., Xiao, H., & Nicholson, E. (2024). Corroboration and contradictions in global biodiversity indicators. *Biological Conservation*, *290*, 110451.

Essential Biodiversity Variables

- A measurement required for study, reporting, and management of biodiversity change.
- EBVs are measurements

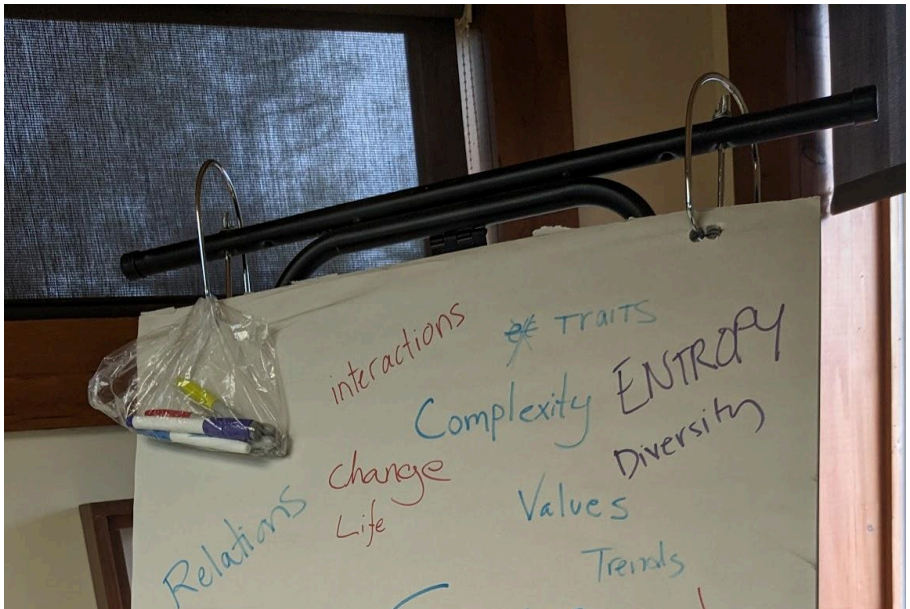
Day 02 - Designing an indicator

Take-home messages from yesterday

- It wasn't clear why it is important to distinguish a EBV from an indicator. Part of that is because we need more clear definitions. For example, it is important to define exactly what we mean when we say, use or measure biodiversity. Moreover, it's difficult to represent different aspects of nature under a useful word for science and communication.
- Sometimes we can use the same concept under different definitions in different contexts: one definition of biodiversity can be used by us when we wear the "scientist hat", and another when we use the "advocate hat" to promote biodiversity as what we use and what we don't know as untopped potential. At the same time, we were caught by the idea about the dissociation of values from ecological concepts. Can we dissociate? Should we dissociate? Do we dissociate? Science should stay impartial, but is it really possible to measure biodiversity changes without interpreting them through our value system?
- In the end, we question what is science worth if it isn't communicated. In this same aspects, we need to design indicators that will talk to the politicians, not to the scientists. It feels like we need to be social scientists to actually change something with science… It stuck with us the importance of politics for conservation biology.
- In the political aspect of how science is made, we question how should we prioritize research initiatives when it seems like a judgement call based on values. We think we have to have a good science ethics because the tools we use could be bend to fill some beliefs, instead of the facts.
- Given all that, we think that some of the competencies/skills that biologists and ecologists should develop are communication (and science outreach), ability to synthesize information, and to understand the political processes.
- In terms of tools, we wonder how we can use remote sensing as a verification that is independent of countries' private interests to monitor biodiversity conservation action.

Our concept of biodiversity

Interactions traits relations change life, complexity, entropy and diversity. Hotspots values trends, and multi-species raw data increase/decrease équilibre, variety of richness and hétérogénéité. The composition measures functional resilience of endemism.



Biodiversity indicators - what are they?

- a metric that summarizes the state of biodiversity at different points in time

The Living Planet Index!!!!111!!!

- It's a component indicator in the GBF
- Tracks the change in wildlife
- Trend of abundance in time
    - Species abundance is the EBV
    - The target is halting biodiversity loss
- THE LEMONS:
    - Taxonomic and geographic biases
    - Biased temporal coverage
    - The units are variable
    - The averages!!!! They mask extreme trends!!11!!
- THE LEMONADES
    - The biases are being addressed, such as inclusion of more languages in the literature review
    - Careful interpretation of baselines - reflection of what it means is a good practice!
    - We can take more accurate averages to account for extremes, and the extremes can help us identify which populations need more monitoring and action.

The baseline syndrome

- The LPI baseline on 1970 is cool, but it's arbitrary.
- Baselines will always be quintessential on the interpretation of biodiversity change.

The variety

- When calculating LPI, we smooth out the annual variation, and then get the average per population
- In the end we get the variation in the range of population means around a total average
- The LPI's confidence intervals always under-represents its variability

Correlated variation - are we oversimplifying biodiversity change?

- Trends are more similar between populations that are nearby
- Closely-related species have more similar trends
- Interacting species are more likely to have correlated trends
- Correlations are very informative, though! We should use them more often.

GEO BON

- BON = Biodiversity Observation Network

EBVs

- Species-focused EBV classes
    - Genetic composition
    - Species population
    - Species traits
- Ecosystem-focused EBV classes
    - Community composition
    - Ecosystem structure
    - Ecosystem function
- EBVs are measured in space and time and create a “cube” of biodiversity monitoring
    - There are many ways to go from raw data to the “cube”, such as species distribution modelling, data imputation and machine learning.
    - These methods help to fill the gaps in space and time.
    - Space, time and taxonomic variables need to be defined in terms of extent, resolution, measurement units and uncertainties.

Lesson from the BDI example:

- Data are imperfect with several biases
- Not easy to reconstruct past ranges with SDMs
- Rich amount of information in the data cube
- Challenge of tracking uncertainty
- It’s feasible 🎉

How we recommend biodiversity indicators

- Indicators should be able to track biodiversity change, identify drivers of biodiversity change and lead to conservation actions and decision-making
- A good suit of indicators is composed of complementary indicators, which are complementary in their sensitivity, so we can detect changes at different scales
- S.M.A.R.T.C evaluation:
    - S = specificity
        - Clearly and directly linked to a target
    - M = measurable
        - Robust, documented, and behave as expected
    - A = achievable
        - possible to calculate with the existing resources
    - R = relevance
        - Sensitive to changes that are considered to be important
    - T = time
        - Possible to export by the time of the target deadline
    - C = communication
        - Interpretable and easy to visualize for multiple levels of expertise

Day 03 - Data pipelines and automated computation

Day 04 - Indicators for decision-makers

Day 05 - Reporting