Literature review

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Programme: Environmental Earth Sciences

Department: Spatial Sciences

"Mapping biodiversity changes across spatio-temporal scales"

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Contents

Outline

Literature review about the link between biodiversity facets trends and spatial/temporal scales.

The idea is to take every paper that talk about biodiversity trends (so far using just the species richness seems already a lot of paper) and to list **1)** which biodiversity metric they use **2)** which taxon/taxa they use, **3)** the spatial scale, **4)** the temporal scale and **5)** what is the dynamic (does the biodiversity metric increase/decrease/doesn't change over time/unclear).

Make a table of all these papers and `group_by(taxa) %>% order_by(spatial_scale | temporal_scale)`. Then see if for each taxa we can find a trend (a bit like in Chase *et al.* 2019 Oikos paper | Jarzyna *et al.* 2015 but here I am not making the analysis, just taking the analysis from papers). Best example found so far: Hill & Hamer 2004

I am using the "Advanced Research" tab of Web of Science which allows me skim through the entire literature using a convenient syntax. For instance:

```
AB = ((biodiversity OR species richness OR diversity) AND
(temporal trend* OR dynamic*) AND
(bird* OR avia*))
```

And

```
AB = ((biodiversity change index)  AND (bird*  OR avia*)  AND trend*)
```

And

```
AB = ((species richness) AND (bird* OR avia*) AND trend*)
```

And

```
ALL=(birds AND species richness AND temporal trend)
```

Dashboard

Reference paper

- 05/07/2021: research wos made with the literature review filter for the first query (stopped at #13) and created the second query (stopped at #2)
- 07/07/2021: questions to Petr: **1)** can the geometric mean of relative abundance + the weighted goodness of fit be used as biodiversity trend index, **2)** can the Farmland Bird Indicator (FBI) be used as biodiversity trend (for me it is more biodiversity health, Chiron et al 2013) **3)** what about the Red List Index trend? **4)** what about Multispecies population indexes?
- 08/07/2021: stopped at the article 41 for research #2.
- 12/08/2021: stopped at article 4 for research #4
- 13/08/2021: stopped at article 8 for research #4
- 17/08/2021: stopped at article 15 for research #4
- 18/08/2021: stopped at article 30 for research #4
- 19/08/2021: stopped at article 46 for research #4
- 20/08/2021: stopped at article 64 for research #4

1. Introduction

Human life quality is intrinsically linked to ecosystems state that he is living in. Indeed, ecosystems services extend in a large spectrum of mechanisms including nutrient cycle, food production, or climate and water cycle regulation (Pereira et al.). Some of those ecosystem functions are managed by bird biodiversity such as seed dispersal, controls pests or pollinate plant. Unfortunately, anthropogenic stressors like habitat loss, over exploitation, pollution or introduction of invasive species could lead biodiversity to its sixth mass extinction (Barnosky et al.).

Biodiversity erosion is now known from everyone and political decisions has been stated in order to limit it (*e.g.* The Convention on Biological Diversity, 2010, 2002). However, these objectives have been so far not reached due mainly to our confusion and misunderstanding about biodiversity dynamic and how to determine it.

As a matter of fact, studying biodiversity can be confusing, especially because several choices must be done. Firstly, the level at which you are looking at the biodiversity must be chosen (*e.g.* species, functional, phylogenetic diversity). Secondly, one must decide which metric is the most appropriate for his study. There are many facets of biodiversity that can be measured by different metrics depending on the objective of your study. Measures of static biodiversity are commonly used such as species richness or α diversity (*i.e.* number of species, Whittaker, b), the Shannon index (Shannon) ,the Simpson index (Simpson) or the Hill number (Hill). The later three biodiversity indexes take into account the relative abundances of the species and can be considered as the *quality* of the biodiversity. On an other hand, the spatial and temporal β diversity will measure the species turnover and can be measured thanks to Whittaker's (Whittaker, a), Sørensen's (Sørensen) or Jaccard's (Jaccard) dissimilarity indexes (*e.g.* Keil et al.).

However, overall biodiversity (*i.e.* taking into account species of every taxa) may not be relevant for one's case study. Thus, several multi-species indicators have also been created, taking into account the abundances of indicator species giving information on the ecosystem health. The most known ones are the Red List Index (Butchart et al., b,a,c) or the Biodiversity Change Index (Normander et al.).

Using all the metrics cited above, we now know that the loss of global biodiversity is unprecedented. However, current scientific literature has also shown that temporal trends in local changes of biodiversity can be opposite to trends at larger scales (*e.g.* Chase et al.). Thus, current changes in biodiversity is far more complex than a simple global decrease: most of the ecosystems undergo alterations of their communities with changes in species composition (Blowes et al.; Dornelas et al.). Wonders persist about how the trend of these different metrics of biodiversity are link to the spatial and temporal scales used when measured.

In order to investigate this link between spatial scales and biodiversity metrics, birds is a relevant taxon. Thanks to the many ornithological monitoring and surveys, we now have a large number of long, high-quality time series on bird populations (Bejček and Stastný). Birds are easy to observe, easy to identify and thus many volunteers are motivated to conduct standardized sampling. Given their ability to change quickly of locations, their presence is also a good indicator for ecosystem health and thus several standardized metrics have been created to assess their populations. For instance, the geometric mean of relative abundances or the goodness-of-fit statistic (Studeny et al.) are some of the baseline. Other multi-species indicators have also been created specifically for birds, such as the Farmland Bird Indicator (Gregory et al., a), the Forest Bird Indicator (Gregory et al., b) or the Wild Bird Indicator (Gregory and Strien).

Here, I propose to review articles assessing the temporal trends of different avian biodiversity metrics and to look at which spatial scales these studies have been done. Summarizing the trends of these qualitative and/or quantitative avian biodiversity indexes along with their spatial and temporal scales will help to see more clearly how the trends of biodiversity are linked to spatio-temporal scales. It is also important to demonstrate that the information about the sampling plan (*i.e.* spatial scale, time span, temporal scales etc) is not systematically indicated in the scientific literature and can bring confusion to the analysis and comparisons of their trends. I believe that this review can help to have a better overview of the current knowledge on the trend of biodiversity metrics of bird populations.

2. Materials and Methods

I used the *"advanced serach"* tool of the ISI Web of Science Core collection database. It allowed me to write these four following queries using key words:

1. `AB = ((biodiversity OR species richness OR diversity) AND (temporal trend* OR dynamic*) AND (bird* OR avia*))` which resulted in 1346 references.
2. `AB = ((biodiversity change index) AND (bird* OR avia*) AND trend*)` which resulted in 60 references.
3. `AB = ((species richness) AND (bird* OR avia*) AND trend*)` which resulted in 313 references.
4. `ALL=(birds AND species richness AND temporal trend)` which resulted in 88 references.

Table 2.1: SR = species richness, Ab = abundance, Eve = evenness,

Reference
Barnagaud et al.
Barnagaud et al.
Barnagaud et al.
Barnagaud et al.
Barnagaud et al.
Barnagaud et al.
Roels et al.
Roels et al.
Wretenberg et al.
Ram et al.
Ram et al.
Ram et al.
Ram et al.
Ram et al.
Harrison et al. (b)
Harrison et al. (b)
Harrison et al. (b)

Table 2.1: SR = species richness, Ab = abundance, Eve = evenness, *(continued)*

Reference
Doxa et al.
Doxa et al.
Doxa et al.
Arnold et al.
Arnold et al.
Arnold et al.
Xu et al.
Jiguet et al.
Jiguet et al.
Jiguet et al.
Keten
Davey et al.
Davey et al.
Davey et al.
Siriwardena et al.
Christian et al.
Dittrich et al.
Dittrich et al.
Dittrich et al.
Dittrich et al.
Sirami and Monadjem
García-Navas et al.
McGeoch et al.
Ellis et al.
Ellis et al.
Ellis et al.
Ellis et al.
Ellis et al.
Ellis et al.
Ellis et al.
Ellis et al.

Table 2.1: SR = species richness, Ab = abundance, Eve = evenness, *(continued)*

Reference
Ellis et al.
Ellis et al.
Ellis et al.
Ellis et al.
Sicurella et al.
Sicurella et al.
Sicurella et al.
Nally
Latta et al.
Latta et al.
Scarton
Scarton
Scarton
Scarton
Chiron et al.
Chiron et al.
Chiron et al.
Chiron et al.
Eglington and Pearce-Higgins
Harrison et al. (a)
Harrison et al. (a)
Harrison et al. (a)
Harrison et al. (a)
Harrison et al. (a)
Harrison et al. (a)
Juslén et al.
Normander et al.
Normander et al.
Normander et al.
Schipper et al.
Schipper et al.

Table 2.1: SR = species richness, Ab = abundance, Eve = evenness, *(continued)*

Reference
Schipper et al.
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Schipper et al.
Schipper et al.

Table 2.1: SR = species richness, Ab = abundance, Eve = evenness, *(continued)*

Reference
Schipper et al.
Schipper et al.
Schipper et al.
Schipper et al.
Schipper et al.
Schipper et al.
Schipper et al.

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