A data specification for efficient archival and meta-analysis of ecological networks

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> This is a *working document* describing `mangal`, a set of `JSON` objects templates to encode ecological networks of virtually any complexity. There are plans to host a pilot database.

I (**TP**) would target *Source Code for Biology and Medicine*.

The need for a data specification

Ecological networks enable ecologists to accommodate the complexity of natural communities, and to discover mechanisms contributing to their persistence, stability, resilience, and functioning [1, 2]. Yet, meta-analyses of a large number of ecological networks are still extremely rare, and most of the studies comparing sveeral networks [3, 4] do so within the limit of particular systems. Networks, as they encode the structure of complex ecological interactions, have been time and egain presented as useful tools to understand ecosystem properties and dynamics [5–9]. Coming up with a clear conceptual and mechanistic understanding of the relationships between the structure of ecological networks and ecosystem properties require to pool a large quantity of data.

On the other hand, the recent years saw the development of the idea that network structure is itself a dynamical object, which will change as a function of environmental conditions and as a result of meta-community processes [10–13]. Although the *existence* of this variation has been demonstrated, the reasons for which it happens are much less clearly understood, and will probably require extensive data mining to be figured out. Beyond just describing the structure of interactions, these data will need to include informations about environmental context, population characteristics, and other relevant additional explanatory variables.

This paper pursues a double goal. First, we outline the different data needed to effectively conduct meta-analyses of ecological networks. Second, we propose an architecture to store these data, which can easily be implemented as a database, allowing for the efficient sharing of large quantities of data between groups. We then discuss the possibility to develop an API surrounding different databases, so that different sources of informations can be seemlessly integrated.

A short paragraph describing the type of data we need and relating them to outstanding questions, ref from the recent literature. Space, evolution, gradients, prediction.

The elements of a network

Basic idea is to have *layers* in the data specification, each corresponding to one layer of organization in the networks. What I see currently is

- nodes
- edges
- networks

This will require some *glue* objects, but it should be simple enough.

The properties of nodes

- scale of organization
- biodiversity descriptors

The properties of edges

The properties of networks

- sample location
- sample date
- methodology
- associated references

Proposed implementation

This will mostly describe several data templates for each of the scales in the previous section.

```json
{
"ID": "MyDB_I_00001",
```

```
"from": "MyDB_P_00001",
"to": "MyDB_P_00002",
"info": {
"binary": true,
"directional": false,
"strength": 1,
},
"type": "predation",
"notes": "none"
}
```


Conclusion and future directions

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