

## Doctoral School of Information and Biomedical Technologies Polish Academy of Sciences

### Subject

The structure and dynamics of aquatic ecological networks

### Supervisor and co-supervisor

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### Institute, in which the topic will be conducted

Systems Research Institute, Polish Academy of Sciences, ul. Newelska 6, 01-447 Warszawa, Poland

**Scientific discipline** Information and Communication Technology

**Recruitment form** Interview

**Available positions** 1 (one person)

### Project description

Species extinctions are compromising ecosystem functioning and services around the globe. Feeding relations between organisms cause cascading effects. The initial perturbation propagates over the food web modelled as a directed graph whose nodes correspond to (groups of) species and links represent biomass flows, such as predation [1].

In cooperation with scholars from Austria, Sweden, South Africa and Japan, we have compiled the world's largest database of 250 geographically diverse, weighted, empirical food webs. This new dataset allows us to overcome the limitations of the previous research, namely using only theoretical models, basing verification on small samples or focusing on binary networks that indicate only the existence of trophic links instead of a complete dietary composition.

The goal of the project is to explore the new dataset. Structural analysis will consist of extraction, aggregation and comparison of the network indicators computed at the node and ecosystem levels [2, 3, 4]. An example could be the analysis of motifs [5], i.e., subgraphs consisting of three nodes that form the building blocks of food webs and whose statistics are related to ecological phenomena such as competition or omnivory. The dynamical analysis will concentrate on analysing diverse perturbations [6] and their impacts on the stability of the ecosystems.

### Bibliography

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2. Kazanci, C. & Ma, Q. Chapter 3 – System-wide measures in ecological network analysis. In Park, Y.-S., Lek, S., Baehr, C. & Jørgensen, S. E. (eds.) *Advanced Modelling Techniques Studying Global Changes in Environmental Sciences*, vol. 27 of Developments in Environmental Modelling, 45–68 (Elsevier, 2015).
3. Lau, M. K., Borrett, S. R., Baiser, B., Gotelli, N. J., and Ellison, A. M. Ecological network metrics: opportunities for synthesis. *Ecosphere* 8 (8), (2017).
4. Williams, R., Martinez, N. Simple rules yield complex food webs. *Nature* 404, 180–183 (2000),
5. Milo, R. et al.. Network motifs: simple building blocks of complex networks. *Science*, 298, 824-827 (2002).
6. Dominguez-Garcia, V. et al. Unveiling dimensions of stability in complex ecological networks. *Proceedings of the National Academy of Sciences* 116 (51), 25714-25720 (2019).

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