Limiting similarity is a sensitivity issue: Large niche overlap results in diverging sensitivity towards external parameters. To formalize this proposition we need the notion of regulating variables – all environmental variables that are involved in the regulating feedback loop of the ecosystem. The niche space is the set of these variables and the niche of a species is characterized by its two-way interactions with the regulating variables. On this basis, a first-principles, model-independent coexistence/niche theory was developed. Then, we cannot resist to write a book “Theory Based Ecology” and suggest that ecology can be based on a deductive theory.

**Is there such thing, as niche theory?**

*Once upon a time we had it:*
- Gauss's principle & limiting similarity
- Lotka-Volterra model & resource utilization function
- Hutchinson's niche space

*Before long, the picture fell apart:*
- Ecology became too complicated for Lotka-Volterra.
- Mechanistic models did not lead general results.
- No clear conclusion on Gauss and limiting similarity.

*Since, theoretical ecology has grown up:*
- Beyond the specific models (eg. Caswell)
- Renewed interest in coexistence theory (eg. Chesson)
- Niche has remained controversial.

**Goal: Clarity to niche theory**

- Needed: a comprehensive mathematical theory of ecological niche.
- It should be applicable to any ecological situation.
- It should provide biological insight.

**Steps from Lotka-Volterra to a general theory**

- Resources \( \leftrightarrow \) regulating variables
- Lotka-Volterra model \( \leftrightarrow \) linearization of dynamics
- Resource utilization \( \leftrightarrow \) impact and sensitivity
- Limit of similarity \( \leftrightarrow \) diminishing sensitivity

**Popular misconceptions**

- Do fluctuations alleviate competitive exclusion? \( \leftrightarrow \) No, but fluctuations allows temporal niche segregation.
- Continuous coexistence? \( \leftrightarrow \) All such models are structurally unstable.
- Self-organised similarity? \( \leftrightarrow \) Instead: hidden, non-modelled niche segregation.

**Conclusion**

Species diversity is generically based on competition-reducing niche segregation, i.e. segregation with respect to the way of being regulated. This is an unequivocal consequence of a first-principles, model-independent sensitivity analysis of species coexistence. Details are complicated, but developed in many respects. The essence was understood by Darwin, Gause, Hutchinson, MacArthur, etc., but has remained controversial because of the lack of the first principles theory. Read our book, which attempts to be a theory-based ecology!