APPLYING AN ECOSYSTEM-BASED-MANAGEMENT FRAMEWORK TO THE MANAGEMENT OF HUNGARIAN CARP FISHPOND SYSTEMS: AN UPDATE ON DECISION SUPPORT USING ECOPATH & ECOLOGICAL NETWORK ANALYSIS

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1. Background and Aims

Carp pond aquaculture in Central and Eastern Europe has a long tradition, utilizing diverse management practices. Varying production intensities and the inclusion of polyculture species impact the trophic interactions of fishpond ecosystems. Effective management depends on understanding these impacts on ecosystem structure and functioning.

We aimed to explore whether Ecopath-based food web modeling (Aubin et al. 2019) combined with Ecological Network Analysis (ENA) can be used to evaluate ecosystem changes due to different management scenarios. We then aimed to identify key ENA indices relevant for managing aquaculture ponds, and suggest how this can be used as decision-support for ecosystem-based management (EBM).

2. Field study

Study site: 6 experimental ponds of differing management regimes (common carp standing stocking, feed addition, fertilizer addition, reed management).

In June & September 2023 ponds were measured for:

- Environmental parameters
- Production parameters
- Aquatic biodiversity

3. Field-based models

Ecopath models created for each pond, balanced and model parameters obtained (Biomass, P/B, Q/B).

Field-based model parameters used to set up 6 hypothetical scenario models.

4. Scenario models & ENA

6 hypothetical model scenarios:

	Low intensity	Standard intensity	**High intensity**
Monoculture	LI-S	SI-S	HI-S
Polyculture	LI-P	SI-P	HI-P

Polyculture scenarios included additional biomass of Grass and Silver carp.

ENA applied and 10 indicators obtained (De Jonge & Schückel, 2021; Fath et al. 2019) and compared amongst scenarios.

Final 4 indicators chosen for pond aquaculture with added production indicator (common carp yield).

FCI: Finn's Cycling Index
→ how self-sustaining under current conditions the food web is due to cycling of matter.

CI: Connectance Index
→ the degree of complexity in a food web.

R: Robustness
→ the balance of efficiency and redundancy in the food web.

D/H: Detritivory to Herbivory ratio
→ reliance of the food web on primary production vs detrital matter.

5. Model perfromance

Along the production intensity gradient:

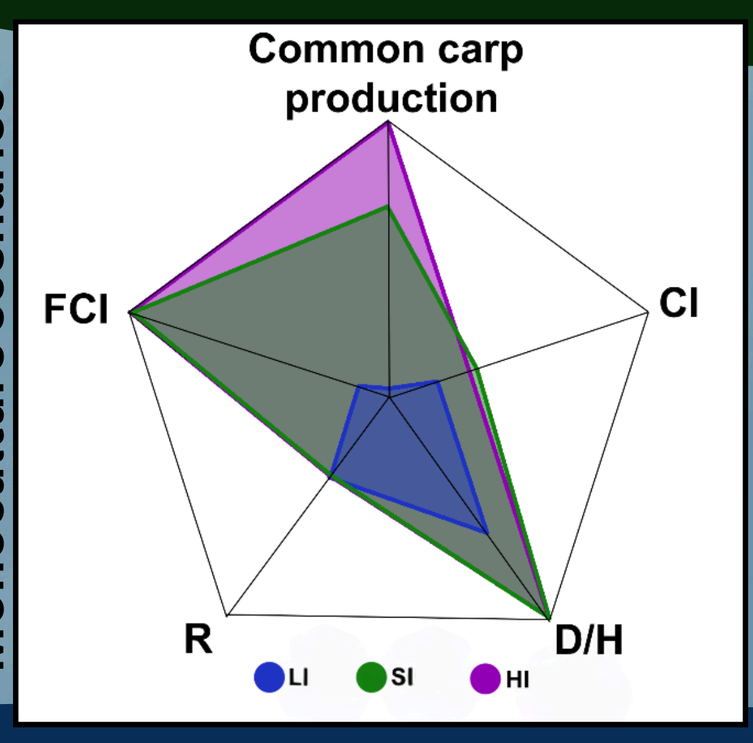
Less difference between SI & HI scenarios
→ Model showed ecological threshold reached at SI.

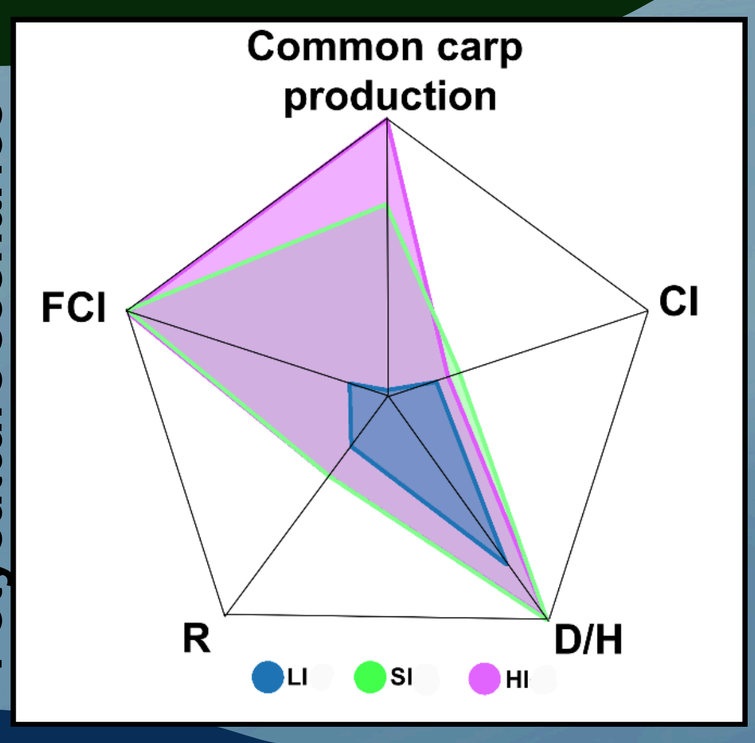
LI scenarios: ecosystems with short trophic chains, reliant on new production rather than cycling of biomass.
→ Model showed corresponding lower D/H, CI and FCI

Polyculture vs monoculture:

LI polyculture scenarios
→ primary production insufficient to support herbivores
→ less redundant, detritus-reliant systems requiring more feed & fertilizer input.

→ Model showed higher D/H and less R than monoculture scenarios





6. DST implications

Ecopath combined with ENA was able to detect changes in ecosystem structure and function due to different management practices.

The chosen indicators provide a holistic view of ecosystem productivity, functionality, and resilience, in line with EBM.

As a tool for exploring ecological interactions, Ecopath relies on high-quality data and consistency for effective relative system comparisons. It should not replace field studies or predict exact outcomes but is valuable as a decision-support tool for simulating management impacts before real-world implementation & identifying areas for further detailed study.

Scan for references and links to contact the author:

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