R^3 – Responses to biotic and abiotic changes, Resilience and Reversibility of lake ecosystems

Universität Konstanz

P1: Sticklebacks in Lake Constance

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Background

The recent **massive increase** of the neozoic **three-spined stickleback** (*Gasterosteus aculeatus*) following over 50 years of inconspicious existence in Lake Constance was, besides the oligotrophication, the decisive factor which **affected native fish** community including severe implications for local fishery. More than 80% of all the fish in the lake are sticklebacks (96% in the pelagic zone of the lake – the habitat of historically dominating fish species whitefish)[1].
The invasive stickleback acts as a **direct competitor for food**, especially for whitefish. Sticklebacks also feed on eggs and larvae which probably decrease recruitment of native fish species.
The situation is a **unique case** for a large, oligotrophic lake like Lake Constance. The **reasons** for mass occurrence remain **unknown**.

Hypotheses

- **Sticklebacks** learn to exploit **neozoans** (eg. *Limnomysis benedeni*) as a **diet**
- **Stocked whitefish larvae** may contribute as **stickleback prey** following winter (cf. figure C)
- Sticklebacks might have **developed** a **pelagic form** which succeeded in capturing the pelagic habitat

Methods

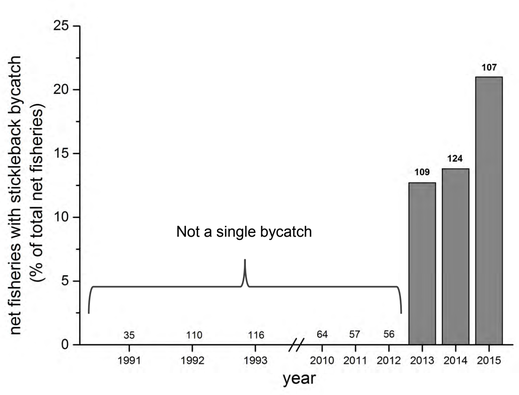
- **Hydroacoustic examinations:** multi-frequency split-beam echosounder → Species differentiation, stock assessment, movement
- **Electro and net fisheries** → Spatial spawning behaviour, abundance assessment and habitat overlap
- **Gut content & stable isotope analyses** → food niche overlap and recruitment effects
- **Age determination via otoliths** → age composition and growth of sticklebacks
- **Morphometrics (landmarks)** → form differentiation
- **Parasitic infection (tapeworm *Schistocephalus solidus*** → Parasite-induced stock control?

Goals

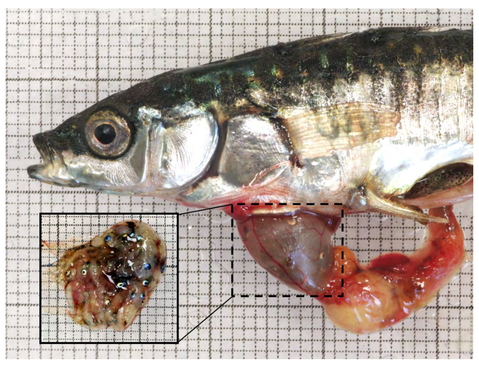
- **Investigation of the sticklebacks autecology**
- **Identification of possible reasons for mass occurrence**
- **Development of fishery management options**

A

B

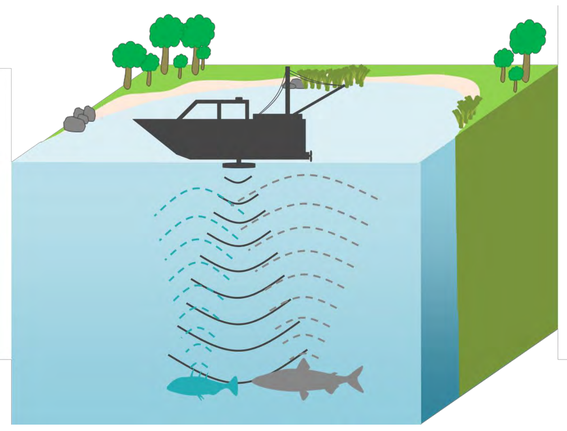


C



(A) A mass catch of sticklebacks in a pelagic drift net. **(B)** Percentage of net fisheries with sticklebacks as bycatch. Numbers above the lines and bars are number of net fisheries in the respective year. **(C)** A three-spined stickleback caught in spring parallel to whitefish larvae stocking. The stomach content comprises mainly whitefish larvae. **(D)** Basic principle of an echosounder. Figure (B) was adapted after Rösch et al. (2017)[2]

D



References

[1]Alexander et al. (2016) Artenvielfalt und Zusammensetzung der Fischpopulation im Bodensee. Project Lac, Eawag, Kastanienbaum.
[2]Rösch et al. (2017) Impact of the invasive three-spined stickleback (*Gasterosteus aculeatus*) on relative abundance and growth of native whitefish (*Coregonus wartmanni*) in Upper Lake Constance. Hydrobiologia

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SeeWandel

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