



Ph.D. study Specialist in biological and biologically-related fields

Topic: *Population dynamics of fish in reservoirs*

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Annotation

Population dynamics of fish in lakes and reservoirs has been studied for decades but is still poorly understood. Recent advances in quantitative sampling promise the improvement thanks to extensive standardized sampling programmes throughout the Europe. Within long-termed monitoring of Czech reservoirs, several decades of quantitative fish data containing the year class strength, survival, growth, and biomass of fish had been collected. New information will come in connection with forthcoming surveys. Using these long-termed sampling campaigns data, the candidate is assumed to create and run mathematical models of the population dynamics of the most important species in model reservoirs. In further steps, the outputs of the models will be confronted to extensive biotic and abiotic background datasets in order to track the main drivers of population changes in fish populations. The topic requires advanced mathematical and modelling skills and deep interest in fish biology and dynamics. Bioenergetic modelling and thinking connected with population dynamics (like the estimation of food consumption of different species) would be also desirable.

The main hypothesis

- Quantitative matrix of fish survival and growth increments can be achieved from the combination of Young-Of-the-Year fish sampling methods (fry seining and trawling) and older fish sampling (multimesh gillnets).
- The size structure of the catches of European standard multimesh gillnets reflects well the year class strength of fish.
- The first winter of life is an important bottleneck deciding the success of individual fish species.
- Finite number of biotic and abiotic predictors determine the natural recruitment success of important fish species.

Aim(s) of the Ph.D. thesis

- To create fish abundance/survival/length matrix of cyprinid/percid fish using age readings from otoliths/scales, catch-per-unit-of-effort (CPUE) and length-frequency distribution of multimesh gillnets.
- To find the connection between year class strength determined by Young-Of-the-Year fish sampling methods and by the above analysis of multimesh gillnets catch.
- Using this relationship to determine the first winter survival of cyprinid/percid fish.



- To establish the relationships between Young-Of-the-Year fish abundance and biotic and abiotic predictors during spawning and early ontogeny.

Possible approaches to reach the aims / to verify the hypotheses

- Most fish data for the thesis are already collected and ready to use in databases. However, the information for the current years of the running thesis will be collected in new surveys (Kubečka et al. 2022) and the candidate will take active part in new data collection.
- Analysis of abundance/survival/length matrix will require multiple year analysis of fish length frequency distributions and identification of individual year classes using age-length keys. Both length frequency and age-length keys are available from IHB BC CAS database. It should be possible to track every year class through its lifetime. See the examples at: https://lipnosimulation.shinyapps.io/fish_dynamics_simulation/
- Young-Of-the-Year fish community abundance is being determined by direct sampling methods (fry seining and trawling) while multimesh gillnets provide only relative abundance and biomass (CPUE/BPUE). The approach of Říha et al., 2023 can be used for putting the two datasets together. This would facilitate tracking the survival over the first winter and throughout the further ontogeny.
- Quantitative data of Young-Of-the-Year fish community available from IHB BC CAS database should be correlated with biotic and abiotic predictors collected for Římov and Lipno reservoirs using common multiple factors regression approaches (GLM, GAMM, Bayesian approaches etc. Tesfaye et al. 2024).

References

- Kubečka, J., Balk H., Blabolil, P., Frouzová, J., Kolařík, T., Kratochvíl, M., Muška, M., Prchalová, M., Říha, M., Sajdllová, Z., Soukalová, K., Souza, A., Tušer, M., Vejřík, L., Vejříková I., 2022. Methodology of monitoring fish communities in reservoirs and lakes. Biology Centre CAS, České Budějovice. ISBN 978-80-86668-95-6. 110 pp. <https://www.hbu.cas.cz/en/lter-long-term-ecological-research/>
- Říha M., Prchalová M., Brabec M., Draštík V., Muška M., Tušer M., Bartoň D., Blabolil P., Čech M., Frouzová J., Holubová M., Jůza T., Ribeiro de Moraes K., Rabaneda Bueno R., Sajdllová Z., Souza A., Šmejkal M., Vašek M., Vejřík L., Vejříková I., Peterka J., Kubečka J. (2023) Calibration of fish biomass estimates from gillnets: Step towards broader application of gillnet data. *Ecological Indicators* 153, 110425. <https://doi.org/10.1016/j.ecolind.2023.110425>
- Tesfaye M., Jůza T., Šmejkal M., Hejzlar J., Čech M., Prchalová M., Muška M., Tušer M., Kočvara L., Sajdllová Z., Draštík V., Říha M., Vašek M., Blabolil P., Symonová R., Brabec M., Kubečka J., Souza A.T. (2024) The impact of climatic conditions and food availability on bimodality size structure and density of YOY pikeperch (*Sander lucioperca*). *Hydrobiologia* 851, 3665–3681, DOI 10.1007/s10750-024-05527-0

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