

Cornell University

College of Agriculture and Life Sciences  
Cornell Biological Field Station  
Department of Natural Resources  
900 Shackelton Point Road  
Bridgeport, NY 13030

Telephone : 315 633 9243  
Fax 315 633 2358  
Web: [www.dnr.cornell.edu](http://www.dnr.cornell.edu)

September 13, 2012.

Report on Milan Riha's PhD thesis "Dynamics of fish spatial distribution in reservoirs" School of Doctoral Studies in Biological Sciences, University of South Bohemia.

This thesis consists of an introduction and 6 papers, of which 5 are published or in press in *Folia Zoologica*, *Fisheries Management and Ecology* (2 chapters), *Aquatic Living Resources* and *Fisheries Research*. Mr. Riha is first author on all of the papers and manuscripts.

In his thesis, Riha is making a substantial contribution to our understanding of the distribution of fish populations in time and space. His investigations span temporal scales from seasonal to diel patterns in distribution, and spatial scales from the whole reservoir to inshore-offshore migrations. He discusses causes for these changes, from spawning migrations to maximizing feeding rates and minimizing predation risk. He also presents an interesting analysis of the long-term development of a reservoir fish community in the Rimov Reservoir and two studies on techniques, evaluating species and size selectivity for in beach seines, midwater trawls, and purse seines. The combination of method development and studies of the results using these methods is a good approach. Testing methods leads to an appreciation of the limits of these sampling gears and therefore a better understanding of the real fish community present in the reservoir.

In his paper on the beach seine, Riha evaluates both day/night sampling and 3 different seine sizes by comparing the catch in the seine with the total number of fish in an area encircled by a block net. Day and night efficiencies were different, efficiencies varied among species in particular for the smaller seine, and efficiency varied with size of the fish, especially for the small seine. Because all fish in the blocked area are caught subsequent to the seining, the true fish population available to be caught by the seine is known. This allows Riha to measure absolute efficiency, not only relative efficiency between two gear which is the most common approach used in the literature.

The other methods paper is about efficiency in the pelagic pair trawl during the night. In this environment, a block net is not possible and Riha therefore use the comparison of two gear, the trawl and a purse seine. He found the species and size distribution to be different between the two gears with the trawl catching relatively fewer small fish and the purse seine relatively fewer large fish. Given the construction of the net, other studies associated with the trawl and boat avoidance, he conclude that the trawl with this particular construction is best used with fish larger than 180 mm when used at night. Smaller fish apparently pass through the larger mesh

and are sampled by a relatively smaller area of the trawl than larger fish. This topic is a large area of research in marine fisheries – there are whole institutes dedicated to the behavior of fish during capture and the behavior of the gear during fishing. This is equally important in freshwater although we lack the financial incentives of a large-scale commercial fishery. Although Riha's paper is specific to the particular trawl used, it is a good example of how these investigations can be done and adds to our understanding of the fishing process in general.

In the paper on post-spawning dispersal, Riha presents an impressive data set on the distribution of marked fish of seven species spanning 4 years. It provides valuable information on the behavior of these species in the Rimov and in reservoirs in general. Reservoirs are often more productive at the upstream river end and less productive in the deeper end by the dam. All species use the more productive site for spawning, but some species are obligatory spawners in this area whereas others are generalist and spawn also in other areas of the lake. Migration patterns were species specific with some species remaining in the tributary and others dispersing throughout the reservoir during the summer and returning to the spawning ground the following spring. This study adds to our understanding of fish distribution in reservoirs.

In the two papers on diel migrations between the inshore and offshore regions, Riha uses beach seine in the unstructured littoral of four reservoirs to infer diel changes in fish use of these habitats. Most species were more abundant at night. Because of the study on seine efficiency, this can be attributed to real differences between day and night rather than differences in gear efficiency. Only bleak was more abundant in the nearshore during the day. The reason for diel changes in habitat use is inferred as associated with food availability and predation risk.

To further investigate these possibilities, predation risk was inferred from catches and prey abundance measured through zooplankton samples in both inshore and offshore regions in the second paper on diel migration. Diet data was also included in this analysis. This study is particularly interesting because Riha attempts to determine causes for distributions in addition to describing them. The use of progression of gut fullness through the intestine in cyprinids was useful for understanding feeding periodicity. Although the distribution of small fish can be understood from feeding in the littoral during the night and avoiding predators during the day, larger fish that were not piscivores also used the littoral mainly at night. These species should have been able to also use the littoral during the day. Reasons given include resting, random movement and bird predation during the day.

Finally, Riha presents a very interesting study on the long-term development of a reservoir fish community. With 21 years of inshore seine data at night following the filling and aging of the reservoir, this is a very valuable study. Such long-term data sets are rare. Riha uses these data to explore several questions associated with this fish community. Thanks to the studies on gear efficiency, we can believe that the seine net used at night adequately describes the littoral fish community in the reservoir. In this reservoir, the fish community during the study went from a perch phase to a cyprinid phase after a perch disease outbreak in 1988, and has remained in the cyprinid phase since then after a 1988-1991 transition phase. Biomanipulation was attempted but did not affect the dominant bream and roach. No effects on cladocerans were observed. The

stability of this system is very interesting, as is the periodicity that appears to be synchronous among roach and bream.

Overall, this thesis is an excellent combination of methods evaluations and field observations of fish distribution in space and time. Riha has advanced our knowledge of diel migrations and long-term fish community dynamics. Reservoirs are very important in the Czech Republic and indeed throughout the world and this thesis contributes to a better understanding of these water bodies. Improved understanding of fish sampling methods is also important and necessary for any ecological investigation in aquatic systems. Such improvements are particularly timely in 2012 as the European Water Frame Work Directive is scheduled to be implemented across Europe in the near future. Classifying lakes under the Frame Work is supposed to also include sampling fish populations.

The amount of effort that has gone into this work is impressive. I doubt this could have been accomplished at many other institutes. Congratulations to a work well done. I thank the University of South Bohemia and the Academy of Sciences of the Czech Republic for the opportunity to comment on this work.



Lars Rudstam  
Professor of Fisheries and Aquatic Science  
Director of the Cornell Biological Field Station  
Cornell University

Univ. Doz. Dr. Josef Wanzenböck  
Research Institute for Limnology  
University of Innsbruck  
Mondseestraße 9  
A – 5310 Mondsee  
Tel. 0043-6232-3125-19  
e-mail: josef.wanzenboeck@uibk.ac.at



Date: Sept. 10<sup>th</sup>, 2012

University of South Bohemia

Re.: Review: Milan Riha – PhD thesis – “Dynamic of fish spatial distribution in reservoirs“

The thesis provides an impressive piece of work with an exceptional broad scope of expertise in various sub-disciplines in fish ecology. Four out of six papers are already published in internationally recognized journals, which ensure a high quality standard. So there is not much left to comment on individual papers. In general I fully support the judgement of reviewers with respect to the scientific and technical quality of the papers meriting publication on the international level.

In the following I will focus on the synopsis of papers and give my account on the thesis as a whole: For me the thesis starts logically with part two, in which methodological issues concerning the selectivity of various sampling gear are addressed (papers IV and V). I fully agree with the authors that field-based work in fish ecology generally suffers from methodological uncertainties and I consider the two papers to represent a major step forward to resolve these problems. Therefore I found the two papers to be of very high scientific relevance and I am confident they will have a profound influence on future studies involving this methodology, i.e. trawling, beach- and purse-seining.

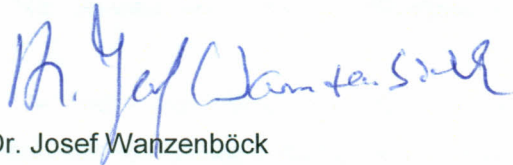
In part one (specifically papers II, III) the methodological progress is used to reveal habitat changes of the fish assemblage on a diel basis. I consider this part again very innovative as the dynamics of fish with regard to pelagic and littoral habitat use is analyzed for all the important species and the full spectrum of fish sizes which is not available in the literature. Paper I uses a different methodology and addresses a different question connected to spawning - but still is linked to the other papers as the overall frame is still spatio-temporal habitat use within the reservoirs. Here the candidate shows that he has gained far reaching experience with different methods and topics on the one hand but also remained focused and concise on the other hand. Therefore I consider this part very well done representing the core of the thesis.

To some extent, my opinion regarding paper I can be expanded to part three (paper VI) of the thesis. Here again, the scope is widened - but still using the progress made in sampling methodology - by

addressing the long term changes in the inshore fish assemblage of the reservoir. To my knowledge there is no other time series of this extent in the literature and therefore I consider this paper to be a highly important contribution. Because of this importance I expected a discussion of the findings in a wider context, i.e. how are the results related to the general theory of fish community succession along trophic gradients in lakes and reservoirs – somehow I missed this as I found the discussion too much focused on specific conditions of reservoirs only.

In summary I confirm my very positive assessment of the thesis: I truly consider this piece of work to be of high scientific relevance, that it will have a profound impact on future developments in the field and that it forms a solid basis for the future scientific career of Milan Riha.

Sincerely



Dr. Josef Wanzenböck