Charles University in Prague
Faculty of Science
Institute for Environmental Studies

Detecting patterens of angler selective behaviour in the Czech recreational fishery statistics

Martin Jankovský

Ph.D. Thesis

Supervisor: prof. RNDr. Karel Pivnička, DrSc.

Prague 2011

I declare that this thesis has been fully worked out by me using the cited literature only and that neither this thesis, nor any of the publications attached within, have been submitted for the purpose of obtaining the title of Ph.D., or any other title, at another institution.

RNDr. Martin Jankovský, Prague, February 21, 2011

Acknowledgements:

For big help with this thesis I would like to thank to my supervisor prof. RNDr. Karel Pivnička, DrSc. who gave me the opportunity to work on the topic, never refused my frequent calls for professional help and introduced me to other local fishery experts. Out of such people I am most grateful to prof. RNDr. Jan Kubečka, CSc. who also gave me some consultations, but especially taught me how to sample fish stocks in reservoirs and put me into a very important contact with Ing. MgA. David Boukal, Ph.D. David pulled me up for a while into the world of top leading data analysts and introduced me a modern way of scientific thinking.
For overall help throughout my Ph.D. studies I would like to thank to the directors of the institute, prof. RNDr. Martin Braniš, CSc. and doc. Ing. Mgr. Jan Frouz, CSc.
Last not least I would like thank to my parents for having me, loving me and helping me. I am sorry being unable to recollect the complete list of the relatives, friends and acquaintances that surely had an influence on my work as well.
The research was also supported by a grant from Iceland, Liechtenstein and Norway financed by the Financial Mechanism of EEA and Norwegian Financial Mechanism (project A/CZ0046/2/0029 "Monitoring the environment of man-made lakes: what can fisheries data and models tell us?").

ABSTRACT

Methods for detecting patterns of angler selective fishing behaviour in the long term recreational fishery statistics are presented in this Ph.D. Thesis. The motivating idea is that mainly different anglers' fishing preferences or attitudes towards particular fish species obstruct applying anglers' catches data for ongoing use in ichthyology research. Better recognising angler selectivity is therefore judged to be the key point from the viewpoint of fish and fishery sciences. Methods affecting angler behaviour can be directly applied by other specialists, e.g. social scientists. The thesis consists of five papers two of which are published (paper 1, 2), other two of which are accepted for publishing (paper 3, 4) and the last of which (paper 5) is in the status of manuscript before submitting.

In the first two papers the role of common carp catches is focused. By using multivariate techniques it is studied if the increased exploitation of carp increases also the exploitation of other fish species. Time series of carp catches serve as an explanatory variable, other species catches through the same time are processed as independent variables. According to expectations the positive effect of carp catches on those of the other species was approved at the river section with the highest expected density of stocked carps (paper 1) or at a reservoir with best conditions for several days fishing trips (paper 2).

In paper 3, not only common carp, but all frequently caught species are focused. Twenty year time series of such species were processed to find either positive or negative correlations, which were hypothesised to be the signals of angler selective behaviour. Datasets from four very different reservoirs were analysed and most likely explanations of the observed correlations were found in various management restrictions, shoreline accessibility or stocking activities. Several of these potential explanations were further tested in the logbook analyses in papers 4 and 5.

In these two papers, individual angler (paper 4) or even individual catches (paper 5) data were analysed to approve, if the positive correlations have at least a theoretical background in angler selective fishing. This was confirmed in paper 4 where a good-sized group of anglers focusing during a year at each other fluctuating species was identified. Nevertheless, the hypothesis that this angler group consists of holiday takers being not so selective and specialized was disproved in paper 5.

ABSTRAKT

V disertační práci jsou prezentovány metody detekce selektivního chování rybářů v dlouhodobých statistikách českého rekreačního rybářství. Práce je motivována myšlenkou, že především různé rybářské preference nebo postoje vůči lovu konkrétních druhů ryb brání širší aplikaci rybářských dat. Poznání selektivity rybářů je proto především z pohledu ichtyologického výzkumu chápáno jako klíčové. Metody postihující chování rybářů mají navíc potenciál sloužit i v dalších, např. sociálně vědních oborech. Práce sestává z pěti článků z nichž dva jsou publikované (paper 1, 2), další dva přijaté k publikování (paper 3, 4) a poslední (paper 5) je ve stadiu rukopisu před postoupením recenznímu řízení.

První dva články jsou věnované roli masivního lovu kapra. Za použití mnohorozměrných metod je studováno, zda zvýšený výlov tohoto druhu zvyšuje výlov dalších rybích druhů. Časové řady výlovu kapra jsou tak analyzovány jako vysvětlující proměnná, výlov ostatních druhů za stejné období jako závislé proměnné. Dle očekávání, pozitivní vliv úlovků kapra na úlovky ostatních druhů byl prokázán v říčním úseku s nejvyšší očekávanou hustotou kapří násady (paper 1) nebo v údolní nádrži vyznačující se nejlepší dostupností a podmínkami pro vícedenní rybářské výlety (paper 2).

V dalším příspěvku (paper 3) je věnována pozornost rybářským preferencím vůči všem častěji loveným druhům. Mezi dvacetiletými časovými řadami úlovků přibližně sedmi druhů byly hledány signifikantně pozitivní i negativní korelace a tyto byly následně analyzované jako možný signál selektivního rybolovu. Takto byla zpracována data ze čtyř velmi odlišných nádrží a přijatelná vysvětlení všech pozorovaných mezidruhových korelací byla v souladu s hypotézou nalezena v různých rybolovných opatřeních, přístupnosti břehové linie nebo násadovém hospodářství. Vybrané konkrétní závěry byly kvantitativně dokládány v navazující analýze individuálních dat v článcích 4 a 5 (paper 4, 5).

V těchto článcích byly analyzovány sumární roční úlovky jednotlivých rybářů (paper 4) či dokonce jednotlivé úlovky z odevzdaných lístků (paper 5) s cílem prokázat, zda pozitivní korelace mají alespoň teoretický základ v selektivním chování rybářů. Toto bylo skutečně v jednom z obou článků (paper 4) prokázáno, neboť se podařilo identifikovat dostatečně početnou skupinu rybářů, kteří se během roku zaměřují na lov právě vzájemně korelujících různých druhů. Nicméně, hypotéza, že tato skupina rybářů sestává z prázdninových návštěvníků s nízkou specializací a selektivitou byla v zamítnuta (paper 5).

Contents

Introduction

Recreational fishing is defined as an activity of individuals, which is conducted for sport and leisure and has a possible secondary objective of catching fish for personal consumption - FAO 1997; Pitcher & Hollingworth 2002; Rangel & Erzini 2007). It more and more gets to the focus of scientific discussions as it turns out to be an important agent, besides the commercial fisheries (Smith 2002; Hilborn *et al*. 2003; Pauly *et al*., 2003), of general fish stock declines (Cooke and Cowx 2004, 2006; Lewin et al. 2006). The higher socio-economic benefit of the recreational concept is sometimes moreover suggested against the commercial one (Kearney 2002; Cooke & Cowx 2006; Arlinghaus *et al*. 2010).

Overfishing is not only a problem of marine fisheries but becomes an important issue in the case of inland stocks as well. Here, the stocking enhancements are usually applied and a variety of semi natural to cultural based fisheries practises comes up worldwide (Lorenz *et al*. 1998; Petr 2004; Jayasinghe *et al*. 2006). In developed countries the artificial stocking is mainly focused on enriching the fishing wards to anglers' use (Pánek 1987; Vácha 1998; Spurný 2001; Wedekind *et al*. 2001; Phelps *et al*. 2008). How do these artificial activities involve the remaining fish stock, the overall anglers' catchments or the anglers' attitudes towards particular fish species seem to be the crucial questions everywhere.

Another issue that can be studied only with using long term data is year class strength variation or the recruitment dynamics. Although the YCS variation research received the biggest attention in commercial fisheries (Eckmann 1987; Cyterski & Spangler 1996; Auvinen *et al*. 2004; Lahnsteiner & Wanzenböck 2004; Salonen 2004; Sutela *et al*. 2004; Valkeajärvi *et al*. 2004; Viljanen *et al*. 2004; Straile *et al*. 2007; Lappalainen *et al*. 2008; Thomas 2008), there is a considerable tradition of such research also in cyprinides (Cragg-Hine & Jones 1969; Hellawell 1972; Mann 1973; Cowx 1988; Nunn *et al*. 2003) and other among anglers popular species: white and black crappie (Maceina 2003), black and stripped basses (Bonvechio & Allen 2007; Secor 2000), glass eel (Sullivan *et al*. 2006), yellow perch (Williamson *et al*. 1997) and murray cod (Humphries 2005).

The usual methods for evaluating recreational fisheries are creel surveys (Vostradovský *et al*. 1978; Malvetusto 1983; Cowx 1991; Pollock *et al*. 1994), routine monitoring surveys (Pivnička & Čihař 1986; Cowx 1995, 1996; Wiśniewolski *et al*. 2007) or various on- and off-sight questioner methodologies (Green *et al*. 1982; Malvetusto 1983, Hudgins 1984, Kershner & Van Kirk 1984; Cowx 1991; Pollock *et al*. 1994; Weithman 1991; Wilde & Ditton 1994).

Even if they have been massively innovated (Cowx 1996; Toivonen *et al*. 1998; Wild *et al*. 1998) and also combining different approaches has been welcome to enhance standard procedures (Ditton & Hunt 2001; Lockwood & Rakoczy 2005; Soupir *et al*. 2006), short time periods to which the resulted data usually refer discourage the desired research of any historical trends.

Fishing clubs records and angler association statistics have the potential to overcome this problem (North 1983; Harris & Bergensen 1985; Gartside *et al*. 1999; Cowx & Frear 2004; Draštík *et al*. 2004). Numerous researches have moreover approved their reliability for indexing long-term trends (Carlander *et al*. 1958; Green 1985; Ebbers 1987; Stanley 1989; Sztramko *et al*. 1991; Kerr 1996; MacLennan 1996; Pivnička *et al*. 2005; Mosidy & Duffy 2007; VanDeValk *et al*. 2007; Younk & Pereira 2007). Unfortunately these anglers statistics are not so common (Essig & Holliday 1991; Pollock *et al*. 1994; Gartside *et al*. 1999) as it is in the case of commercial fisheries (Smith 2002; Hilborn *et al*. 2003; Pauly *et al*. 2003; Auvinen *et al*. 2004; Salonen 2004; Sutela *et al*. 2004; Valkeajärvi & Marjomäki 2004; Viljanen *et al*. 2004; Zeeberg *et al*. 2008).

This is a big opportunity for making most of Czech anglers' statistics. An organized recreational fishery has got a long tradition in The Czech Republic and the fishery statistics refer up to more than fifty years backwards. Their quality has resulted in a lot of interesting even if mostly descriptive studies: Lusk & Gajdůček 1977; Lusk 1978; Lusk & Krčál 1983; Lusk 1984 a, b; Pivnička 1985; Pivnička & Ježek 1989; Lusk & Halačka 1995; Baruš *et al*. 2000; Habán 1999; Spurný & Chára 1999; Baruš *et al*. 2000; Pivnička & Rybář 2001; Smutný & Pivnička 2001; Spurný 2001; Baruš et al. 2002; Lusk *et al*. 2003; Draštík *et al*. 2004; Spurný 2004, Jankovský 2007a,b; Jankovský & Pivnička 2008.

To make the first step (Jankovský 2010d, Jankovský *et al*. in press b) over the speculative character of any potentially important results and uncertainty what is the real population status and what is the consequence of a selective fishing, detecting patterns of angler behaviour was focused in this Ph.D. Thesis. The thesis consists of five articles and other hypotheses and papers in draw are introduced in "Perspectives". Two of the papers have been already published (paper 1 and 2), two are accepted for publishing (paper 3 and 4) and one is in the status of manuscript. Within the Perspectives, issues are revealed whose research has already started with this thesis or is ready to start as a consequence of the results presented in the papers submitted here.

List of attached papers

Paper 1 Humpl M., Pivnička K. & Jankovský M. (2009): Sport fishery statistics, water quality and fish assemblages in the Berounka River in 1975 - 2005. *Folia Zool*ogica, 58(4):457-465.

Paper 2 Jankovský M. (2009): The role of the common carp catches in the overall angling exploitation on two different reservoirs in the Czech Republic. *Acta Universitatis Carrolinae Enviromentalica*, 1-2, 79-90

Paper 3 Jankovský M. & Pivnička K. (in press): Angler fishing strategies in different reservoirs as assessed from fisheries statistics (1988 - 2007). *Acta Universitatis Carrolinae Environmentalica* 24 (1-2)

Paper 4 Jankovský M., Boukal D., Pivnička K. & Kubečka J. (in press): Tracing possible drivers of synchronously fluctuating species catches in individual logbook data. *Fisheries Management and Ecology*

Paper 5 Jankovský M., Boukal D., Pivnička K. & Kubečka J. (in prep): Seasonality in anglers' fishing preference: Are holiday anglers agents of synchronously fluctuating species catches in the fisheries statistics?

Thesis Summary

Patterns of angler selective fishing behaviour were suggested (**paper 3**) or quantitatively identified (**paper 1**, **2, 4**, **5**) in the Czech recreational fishery statistics throughout this thesis. Use of the Czech catch statistics for studying trends in fish populations is thus recommended only after a thorough analyses introduced in the separate papers: a multivariate analyses (**paper 1**, **2**), correlation analyses (**paper 3**) or even individual logbook data analyses: either better reachable individual angler data analysis (**paper 4**) or an advanced analysis of individual catches (**paper 5**).

Multivariate ordination techniques were successfully applied for evaluating the relationship between the catches of common carp on one side and the catches of all other species on the other side (**paper 1**, **paper 2**). Carp catches were handled as one of the explanatory (environmental) variables and other species catches represented independent variables. In **paper 1**, the effect of increased carp catches and other environmental factors on the spectrum of other species catches was evaluated over long time series and was studied at different stretches of a long river. At some cases, the effect of separate environmental factors was significant, even if it was only at those river stretches where the variability of these factors in time was higher. Time series of non-carp species catches are concluded to be a useful instrument for description long-term changes in selected stream environments. Catches of common carp processed as an environmental factor were significant at places with exceptionally high concentration of stocked carps. The other fish species can therefore be roughly called "by-catches" of common carp at such places.

The role of common carp as a preferred species was specially focused in **paper 2**. Unlike in the **paper 1**, environment of reservoirs was adopted instead of rivers to prevent from speculations about fish migrations. The multivariate ordinations were applied as in **paper 1**, plus catch-stock correlations of carp were tested. Study period was considerably shortened against **paper 1** and the "past" and "recent" periods were evaluated separately. In the "past", when the stocking with common carp was generally low, the above mentioned significant relationship between carp and all non-carp catches was always missing. At "present", nevertheless, the significant results were observed in the case of a reservoir with higher anglers' pressure, while the negative ones occurred at a reservoir with low expected anglers' attendance. The positive linear dependence of carp catches on carp stocking was also significant only at the reservoir with higher anglers' attendance and in the "present" period.

The analysis applied is recommended for rough assessing angler fishing preferences toward selected species.

Results concerning common carp in the previous two papers provoked an overall correlation analysis comprising all frequently caught species (**paper 3**). It was widely hypothesised, that not only common carp is preferably caught and that significant correlations between long-term catches of any different species can indicate anglers' strategies or techniques. A number of positive and negative correlations were really discovered in the datasets from four very different reservoirs. These data structures were attempted to be handled as pointing only at angler behaviour even if an alternative explanation in fish population dynamics is theoretically same well likely. Potential explanations for particular cases of significant correlations were found in various management restrictions, shoreline accessibility or stocking activities. The speculative character of these explanations became a motivation for logbook analyses in the following two papers. **Paper 4** and **paper 5** thus use individual anglers' logbooks to test a probability that angler selective fishing causes the observed positive correlations identified in **paper 3**.

In **paper 4,** a method is suggested and demonstrated how to approve the possibility that the positive correlations observed between long term catches of different species become as a consequence of the same anglers' catches. The necessary prerequisite is worked out that such group of anglers must be good-sized and that the total catches of both taken species reached by these anglers must be significantly higher that those of the remaining angling visitors. The synchronous fluctuations identified in the dataset from a valley reservoir thus showed up to be explainable by the defined group of same anglers, called here the "generalists" as they do not specialize on catching just one of the focal species. Their number was higher than expected by chance and their catches were also significantly higher than those of the "specialists" the category defined for anglers that caught only one of the "each-other-correlating" species in the whole year. The great advantage of the method is its dependence on only summarized annual catches information about individual anglers which is easily available in the databases of both angler unions in the Czech Republic.

Contrary, a manual rewriting the daily catches from the logbooks was necessary for analyses suggested and applied in **paper 5**. Here, the conclusions about the same anglers made in the **paper 4** and speculations about holiday anglers from the **paper 3** are further evolved. It is hypothesised that anglers being at the background of the observed positive inter-species correlations are holiday takers, as these are expected to be not so specialized. The fact that a number of the synchronous inter-species fluctuations were observed at a reservoir with high

peaks of anglers' attendance in the summer, while no such synchronicities appeared in the case of a small urban reservoir where the angler attendance is spread into the whole year, was the reason of demonstrating the method on both these reservoirs. The proposed analyses revealed that time intervals between catches of selected species were usually significantly longer than expected by chance, suggesting that anglers at both studied reservoirs shift their focus from species to species during the season. The hypothesis about unselective holiday fishermen being agents of the observed synchronous fluctuations was thus disproved and the group of "same anglers" as defined in **paper 4** therefore must be more heterogeneous than judged in **paper 3**.

Perspectives

However well angler behaviour towards the positively correlated long term catches was evaluated (papers 4 and 5), the same should be done in the case of the **negatively correlating long term catches** as they were identified in paper 3. The aim is to find if it is anglers' switch in the interest or anyhow else motivated alternation of the fishing focus on one or the other species what causes the negative correlations of catches in time. If this is not approved, there is an alternative explanation in population dynamics, particularly in competition or predation. These density dependent mechanisms have received a considerable attention recently (Auvinen et al. 2004; Salonen 2004; Valkeajärvi & Marjomäki 2004; Humphries 2005; Boukal 2010). Unfortunately, lack of any longer term scientific fish sampling is the problem for direct testing the influence of these density dependent factors in case of the Czech reservoirs.

Much better position exists for also not yet realized research of the **alternative explanation** (= not connected with angler behaviour) **of the positive long term correlations** that were indentified both within one reservoir (paper 3) and among different waters (Pivnička et Rybář 2001; Jankovský 2007b), as long term data on possible density independent factors are archived in the Czech Hydrometeorology Institute. The generally well known factors influence of which is most likely is the water temperature (e.g. Mann et al. 1984, Mills & Mann 1985, Copp 1990; Wootton 1990; Mann 1995; Cowx 2000; Grenouillet et al. 2001) and the discharge rate together with the water level fluctuations (Lucas et al. 1998, Cowx 2001; Nunn et al. 2003; Bonvechio & Allen 2007).

A special case was observed in the dataset of the Slapy reservoir, where the positive long term correlation occurred between catches of a fully (common carp) and strongly (pike) stocking dependent species. Both species are artificially recruited because they are stocked in a harvestable size and stocking management data thus can provide the desired evidence of the recruitment fluctuation in time. Even if a preliminary analyses using linear regressions shows some theoretical possibility of the coincidence between regular stocking events of both species (Jankovský *et al*. 2010 a), an advanced "generalized least squares regressions" should be used here (Jankovský *et al*. 2010 c).

Generalized least square models seem to be especially advantageous for better recognising **common carp catch-stock correlations** in the conditions of the Czech recreational fishery. A strong positive dependence of caught carps total weight on the stocked carps total weight has been already noticed (Pivnička & Rybář 2001; Draštík *et al*. 2004) and in a number of studies, carp catch-stock dependences within different water bodies were evaluated using linear regressions (Jankovský 2007a; Jankovský 2007b; Jankovský & Pivnička 2008; Jankovský M. & Pivnička in press.) Nevertheless, the advanced method has the potential to determine the precise residence time of stocked fish and to assess also the mean growth rate (Jankovský *et al*. 2010 c). There is a unique opportunity to compare such results on the growth with the growth data obtained in the traditional research currently performed at some Moravian reservoirs (Habán *et al*. 2006, 2007; Prokeš *et al*. 2008, 2009, 2010).

Even if the pilot studies in paper 4 and 5 open the great potential of individual logbook data for future investigations, direct **interviewing and creel surveys** will be necessary as well. For example, whether anglers purposely switch their attention toward another species or if the decreasing catches really reflect decreasing population status of one species can be found out only through interviews. More difficult task that should be solved in the field is evaluating issues like misidentifying species, misreporting catches or even some serious cases of pouching, things that were questioned many times and never sufficiently answered (Essig and Holliday 1991, Pollock et al. 1994; Bray & Schramm 2001; Sullivan 2003; Page et al. 2004). Exceptionally good cooperation was already experienced by the author of this Thesis during both performing structured interviews on large Lipno reservoirs (Boukal *et al*. 2010) and designing and leading the questioner research on a small urban Hostivař reservoir (Winterová 2010).

The last issue that has been started (Jankovský *et al*. 2010b) and deserves to be mentioned here comes from a comparison between the relative species structure of anglers' catches on

one hand and scientific **benthic gillnets estimates** (Appelberg *et al*. 1995; European Standard 14 757, 2005; Prchalová *et al*. 2008) on the other. The idea that both datasets can be compared is based on the considerably overlapping peaks of fish feeding activity (Prchalová *et al*. 2010) and anglers attendance (Winterová 2010). Three naturally recruited, frequently (minimal „eatable“ size judged after consultation with bailiff) and hopefully randomly (Pivnička & Rybář 2001; Jankovský & Pivnička in press) caught species were only focused on: bream (over 23 cm), roach (over 23 cm) and perch (over 15 cm). The one-time gillnet sampling of nine Czech reservoirs was realized during August and September (in 2008) when fishes are expected to utilize whole productive potential of a water body (Hladík & Kubečka, 2003; Vašek *et al*. 2004).

Even if the lack of anglers' effort data allowed only qualitative comparison of the relative abundances (percentage of all three species consisted 100 %) and it is thus impossible to be sure if a certain species is really over/underestimating by anglers or if its percentage is just a passive reaction on the percentages of the remaining species, one remarkable pattern occurred. Although roach seems to be generally (similarly like perch and unlike bream) underestimated by anglers (from the viewpoint of gillnets) it is surprisingly overestimated at two middle-sized reservoirs laying only a few kilometres away from each other in the region with the highest unemployment in the Czech Republic. It can thus be speculated whether the residents after the recent collapse of local mining and heavy industries are trying to maximize their exploitation of available fish stock resources by not releasing even the low favoured fish species here which roach definitely is. The real approval of this speculation can be only revealed by interviewing anglers or at least a logbook data analysis.

References

Appelberg M., Berger H.M., Hesthagen T., Kleiven E., Kurkilahti M., Raitaniemi J.& Rask M. (1995). Development and intercalibration of methods in Nordic freshwater fish monitoring. *Water, Air and Soil Pollution* 85, 401–406.

Arlinghaus R., Cooke S.J. & Cowx I.G. (2010) Providing context to the global code of practice for recreational fisheries. *Fisheries Management and Ecology* 17, 146-156.

Auvinen H., Kolari I., Pesonen A. & Jurvelius J. (2004) Mortality of vendace (*Coreginus albula*) caused by predation and trawling. - *Annales Zoologici Fennici* 41: 339-350.

Baruš V., Prokeš M. & Peňáz M. (2000) Tendencies appearing in fishery yields by angling in the river Dyje downstream of the Nové Mlýny Reservoirs. - *In*: Mikešová (ed.): The 4th czech conference of ichthyology : proceedings of the international conference, Vodňany 10.-12.5. 2000, 198-201. [In Czech with English summary.]

Baruš V., Peňáz M. & Prokeš M. (2000) What coclusions could be made on diversity of fish community in lower reaches of the Morava River from anglers‘ fishing yields. *Biodiverzita ichtyofauny ČR (III)*: 45-50 [In Czech with English summary.]

Baruš V., Peňáz M. & Prokeš M. (2002) Phase of the ontogenesis of the Mušov Reservoir fo the waterwork Nové Mlýny – fish yield and condition parameters of silver bream (*Blicca bjoerkna*) Moravy. - *In*: Mikešová (ed.): The 5th czech conference of ichthyology : proceedings of the international conference: Brno, 25. - 26.9.2002, 114-118. [In Czech with English summary.]

Bonvechio F.T. & Allen M.S. (2007) Relations between hydrological variables and year.class strength of sportfish in eight Florida waterbodies. *Hydrobiologia*, 532, 193-207.

Boukal D. (2010) Modelling the impact of selective fishing on freshwater fish populations: current status and future challenges. - In: Vykusová B. et Dvoráková Z. (eds): *The 12th Czech conference of ichthyology: proceedings of the international conference*, Vodňany 19. - 20. 5.2010, 22 [In Czech with English summary.]

Boukal D., Dankel D., Jankovský M., Stachová T.**,** Heino M., Vašek M, Kubečka J. (2010) Case study of presumed pikeperch collapse in Lake Lipno. - In: Boukal D, Soukalová K., Hohausová E. (eds): Book of abstracts, *DINFISH 2010*: *Toward a Synthesis of Objectives, Models and Data Analyses for Sustainable Management*, September 13. - 16. 2010, České Budějovice. Czech Republic, 8

Bray G.S., Schramm H.L. (2001) Evaluation of a statewide volunteer angler diary program for use as a fishery assessment tool. N Am Fish Manage 21:606-615.

Carlander K.D., DiCostanzo C.J. & Jessen R.J. (1958) Sampling problems in creel census. *Progressive Fish-Culturist* 20, 73-81

Cooke S.J., Dunlop W.I., Macclennan D. & Power G. (2000) Applications and characteristics of angler diary programmes in Ontario, Canada. *Fisheries Management and Ecology*, 7: 473-487.

Cooke S.J. & Cowx I.G. (2004) The role of recreational fishing in global fish crisis. *Bioscience*, 54: 857-859.

Cooke S.J. & Cowx I.G. (2006) Contrasting recreational and commercial fishing: searching for common issues to promote unified conservation of fisheries resources and aquetic environments. *Biology Conservation*, 128: 93-108.

Copp G.H. (1990) Recognition of cohorts and growth of larval and juvenile roach Rutilus rutilus (L.), using sizeclass ordination of developmental steps. *Jornal of Fish Biology*, 36, 803-819.

Cowx I.G. (1988) Distribution and variation in the growth parameters of roach, *Rutilus rutilus* (L.) and dace, *Leuciscus leuciscus* (L.), in a river catchment in the south-west of England. *Journal of Fish Biology* 33, 59-72.

Cowx I.G. (ed.) (1991) *Catch Effort Sampling Strategies and their Application in Freshwater Fisheries Management.* Oxford: Fishing News Books, Blackwell Scientific Publications, 420 pp.

Cowx I.G. (1995) Fish Stock assessment – biological basis for sound ecological management. In: D. Harper & A. Ferguson (eds) *Biological Basis for River Management*. London: Wiley and Son, pp. 375-388.

Cowx I.G. (ed.) (1996) Stock *Assessment in Inland Fisheries*. Oxford: Fishing News Books, Blackwell Science, 517 pp.

Cowx I.G. (2000) Potential impact of groundwater augmentation of river flows on fisheries: a case study from the River Ouse, Yorkshire, UK. *Fisheries Management and Ecology*, 7, 85-96.

Cowx I.G. (2001) *Factors Influencing Coarse Fish Populations in Lowland Rivers*. Bristol: Environment Agency R & D Report, 179 pp.

Cowx I.G. & Frear P.A. (2004) Assessment of year class stregth in freshwater recreational fish populations. *Fisheries Managemnet and Ecology* 11: 2, 117-123.

Cragg-Hine D. & Jones J. W. (1969) The growth of dace, *Leuciscus leuciscus* (L.), roach, *Rutilus rutilus* (L.) and chub, *Squalius cephalus* (L.) in Willow Brook, Northamptonshire. *Journal of Fish Biology* 1, 59-82.

Cyterski M.J. & Spangler G.R. (1996) Development and utilization of a population growth history of Red Lake walleye, *Stizostedion vitreum*. *Environmental Biology of Fishes*, 46(1), 45-59.

Ditton R.B. & Hunt K.M. (2001) Combining creel intercept and mail survey methods to understand the human dimensions of local freshwater fisheries. *Fisheries Management and ecology*, 8, 295-301.

Draštík V., Kubečka J. & Šovčík P. (2004) Hydrology and angler's catches in the Czech reservoirs. *Ecohydrology and Hydrobiology*, 4: 429-439.

Ebbers M.A. (1987) Vital statitsics of a largemouth bass population in Minnesota from electrofishing and angler-supplied data. *North American Journal of Fisheries Management* 7, 252-259.

Eckmann R. (1987) A comparative study on the temperature dependence of embryogenesis in three coregonids (*Coregonus* spp.) from Lake Constance. *Schweizerische Zeitschrift für Hydrobiologie* 49, 353-362.

European Standard EN 14 757, 2005. Water Quality—Sampling of Fish with MultimeshGillnets, CEN TC 230, March 2005.

Essig R.J. & Holliday M.C. (1991) Development of a recreational fishing survey: the marine recreational fishery statistics survey case study. American Fisheries Society Symposium 12, 245-254.

FAO (1997) Inland fisheries. FAO Fisheries Department Technical Guidelines for Responsible Fisheries No 6 (Technical guidelines for the sustainable management of inland fisheries). FAO, Rome.

Gartside D.F., Harrison B. & Ryan B.L. (1999) An evaluation of the use of fishing club records in the management of marine recreational fisheries. *Fisheries Research* 41: 47-61.

Green D.M., Schonhoff B.J. & Youngs W.D. (1986) The New York State Bass Study, 1977-1980: Use of Angler Collected Data to Determine Population Dynamics. Ithaca, New York: Cornell University, Department of Natural Resources. 157 pp.

Grenouillet G., Hugueny B., Carrel G.A., Olivier J.M. & Pont D. (2001) Large-scale synchrony and inter-annual variability in roach recruitment in the Rhône River: the relative role of climatic factors and density - dependant processes. *Freshwater Biology*, 46, 11-26.

Habán V. (1999) Management in districts of the Moravian fishery union and trends in sport fishing. - *In*: Spurný (ed.): The 3rd czech conference of ichthyology: proceedings of the international conference, 1.-2.12. 1999, 167-173. [In Czech with English summary.]

Habán V., Prokeš M., Baruš V. & Mareš J. (2006) Individual growth and weight condition of the common carp (*Cyprinus carpio* m. *domestica*) in the Nové Mlýny Reservoir (Preliminary results). - In: Vykusová B. (ed.), *The 9th Czech conference of*

ichthyology: *proceedings of the international conference*, Vodňany, 16-21. [In Czech with English summary.]

Habán V., Prokeš M., Baruš V., Mareš J. & Peňáz M. (2007) The individual growth of carp (*Cyprinus carpio* m. *domestica*) in two different water reservoirs in drainage area of Morava (Czech Republic) the first year after stocking]. In: Švátora M. (ed.), *The 10th Czech conference of ichthyology*: *proceedings of the international conference*, Praha, 41-47. [In Czech with English summary.]

Harris C.C. & Bergersen E.P. (1985) Survey on demand for sport fisheries: problems and potentionalities for Its use in fishery management planning. *North American Journal of Fisheries Management*, 5: 400-410.

Hellawell J.M. (1972) The growth, reproduction and food of roach *Rutilus rutilus* (L), of the River Lugg, Herefordshire. *Journal of Fish Biology* 4, 469-486.

Hilborn R., Branch T.A., Ernst W., Magnusson A., Minte-Vera C.A., Scheuerell M.D. & Valero J.L. (2003) State of world's fisheries. *Annual Treview of Environment and Resources* 28, 359-399.

Hladík M. & Kubečka J. (2003) Fish migration between a temperate reservoir and its main tributary. *Hydrobiologia* 504, 251–266.

Hudgins M. D. (1984) Structure of Angling Experience. *Translations of American Fisheries Society*, 113: 750-759.

Humphries P. (2005) Spawning time and early life history of Murray cod, *Maccullochella peelii peelii* (Mitchel) in an Australian river. *Environmental Biology of Fishes*, 72, 393-407.

Jankovský M. (2007a) Long term trends in the recreational fishery yields in rivers and reservoirs of the Vltava River watershed. - In: Švátora M. (ed.): *The 10th Czech conference of ichthyology* : *proceedings of the international conference*, Praha 26. - 27.6. 2007, 55-61 [In Czech with English summary.]

Jankovský M. (2007b) Long-term trends in sport fishery yield from different reservoirs and large rivers in the Labe watershed (Czech Republic) between 1958-2006. *Proceedings of the international conference* "*Fish Stock Assessment Methods for Lakes and Reservoirs*: *Towards the true picture of fish stock*", September 11-15, 2007, České Budějovice, Czech Republic, 32.

Jankovský M. & Pivnička K. (2008) Long term dependences of the common carp yields on the stocking with carp in different reservoirs and rivers of the Vltava River watershed.

- In: Hladík (ed.): *Proceedings of the national conference on the occasion of the 50th anniversary of the Lipno reservoir*, Frymburk 16. - 17. 5. 2008 [In Czech.]

Jankovský M., Pivnička K. & Kubečka J. (2010a) Anglers' selective behaviour as the driver of the often observed positive inter-specific correlations in the long-term catch statistics data. - In: Vykusová B. et Dvoráková Z. (eds): *The 12th Czech conference of ichthyology: proceedings of the international conference*, Vodňany 19. - 20. 5.2010, 21 [In Czech with English summary.]

Jankovský M., Boukal D., Prchalová M. & Kubečka J. (2010b) Estimating anglers' preferences for various freshwater fish in man-made lakes: lessons from fisheries statistics and direct ichthyologic assessments. *Book of abstracts, Fishery Dependent Information*: *Making the most of fisheries information*, August 23. - 26. 2010, Galway, Ireland, 98

Jankovský M., Boukal D., Heino M. & Kubečka J. (2010c) Stock-catch analyses of selected fish species in Czech reservoirs. - In: Boukal D, Soukalová K., Hohausová E. (eds): Book of abstracts, *DINFISH 2010*: *Toward a Synthesis of Objectives, Models and Data Analyses for Sustainable Management*, September 13. - 16. 2010, České Budějovice. Czech Republic, 13

Jankovský M., Boukal D., Pivnička K. & Kubečka J. (2010d) Anglers' fishing behaviour as the possible driver of inter-specific catches synchrony in long-term fishery statistics. - In: Boukal D, Soukalová K., Hohausová E. (eds): Book of abstracts, *DINFISH 2010*: *Toward a Synthesis of Objectives, Models and Data Analyses for Sustainable Management*, September 13. - 16. 2010, České Budějovice. Czech Republic, 12

Jankovský M. & Pivnička K. (in press) Angler fishing strategies in different reservoirs as assessed from fisheries statistics (1988 – 2007). *Acta Univesitatis Carrolinae Enviromentalica*

Jankovský M., Boukal D., Pivnička K. & Kubečka J. (in press) Tracing possible drivers of synchronously fluctuating species catches in individual logbook data. *Fisheries Management and Ecology*

Jayasinghe U.A.D., Amarasinghe U.S. & de Silva S.S. (2006) Culture-based fisheries in non-perennial reservoirs of Sri Lanka: influence of reservoir morphometry and stocking density on yield. *Fisheries Management and Ecology*, 13, 157-164.

Kearney R.E. (2002) Co-management: the resolution of conflict between commercial and recreational fisheries in Victoria, Australia. *Ocean and Coastal Management*, 45, 201-214.

Kerr S.J. (1996) A summary of Muskies Canada Inc. Angler log information, 1979-1994. Technical Report TR-011. Ontario Ministry of Natural Resources, Kemptville, Ontario: Science and Technology Transfer Unit. 107 pp.

Kershner L. J. & Van Kirk R. P. (1984) Characteristics and attitudes of some Klamath river anglers. *Californian Fish and Game* 70 (4): 196-209.

Lahnsteier B & Wanzenböck J. (2004) Variability in the spatio-temporal distribution of larval European whitefish (*Coreonus lavaretus* (L.)) in two Austrian lakes. - *Annales Zoologici Fennici* 41: 75-83.

Lappalainen J., Milardi M., Nyberg K. & Venäläinen A (2008) Effects of water temperature on year-class strengths and growth patterns of pikeperch (*Sander lucioperca* (L.)) in the brackish Baltic Sea. *Aquat*ic *Ecology*, 43, 1, 181-191

Lewin W.C., Arlinghaus R. & Mehner T. (2006) Documented and Potential Biological Impacts of Recreational Fishing: Insights for Management and Conservation. *Reviews in Fisheries Science* 14: 305-367.

Lockwood R.N. & Rakoczy G.P. (2005) Comparison of interval and aerial count methods for estimating fisher boating effort. North American *Journal of Fisheries Management*, 25, 1331-1340.

Lorenz K., Juntana J., Budit J. & Touronruang D. (1998) Assessing culture fisheries practices in small waterbodies: a study of village fisheries in north-east Thailand. *Aquaculture Reesarch*, 29, 211-224.

Lucas M.C., Mercer T., Batley E., Frear P.A., Peirson G., Duncan A. & Kubečka J. (1998) Spatio-temporal variations in the distribution and abundance of fish in the Yorkshire Ouse system. *Science of the Total Environment*, 210, 437-455.

Lusk S. (1978) Fish Stock and Angling in the middle course of the Svratka River. *Folia zool*ogica, 27(1): 71-84

Lusk S. (1984a) Fishery management on the upper reservoir of the Nové Mlýny on the river Dyje. *Živočišná Výroba*, 29, 1043-1051 [In Czech with English summary.]

Lusk S. (1984b) The efect of The Nové Mlýny reservoirs on the river Dyje on fish catches. *Folia zoololgica*, 33, 19-28

Lusk S. & Gajdůšek J. (1977) Harvest of Bream, *Abramis brama* Linn., in the Waters of Czechoslovakia. *Vertebrat*ologické *Zprávy*, 57-63. [In Czech with English summary.]

Lusk S. & Halačka K. (1995) Anglers‘ catches as an indicator of population size of the nase, *Chondrostoma nasus*. *Folia zoologica*, 44 (2), 185-192

Lusk S & Krčál J. (1983) Exploitation of River Valley Reservoirs in the Dyje River Drainage Area. *Živočišná Výroba,* 28, 809-816 [In Czech with English summary.]

Lusk S., Lusková V., Halačka K. & Smutný M. (2003) Anglers' catches as an indicator of fish population status. *Ecohydrology and Hydrobiology*, 3(1): 113-119.

Maceina M.J. (2003) Verification of the influence of hydrologic factors on crappie recruitment in Alabama reservoirs. *North American Journal of Fisheries Management,* 23(2), 470-480.

MacLennan D. (1996) Changes in the muskellunge fishery and population of Lake St. Clair after an increase in the minimum size limit. In: S.J. Kerr and C.H. Oliver (eds.) Managing Muskies in the '90s Workshop Proceedings. Ontario Ministry of Natural Resources, Southern Region Science and Technology Transfer Unit Workshop Proceedings WP-007, pp. 19-27.

Malvetusto S.P. (1983) Sampling the recreational fishery. In: L.A. Neilsen & D.L. Johnson (eds) Fisheries Techniques. Bethesda: American Fisheries Society, pp. 397-420.

Mann R.H.K. (1973) Observations on the age, growth, reproduction and food of roach *Rutilus rutilus* (L.) in two rivers in southern England. *Journal of Fish Biology* 5, 707-736.

Mann R.H.K., Mills C.A. & Crisp D.T. (1984) Geographical variation in the life-history tactics of some species of freshwater fish.- *In*: Fish Reproduction: Strategies and Tactics (Eds G.W. Potts & R.J. Wootton), pp. 171-186. Academic Press, London

Mann R.H.K. (1995) Natural factors influencing recruitment success in coarse fish populations. - *In*: D:M. Harper and A.J.D. Ferguson (eds) The Ecological Basis for River Management. Chichester: Wiley, pp. 339-348.

Mann R.H.K. (1997) Temporal and spatial variations in the growth of 0 group roach (*Rutilus rutilus*) in the River Great Ouse, in relation to water temperature and food availability. *Regulated Rivers*: *Research and Management*, 13, 277-285.

Mills C.A. & Mann R.H.K. (1985) Environmentally-induced fluctuations in year class strength and their implications for management. *Journal of Fish Biology* 27 (Suppl. A), 209-226.

Mosindy T.E. & Duffy M.J. (2007) The use of angler diary surveys to evaluate long-term changes in muskellunge populations on Lake of the Woods, Ontario. *Environmental Biology of Fishes*, 79, 71-83.

North E. (1983) Relationships between Stocking and Angler's Catches in Draycote water Trout Fishery. *Fisheries Management*, 14: 187-199.

Nunn A.D., Cowx I.G., Frear P.A. & Harvey J.P. (2003) Is water temperature an adequate predictor of recruitment success in coarse fish populations in lowland rivers? *Freshwater Biology* 48, 579-588.

Page K.S., Grant G.C., Radomski P., Jones T.S. & Bruesewitz R.E. (2004) Fish total length measurement error from recreational anglers: Causes and contribution to noncompliance for the Mille Lacs walleye fishery. N Am Fish Manage 24:939-951.

Panek F.M. (1987) Biology and ecology of carp. - *In*: E.L. Cooper (ed.) Carp in North America. Bethesda, M.D.: American Fisheries Society, pp. 1-15.

Pauly D., Alder J., Bennett E., Christensen V., Tyedmers P. & Watson R. (2003) The future for fisheries. *Science* 302, 1359-1361.

Phelps Q.E., Graeb B.D.S. & Willis D.W. (2008) First year growth and survival of common carp in two glacial lakes. *Fisheries Management and Ecology*, 15, 85–91.

Petr T. (2004) Inland Fisheries - The Global Situation. *Acta Universitatis Carolinae Environmentalica*, 18, 7-34.

Pitcher T. J. & Hollingworth C.E. (eds) (2002) *Recreational Fisheries: Ecological, Economic and Social Evaluation.* Blackwell Science, Oxford, pp. 1-16.

Pivnička K. (1985) The effectiveness of Fishing in Selected Reservoirs in The Czech Socialist Republic. *Živočišná Výroba*, 30, 927-935 [In Czech with English summary.]

Pivnička K. & Čihař M. (1986) An analysis of the Sport-Fishing Use of the Hostivař Reservoir in Prague. *Živočišná Výroba*, 31, 953-960 [In Czech with English summary.]

Pivnička K. & Ježek J. (1989) An application of a mathematical model in management of common carp in the valley reservoir. *Živočišná Výroba*, 34 (10): 925-930. [In Czech with English summary.]

Pivnička K. & Rybář M. (2001) Long-term trends in sport fishery yield from selected reservoirs in the Labe watershead (1958-1998). *Czech Journal of Animal Sciences*, 46: 89-94.

Pivnička K., Švátora M., Křížek J., Humpl M. & Sýkora P. (2005) Fish Assemblages in the Berounka River and its tributaries (Úhlava and Mže) in 1975-2004 - Environmental Parameters, Fishery Statistics and Electroshocker data. *Acta Universitatis Carolinae Environmentalica*, 1, 33-89.

Pollock K.H., Jones C.M. & Brown T.L. (eds) (1994) *Angler survey methods and their applications in fisheries management.* Bethesda: American Fisheries Society Special Publication 25. 371 pp.

Prchalová M., Kubečka J., Vašek M., Peterka J., Seďa J., Jůza T., Říha M., Jarolím O., Tušer M., Kratochvíl M., Čech M., Draštík V., Frouzová J. & Hohausová E. (2008) Distribution patterns of fishes in a canyon-shaped reservoir. *Journal of Fish Biology* 73, 54-78.

Prchalová M., Mrkvička T., Kubečka J., Peterka J., Čech M., Muška M., Kratochvíl M. & Vašek M. (2010) Fish activity as determined by gillnet catch: A comparison of two reservoirs of different turbidity. *Fisheries Research* 102: 291-296.

Prokeš M., Mareš J, Baruš V., Habán V. & Peňáz M. (2008) Common carp *(Cyprinus carpio)* growth and distribution in the Brno and Dalešice reservoirs. - In: Kopp R. (ed.), *The 11th Czech conference of ichthyology*: *proceedings of the international conference* Brno, 180-186. [In Czech with English summary.]

Prokeš M., Mareš J, Baruš V., Habán V. & Peňáz M. (2009) Spatio-temporal distribution of catches, growth and length-weight relationship of tagged common carp (*Cyprinus carpio*) in the fishing ground Dyje 5, Novomlýnská reservoir, and in the related fishing grounds. - In: Kopp R. (ed.), *Proceedings of the International Conference* „*60 years of the study programme of the Fischery specialization at Mendel University of Agriculture and Forestry in Brno*“, Brno, Czech Republic, 22-29. [In Czech with English summary.]

Prokeš M., Baruš V., Mareš J., Habán V. & Peňáz M. (2010) The growth and spatio-temporal distribution of tagged common carp *Cyprinus carpio* in three very different water reservoirs in drainage area of the Dyje, Jihlava and Svratka rivers (Czech Republic). - In: Vykusová B. & Dvoráková Z. (eds): *The 12th Czech conference of ichthyology*: *proceedings of the international conference*, Vodňany 19. - 20. 5.2010, 21 [In Czech with English summary.]

Rangel M.O. & Erzini K. (2007) An assessment of catches and harvest of recreational shore angling in the north of Portugal. Fisheries management and Ecology, 14, 343-352.

Salonen E. (2004) Estimation of vendace year-class strength with different methods in the subarctic lake Inari. - *Annales Zoologici Fennici* 41: 249-254.

Secor D.H. (2000) Spawning in the nick of time? Effect of adult demographics on spawning behaviour and recruitment in Chesapeake Bay striped bass. *Journal of Marine Science*, 57, 403-411.

Smith T.D. (2002) A history of fisheries and their science and management. In: Hart, P., Reynolds, J. (eds), *Handbook of fish Biology and Fisheries*, vol. II. Blackwell Science, Oxford, pp. 61-83.

Smutný M. & Pivnička K. (2001) Analysis of sport fishing yields from the Mže and Berounka rivers in 1975 to 1998. *Czech Journal of Animal Science*, 46: 126-133

Soupir C.A., Brown M.L., Stone C.C. & Lott J.P. (2006) Comparison of creel survey methods on Missouri river reservoirs. *North American Journal of Fisheries management*, 26 (2), 338-350.

Spurný P. & Chára P. (1999) Evaluation of fishery managgement of the Oslava 2 district - *In*: Spurný P. (ed.): The 3rd czech conference of ichthyology : proceedings of the international conference, 1. - 2.12. 1999 [In Czech with English summary.]

Spurný P. (2001) An appraisal of standards in practising the fishery law by the fishery unions of the Czech Republic between 1990-1999. ÚRH MZLU, Brno. [In Czech with English summary.]

Spurný P. (2004) Catch frequency of the barbel, barbus barbus (L.) and nase, Chondrostoma nasus (L.) in the Moravian Angling Union fisheries. - *In*: Vykusová (ed.): The 7th czech conference of ichthyology : proceedings of the international conference, Vodňany, 28-31 [In Czech with English summary.]

Stanley D.R. (1989) Factors affecting the abundance of selected fishes and recreational angler catches around oil and gas platforms in the northern Gulf of Mexico. Master's Thesis. Louisiana State University, Louisiana.

Straile D., Eckmann R., Jüngling T., Thomas G. & Löffler H. (2007) Influence of climate variability on whitefish (*Coregonus lavaretus*) year-class strength in a deep, warm monomictic lake. *Oecologia* 3, 521-529.

Sullivan MG (2003) Exaggeration of walleye catches by Alberta anglers. *North American Journal of Fisheries Management*, 23: 573-580

Sullivan M.C., Able K.W., J.A. Hare & Walsh H.J. (2006) *Anguilla rostrata* glass eel ingress into two , U:S: east coast estuaries: patterns, processes and implications for adult abundace. *Journal of Fish Biology*, 69, 1081-1101.

Sutela T., Mutenia A. & Salonen E. (2004) Density of 0+ peled (*Coregonus peled*) and whitefish (*C. lavaretus*) in late summer trawling as an indicator of their year-class strenth in two boreal reservoirs. - *Annales Zoologici Fennici* 41: 255-262.

Sztramko L.K., Dunlop W.I., Powell S.W. & Sutherland R.G. (1991) Applications and benifits of an angler diary program on Lake Erie. American Fisheries Symposium 12, 520-528.

Toivonen A.L., Tuunainen P., Navrud S., Roth E., Bengtson B. & Gudbergsson G. (1999) Measuring the total economic value of recreational fisheries in Scandinavia.

University of British Columbia, Fisheries Centre Research reports - Evaluating the Benefits of Recreational Fisheries, 7, 150-153.

Thomas G. & Eckmann R. (2007) The influence of eutrophication and population biomass on common whitefish (*Coregonus lavaretus*) growth - the Lake Constance example revisited. *Can*adian *Journal of Fisheries and Aquat*ic *Sciences*. 64, 402-410.

Valkeajärvi P. & Marjomäki T. J. (2004) Perch (*Perca fluviatilis*) as a factor in recruitment variations of vendace (*Coregonus albula*) in lake Konnevesi, Finland. - *Annales Zoologici Fennici* 41: 329-338.

Vácha F. (1998) Information on Czech Republic fisheries. In: P. Hickle & H. Tompkins (eds.). Recreational Fisheries: Social, Economic and Management Aspects. Oxford, UK: Fishing New Books, pp. 48-57.

Vašek M., Kubečka J., Peterka J., Čech M., Draštík V., Hladík M., Prchalová M. & Frouzová J. (2004) Longitudinal and vertical spatial gradients in the distribution of fish within a canyonshaped reservoir. *International Review of Hydrobiology* 89, 352-362.

Viljanen M., Turnen T. & Väisänen P. (2004) Fluctuations in year-class strengt and growth of the vendace (*Coregonus albula* (L.)) in the small, mesohumic, oligotrophic Suomunjärvi, a lake in eastern Finland. - *Annales Zoologici Fennici* 41: 241-248.

VanDeValk A.J., Jackson J.R., Krueger S.D., Brooking T.E. & Rudstam L.G. (2007) Influence of party size and trip length on angler catch rates on Oneida Lake. New York. *North American Journal of Fisheries Management*, 27, 127-136.

Vostradovský J., Leontovič I. & Vostradovská M. (1978) Analysis of Anglers‘ catches at the World Championship (CIPS). *Buletin VÚRH Vodňany*, 1: 31-34. [In Czech with English summary.]

Wedekind H., Hilge V. & Steffens W. (2001) Present status and social and economic significance of island fisheries in Germany. *Fisheries Management and Ecology*, 8, 405-414.

Weithman A.S. (1991) Telephone survey preferred in collecting angler data statewide. American Fisheries Society Symphosium, 12, 271-280.

Wilde G.R. & Ditton R.B. (1994) A management-oriented approach to understanding diversity among largemouth bass anglers. *North American Journal of Fisheries Management*, 14, 34-40.

Wilde G.R., Riechers R.K. & Ditton R.B. (1998) Differences in attitudes, fishing motives, and demographic characteristics between tournament and non-tournament black bass anglers in Texas. *North American Journal of Fisheries Management*, 18, 422-431.

Williamson C.E., Metzgar S.L., Lovera P.A. & Moeller R.E. (1997) Solar ultraviolet radiation and the spawning habitat of yellow perch, *Perca flavescens*. *Ecological Aplications* 7(3), 1017-1023.

Winterová M. (2010) *The dynamics of anglers´ attendance and exploitation of carp in the Hostivař Reservoir directly after stocking and out of this period*. MSc Thesis, Prague: University in Prague, 73 pp. [In Czech with English summary.]

Wiśniewolski W., Wołos A. & Borzęcka I. (2007) Assessment of anglers' catches in dam reservoirs on the example of Zegrze Dam Reservoir. Book of abstracts, *Fish Stock Assessment Methods for Lakes and Reservoirs: Towards the true picture of fish stock*, September 11-15, 2007, České Budějovice, Czech Republic, 64

Wooton R.J. (1990) *Ecology of Teleost Fishes*. Chapman & Hall, London.

Younk J.A. & Pereira D.L. (2007) An examination of Minnesota's muskellunge waters. *Environmental Biology of Fishes*, 79, 125-136.

Zeeberg J., Corten A., Tjoe-Awie P., Coca J. & Hamady B. (2008) Climate modulates the effects of *Sardinella aurita* fisheries off Northwest Africa. *Fisheries Research*, 89 (1), 65-75.