

FEASIBILITY STUDY



Monitoring of the fish stock of Czech Reservoirs

Compiled by: Institute of Hydrobiology, Biology Centre
Academy of Sciences of the Czech Republic
with the assistance AgroConsult Bohemia s.r.o.
and KP project s.r.o.

November 2007



Feasibility study

Monitoring of the fish stock of Czech Reservoirs

Compiled by: Institute of Hydrobiology, Biology Centre

Academy of Sciences of the Czech Republic

with the assistance of. AgroConsult Bohemia s.r.o. and KP project s.r.o

České Budějovice, Czech Republic, November 2007

Content:

1. Introduction	4
1.1. The investigator	4
2. Background and justification of the project, complementarity to EU projects.....	5
3. Need for the project and target groups.....	7
4. Substantiation of the project, activities	9
4.1 Project summary.....	9
4.2 Project activities.....	10
5. Time schedule.....	12
6. Project management	13
6.1 Team members.....	13
6.2. Project experience of the applicant.....	14
6.3 Project partners	15
7. Technical and technological aspects of the project.....	16
Monitoring methods:.....	16
8. Assessment of efficiency and sustainability of the project.....	17
The Project itself:.....	17
The equipment purchased:	18
Null variant of the project:	18
9. Capital equipment	19
10. Analysis of cash flow	19
10.1. Budget*:	19
Project Cash-flow:	22
11. Economical analysis.....	24
12. RISK ANALYSIS.....	25
13. Final project evaluation on the basis of Feasibility study.....	26
Quoted references:.....	27

Abbreviations

CR	Czech Republic
WFD	Water framework directive of the EU 2000/60/EC
CZK	Czech currency, 1 EUR = 28.501 CZK
EU	European Union
NFM	Norwegian financial mechanism
IMR	Institute of Marine Research
VAT	Value added tax
IHB BC	Institute of Hydrobiology, Biology Centre
CPUE	Catch-per-unit-of-effort
UIO	University of Oslo

Picture on the cover page: The research vessel of the IHB 'Ota Oliva' carrying a fry trawl in one of Czech reservoirs. Night fry trawling developed by IHB represents a significant advancement in understanding the biology of juvenile fish. However monitoring of all older age groups of fish by trawls remains the challenge for the project proposed. 'Ota Oliva' itself is too weak for the task.

1. Introduction

Feasibility study of the project 'Monitoring of the fish stock of Czech Reservoirs' is a part of the project grant application for the second call for individual projects within the framework of Norwegian Financial Mechanism (NFM). The aim of this document is to present all relevant materials in order to document feasibility of the project with respect to required funds, to demonstrate the benefits for the target groups and to outline timing, technical, financial, personal and other aspects of the project.

The study was written on the basis of information supplied by the applicant, Institute of Hydrobiology of the Academy of Sciences of the Czech Republic. The following table stipulates the basic information about the applicant and project consultants.

Table 1 – Basic information about the applicant and his consultants

	Applicant	Responsible unit of the applicant	Consultancy	Consultancy
Name	Biology Centre AS CR	Institute of Hydrobiology	Agroconsult Bohemia s.r.o.	KP projekt s.r.o.
Address	Branišovská 31, 370 05 České Budějovice, CR	Na Sádkách 7, 370 05 České Budějovice, CR	Rudolfovská 80 37021 České Budějovice	Riegrova 1756/51, 370 01 České Budějovice, CR
Contact persons	Prof. František Sehnal, CSc.	Doc. RNDr. Josef Matěna, CSc. Doc. RNDr. Jan Kubečka, CSc.	Ing. Zdeněk Kučera, PhD.	Ing. Martin Rybář
Contact s	Tel.: 420387 771 111 Fax: 420385 310 338 Email: bc@bc.cas.cz	Tel: 420 387 775 881 Fax: 420 385 310 248 Email: kubecka@hbu.cas.cz	Tel. 420387693113 Mobile 420602552899 Email: kucera@agroconsult.cz	Tel.:420389 04 333 Mobil: 420 721 111 566 Email: rybar@kpprojekt.cz

1.1. The investigator

Biology Centre of the Academy of Sciences v.v.i. (public research institution) was created by the decision of XXVII session of Academic Council of the Academy of Sciences of the Czech Republic on 15. Dec. 2005. By this decision five individual research institutes in České Budějovice were merged into one new institution.

Biology Centre v.v.i. consists of the following parts:

Institute of Entomology

Institute of Hydrobiology

Institute of Parasitology

Institute of Molecular Biology of Plants

Institute of Soil Biology

Estates and economical management

The Institute of Hydrobiology is one of the institutes associated with the Biology Centre of the Academy of Sciences of the Czech Republic in České Budějovice. The town Ceske Budejovice is situated in south Bohemia, 160 km south of Prague.

The main aim of the Institute is the research of biotic interrelations and their interactions with abiotic factors in lenitic water bodies, especially man-made reservoirs and natural lakes. Both the ecosystem approach and investigations focused on processes involve a multidisciplinary teamwork. The specializations of the staff members of the Institute include water chemistry, biochemistry, bacteriology, protozoology, algology, zooplanktonology and ichthyology. This structure enables studying interrelations within the trophic food chains using both principal approaches: bottom-up (from chemistry to fish biology) and top-down (vice versa).

Another characteristic feature of the Institute is an alternation of experimental and field approaches and basic regular long-term ecological research of selected Czech reservoirs, which allows to distinguish the phenomena on different time-scales. The Institute runs two permanent field stations at Římov and Slapy Reservoirs.

Many scientists of the Institute take part in teaching programmes and/or research cooperations with Faculty of Sciences of the University of South Bohemia in České Budějovice and Faculty of Science of the Charles University in Prague. Every 4-5 years IHB runs an international conference on Reservoir Limnology and Water Quality Management (the last was in 2006). In 2007 IHB organised the international conference Fish Stock Assessment Methods for Lakes and Reservoirs: Towards the true picture of fish stock.

More info on <http://www.hbu.cas.cz/>

2. Background and justification of the project, complementarity to EU projects

Fish stock plays an important role in the ecology of lakes and reservoirs. The water quality and multipurpose use of the water reservoirs in the Czech Republic can be enhanced by good fisheries management and vice versa. This is especially true for drinking water reservoirs, which are ordered by the Czech Ministry of Agriculture to run adequate fisheries management, aimed on maintaining and improving the water quality (NB: Czech Republic has very few small natural lakes, this is why the dam water reservoirs are extremely important for whole water balance of the country). This approach of biological care for water quality is called 'biomanipulation' and applicant's institution (IHB) was one of the first in the world to discover it (Hrbáček et al. 1961 and 1981). Biomanipulation and the role of fish in the reservoirs represent significant part of IHB's focus (Sed'a and Kubečka, 1997, Sed'a et al. 2000, Vašek et al. 2004, 2006). IHB is an internationally recognized research centre for these issues. Current results are based mainly on the investigations of either shallow parts of the reservoirs (Říha et al. in press) or open water using passive gear (mainly gillnets, Prchalova et al., 2008a). Data from passive gear are robust with respect to number of fish captured and recently they represent the main part of the current fish monitoring system for Czech reservoirs (IHB, 2006). However, the passive character of fish sampling by the gillnets have a number of inherent problems (Kubecka et al. 2007):

- 1) Passive sampling gear is not able to provide the estimate of fish abundance in a direct way (individuals/hectare), only indirect metrics of abundance – catch-per-unit-of-effort CPUE. The relationship between the fish abundance and CPUE is not known for most freshwater systems. This is a very significant problem of passive sampling because WFD EU uses the abundance of organisms as a basic parameter of ecological status of the waterbody.
- 2) The gillnets are prone to saturation with the catch (filling-up of the gillnets by the fish catch so no more fish can be captured and the sample underestimate the true abundance; in other words, the gillnet sampling loose sensitivity in medium density or abundant fish stock). This phenomenon has not been studied intensively so far (Degerman et al., 1988; Olin et al., 2004) and needs further scientific attention.
- 3) The passive character of the gillnet catch is extremely dependent on fish behaviour. The catches are very different with different periods of fish activity (Vašek, et al., 2000 and in press).
- 4) The mechanism of the capture by gillnets depending on fish activity and morphology (number of body extremities) leads to significant species selectivity. For example in European reservoirs, the share perch-family fish is regularly overestimated by the gillnet sampling (Prchalová and Kubečka, 2004, Prchalová et al. 2008b).
- 5) The gillnets have inherent problems in providing the true size- and age-frequency composition of the fish stock. Small fish (indicators of coming new generations, population recruitment) are notoriously underestimated (Kurkilahti, 1999, Kurkilahti et al., 1998; Mehner and Schulz, 2002; Olin and Malinen, 2003 Prchalová et al., in press) leaving thus a significant gap in the information required.
- 6) Last-but-not-least. Gillnet cause verwhelming mortality of most captured fish. Even with maximum possible care of the sampling team, only smaller proportion of fish captured can be released undamaged.

The use of active gear for fish sampling has a potential to overcome all the above shortcomings. Unfortunately, the application of trawll is a long-term problem of freshwater science in general, mainly due to extensive requirements on equipment, dragging power, know-how and highly skilled manpower. In 2007 IHB organised the international conference 'Fish Stock Assessment Methods for Lakes and Reservoirs' (<http://fsalmr2007.czweb.org>) and the structure of conference's contributions showed alarming lack of knowledge in the use of active gear. IHB has been tackling the problem for number of years (Kubecka et al. 2003) and has managed to put forward new approach for active sampling of juvenile fish, which appears absolutely quantitative exactly as required for unbiased abundance estimates (Jůza and Kubečka, 2007). For proper monitoring of the fish stock of the reservoirs we need fair, unbiased sampling of all age categories of all species in all important habitats and this aim is impossible to achieve for IHB without substantial investment and foreign know-how. The platform of Norwegian FM provides an ideal solution to both requirements: economical aid for purchasing and running the necessary hardware and the know-how from Norwegian physics and marine institutions, which are one of the most advanced in the world in using active methods of fish sampling. There is an unique opportunity to strengthen already existing long-term scientific cooperation between IHB and Norwegian partners.

Bio-manipulation of the fish stock represents one of the most ecological approaches to maintain and improve quality of water environment. The project would revolutionize the monitoring of fish stock in Czech reservoirs and would represent a significant potential for improvements of environmental

conditions in Czech waters. The impact of introducing the sampling of fish by active gear in Czech reservoirs goes far beyond just the monitoring system. The experience gained during this project is likely to be utilized for direct fish capture for biomanipulation (removing of expansive undesirable species) and exploitation of reservoir's fishery resources in future.

The project is being applied within priority 2 – Environment Protection, part 2.2. Monitoring systems in the regions and subsequent use of monitoring results.

Complementarity with structural funds EC 2007-2013:

Operation programme Enterprising and innovations - The project is not dealing with innovations as the way to enhance the potential and competitive ability of Czech Economy (business enterprises)

Operation programme Research for innovations - This programme is not aimed at individual projects but rather on building general infrastructure

Operation programme Environment, area 1.1. Reduction of water pollution - supports only direct methods of analysis of surface and ground water

This project is not suitable for financing by Structural Funds EC from any of operation programmes or other known EU source.

The project is suitable for priority 2, Environment protection, part: Monitoring systems in the regions.

3. Need for the project and target groups

The need for the project appears on several levels. Basic areas are as follows:

1. Ecology – improvement of the ecological potential of the reservoirs, water quality, reduction of algal production, biomanipulation, protection of valuable ecosystems, which may be endangered by the decrease of ecological potential (the term 'ecological potential' was introduced by EU WFD).
2. Economy – Introduction of active fish capture: cheaper and more reliable methods of monitoring, consequently improvements in the management of the reservoirs and reduced costs of water treatment including easier handling of eutrophication (overproduction of freshwater systems by algae and cyanobacteria due to high nutrient load and unbalanced food web). In a long run, the active methods of fish sampling are expected to be used in direct management of the reservoirs and in the utilization of fish production.
3. Scientific methodical advances – Improving the information about open water fish, better understanding of the pelagic food web of the reservoirs, improved international reputation and ratings of Czech and Norwegian aquatic sciences.

Analysis of demand At present, the main demander for the monitoring of the fish stock in the Czech Republic are water authorities (owners of the reservoirs). Czech republic has been ordered by EU WFD initiative to carry on the monitoring of all significant waterbodies. 65 largest water reservoirs are assumed to be monitored once approx. 3 years since 2008 by the current passive methods (IHB, 2006). Such monitoring for the water authorities has been carried out only at about 5 Czech reservoirs so far.

10 monitoring surveys per year is a pessimistic estimate of the demand during the project period. Current monitoring is highly demanding on financial resources and the market price is close to the monitoring cost level. The current price for monitoring of one average-sized reservoir is on the level of 12500 Eur.

Analysis of supply. At the moment, the applicant is the only institution in the Czech Republic capable of methodological and technical execution of the monitoring. Besides the applicant, there are about 5 academic or commercial institutions providing the monitoring of fish stock in the Czech Republic, but they specialize on smaller waters and are not technically and methodically capable of monitoring the reservoirs. Based on market competition analysis, there is no other economical subject, which could compete on the market for monitoring of fish stock of Czech reservoirs. During the application period, the Ministry of Environment of CR has been negotiating with the applicant the exclusive agreement on the monitoring of the reservoirs.

More detailed analysis including the target groups is shown in the following table:

Needs	Target groups	Expected effects
Ecological need	Managers of the reservoirs: River catchments authorities Ecological organizations Czech and Moravian Anglers' Union Government bodies of different levels Organizations transforming former coal mines into new lakes Wider public with fishing and ecological interests	Definition and Increase of ecological potential Improvement of water quality Decrease of eutrophication – redirection of the nutrients from the pelagic food web (algae) to littoral food web (submerged plants) Methodical procedures: For monitoring of the fish stock and in a long run also for direct fish stock management through the capture by trawls (beyond the scope of current project)
Economical need	Managers of the reservoirs: River catchments authorities Czech and Moravian Anglers' Union Government bodies of different levels Consumers of tap water	Lowering of water treatment costs (long-term effect). Lowering the risk of managerial errors in managing fish of reservoirs. Improvement of quality of monitoring, in a long run, decrease of monitoring costs. Assessment of economical value of the fishery. Cost effective method of capture of fish by trawls.
Scientific needs	AS CR Universities, Institutes of applied research, Consultancies Scientific community – fisheries biologists in all countries All project partners Wider public	Methodical progress in sampling open water. Improved understanding of pelagic food webs and fish populations of water reservoirs. Increasing international reputation and ratings of the project's partners.

The applicant has a long-term cooperation with the most of professional target groups. The cooperation has included joint surveys of the reservoirs, seminars and workshops of available data. The organizations managing the fish stock of the reservoirs (Water Authorities and Anglers Union) have been consulting with IHB their managerial problems and they are directly interested in the

output of the project. To confirm this, some of them issued their official statements (attached as appendices to the application). This project will further strengthen close cooperation of the applicant with the target groups. We have to be aware that presently available data on the fish of most of Czech reservoirs are not sufficient for sound management decisions. This is why the active monitoring methods are to be welcomed by fishery managers. IHB will publicise the findings of the project and demonstrate the applicability to individual case studies. The improved monitoring of the reservoirs will better show which reservoirs need immediate action and specify the type of actions.

4. Substantiation of the project, activities

4.1 Project summary

The project Monitoring of fish stock of Czech Reservoirs is aimed at improvement of ecological potential of Czech reservoirs and enhancement of fisheries management by improving the methods of assessment of qualitative and quantitative composition of the fish stock. The project includes introduction of active methods of monitoring, namely new hydroacoustic and trawling approaches. Managing of the use of active trawling gear for fish capture would represent the revolution both in monitoring and the management of reservoirs. Active methods should mitigate the main weaknesses of the current monitoring based predominantly on passive methods. The project follows the philosophy of the EC water framework directive 2000/60/EC and promises to create new fish monitoring methodology and to bring new crucial knowledge to the methods of fish capture in general.

The project consists of:

- 1) Design and purchase of the gear necessary for fish monitoring (a research vessel, trawls, a trawl sonar, a scientific echosounder)
- 2) Testing of the above equipment, assessment and remedy of sampling difficulties and developing methodical procedure for fish monitoring under the conditions of Czech reservoirs
- 3) Trial monitoring of the fish of selected reservoirs (Římov, Lipno, Orlík, Želivka, Nýrsko). Comparisons of the new approaches to the current ones (intercalibration).
- 4) Processing of the collected information and creation of a tentative methodical guide for the fish monitoring (after the 1st and 2nd field seasons).
- 5) Pilot full monitoring of selected reservoirs (3rd field season).
- 6) Assessment of the results and creation of final methodical guides
- 7) Project publicity: scientific publications, an international conference

Basic project outputs:

- mapping of ecological potential of the fish stocks of 10 Czech reservoirs
- creation active sampling monitoring system which will be more accurate and more economically efficient than the current one
- outline of the potential of trawling gear for the management of the fish stock of Czech reservoirs

- enhancement of international reputation of Czech and Norwegian hydrobiological, fisheries and acoustics schools

Project duration 36 months (1.1.2008 - 31.12.2010)

4.2 Project activities

The project has a tight time schedule with assumed start in January 2008.

The main activities of the project (work periods and expenses given in brackets):

1. Project management. The steering committee consisting of all Czech team members with PhD degree will meet every two months to assess the progress and outline the immediate tasks. Whenever a Norwegian team member will be present in the Czech Republic, the steering committee will meet to discuss international perspective of the progress. Special attention will be paid to the project publicity, preparation of interim reports and financial reporting. Part of this activity is a tendering procedure for capital equipment. Due to extent of the purchase and its specificity, the emphasis will be given to detailed specification of the order. Technical specifications shall be repeatedly consulted with Norwegian partners who have extensive experience with trawling and echosounding. A built-to-suit research vessel will be ordered on the basis of a special contract. (the activity extends over all project duration, expenditure: 8656 Eur of which Eur. 2250 goes towards project accounting and financial reporting and Eur 6406 towards personal costs).

2. Developing and testing of the new monitoring system and trial monitoring.

The first part of this activity is the design of the capital equipment (a research vessel, an echosounder, a trawl sounder, trawls), the building and purchase. The design of gear plans and the vessel specification will be done in close cooperation with IMR early in 2008 before the tender. Due to special technical specifications, the production time is about 8 months. The construction of the research vessel and trawls will be directly supervised by IHB staff. Testing the echosounder system on board of existing research vessel of the IHB Ota Oliva, adjustments of the sonar system for the monitoring of the fish stock in Czech Reservoirs. Testing of transducer holders, physical patterns of sound propagation underwater, the accuracy of fish records, sampling design, developing of the methodical procedure for the data processing in close cooperation with UIO. Testing and modification of the trawls and the research vessel, creation of methodical procedure of trawling hauls. Observations of trawls performance while towed under water, modifications of trawl and research vessel construction according to direct observations and fish behaviour. Assessment of catch selectivity by the intercalibration with other methods of sampling open water fish (purse seining, pelagic gillnets, scientific echosounder, trawlsounder, acoustic and optical camera, scuba diving). Comparisons of the results of active monitoring based mainly on trawling with sampling by other means (acoustics, gillnets, purse seining). Trial monitoring of 10 Czech reservoirs with both old (passive) and new (active) approach. Assessment of the ecological potential of the reservoirs (1/2008 - 10/2010, expenses of whole Activity 2: Eur. 294625).

Breakdown of the expenditure of Activity 2 is given in the following table

Item	Expenditure, Eur.
Services	8245
Capital equipment	226344
Small equipment & consumables	5598
Travel expenses	19894
Personal costs, Salaries & insurance	34544
Total	294625

3. Processing of monitoring results and preparation of official conclusions of the research.

Processing of netting and hydroacoustics records from all fieldwork. Assessment of sampling gear efficiency and selectivity, development of the methodical procedure of the newly developing monitoring system. Writing of the official methodical booklet on monitoring of fish stock in reservoirs and the potential of active fishing gear for biomanipulation of reservoirs. Preparation and submission of manuscripts for scientific journals ('impacted publications'). Organization of the **International conference on fish monitoring by the active gear**. Preparation of the final report. NB: Processing of results and especially the preparation of the manuscripts of the scientific papers is a time consuming process which takes usually longer than the data collection; this explains relatively long period dedicated to this activity. In fact, due the length of peer review process, some further publications processing collected information can be expected after termination of the project. (10/2008-12/2010, expenses of whole Activity 3: Eur. 36881; Eur 35000 towards personal costs, Eur. 1881 towards publicity expenses).

5. Time schedule

This schedule assumes the start of the project by **Jan.1st.2008**. Assumed end of the project including final report and settling of all accounts is set on Dec. 31. 2010. This means very tight time schedule. The table shows individual activities quarterly:

Activity	I/08	II/08	III/08	IV/08	I/09	II/09	III/09	IV/09	I/10	II/10	III/10	IV/10
1. Project management												
2. Developing and testing of the new monitoring system and trial monitoring.												
3. Processing of monitoring results and preparation of official conclusions of the research												

6. Project management

6.1 Team members

The project team consists of both Czech and Norwegian partners. Norwegian partners agreed to provide a limited amount of their time with no cost to the project. Norwegian partners will participate mostly as advisors and will not take direct part in most data collection and processing work. Czech members of the team will carry out all these duties. Czech team members will be part-time employed by the project. The following list gives the percentage of the full capacity for Czech members of team.

Project manager:

Jan Kubečka, Assoc.Prof., RNDr., PhD.; Biology Centre AS CR, head of department, web page: <http://www.hbu.cas.cz/fishecu/staffmembers/kubecka.html>;

The project manager is responsible for professionalism of all activities of the project, leads the project and project team members and represents the project in all negotiations. He is in charge of the Czech team members in line with his position as head of the department.

Team members can be divided in more specialized sub-teams

Sub team - acoustic surveys:

Jaroslava Frouzová, ing., PhD.; IHB BC AS CR; research worker, 20% of full time capacity

Vladislav Drašík, Mgr.; IHB BC AS CR; research worker, 10% of full time capacity

Martin Čech, RNDr., CSc.; IHB BC AS CR; research worker, 10% of full time capacity

Michal Tušer Mgr., BC; IHB BC AS CR; junior research worker, 30% of full time capacity

Milan Muška Mgr., IHB BC AS CR; junior research worker, 10% of full time capacity

Oldřich Jarolím, Bc. IHB BC AS CR; junior research worker, 10% of full time capacity

Sub team - trawling surveys:

Jiří Peterka, RNDr., PhD.; IHB BC AS CR; research worker, 15% of full time capacity

Mojmír Vašek, Mgr., PhD.; IHB BC AS CR; research worker, 10% of full time capacity

Marie Prchalová, RNDr.; IHB BC AS CR; research worker, 10% of full time capacity

Tomáš Jůza, Mgr.; IHB BC AS CR; junior research worker, 15% of full time capacity

Michal Kratochvíl, Mgr.; IHB BC AS CR; junior research worker, 10% of full time capacity

Zdeněk Prachař; BC HBÚ AV ČR; senior technician, 10% of full time capacity

Sub team - construction and application of trawls:

Olav Rune Godø, PhD.; IMR Bergen, research worker, head of Department

Valdemarsen, John Willy, MSc.; IMR Bergen, research worker

Sub team - application of acoustic systems:

Lindem Torfinn Assoc. Prof. Dr.; University of Oslo; head of workgroup

Balk Helge, Assoc. Prof., Dr.; University of Oslo; research worker

Salaries of the Czech members of the team will be paid on the basis of special contracts in accordance to the work done for the project (eligible expenses).

Biology Centre of the Academy of Sciences in general and IHB in particular has extensive experience with the management of national and international research projects covered by national or international grants. Over 20 different projects are run in the IHB at a time. The list of selected projects is given in the Feasibility study, chapter 6.2. Project experience of the applicant. IHB can rely on the backup of the Estates and economical management department of the BC AS CR in services like organization of tender procedure, economical management and monitoring of the project.

6.2. Project experience of the applicant

Work on any scientific project is standard way of scientific work at the BC AS CR and IHB. All of their activities are covered by grants of different Czech and foreign sources. The following table provides several examples of projects, which involve the Fish ecology unit of the IHB

Project	budget	Title	Grant size	period	reg.No.
	Thousands CZK		Thousands CZK		
Structure, function and development of water ecosystems.	161489	Institutional Research Project AS CR	Not yet closed	2005-2010	AVOZ 60170517
Limnological basis of sustainable management of reservoirs.	6378	Prog.of Applied Research of AS CR	6378	2005-2009	1QS600170504
Hydroacoustic investigations of Neusiedlersee, Austria	2244	National Park, Neusiedlersee Seewinkel	2244	2004-2007	
Tributary zone as a key factor of fish stock development in reservoirs	4800	Grant Agency of CR	3756	2002-2004	206/02/0520
Management of the Water Quality in the Reservoirs	10320	Prog.of Applied Research of AS CR	10320	2000-2004	S6017004
Understanding of fish role in Biesbosch reservoirs	4600	WBB, the Netherlands	4600	1998-2004	

6.3 Project partners

Norwegian partner No.1

Department of Physics, University of Oslo (UiO), partner in the area of sonar technology.

PO.Box.1081..Blindern, NO-0317 Oslo

Dr. Helge Balk, + 47 22856489, + 47 22856422, helge.balk@fys.uio.no

The cooperation between IHB and UiO started in 1996. The main focus of the joint activity was development of methods for fish detection and assessment by horizontally aligned acoustic beam (exchange of ideas and experience, joint tests of sonar performance in different environment). The cooperation has benefited from optimal combination of physicists with biological interests (UiO) and the biologists recognizing the need for the use of physical approaches in detection of fish (IHB). IHB staff helped to develop the internationally recognized software SONAR 4,5,6 for processing of hydroacoustic data by Norwegian partners. The first page of the acknowledgement of the SONAR 4,5,6, manual mentioning the contribution of Dr. Kubecka and his colleagues is included in the application. The cooperation resulted in number of joint manuscripts, publications and presentations at the international conferences. IHB and UiO have been together carrying out the hydroacoustic surveys of the lake Neusiedlesee in Austria on regular basis.

Norwegian partner No.2

Institute of Marine Research, Bergen (IMR) - partner in the area of trawling technology

P.O.Box1870,Nordnes5817, Bergen Norway

Dr. Olav Rune Godø, + 47 55 23 86 75, + 47 55 23 85 31, olav.rune.godo@imr.no

The cooperation so far consisted mainly of consultations of fish sizing approaches from the acoustic data (Dr. Egil Ona) and fish behaviour in the active zone of the trawl (Dr. Olav Godo). Dr. Jaroslava Frouzova (IHB team member) has taken part in the marine survey cruise of IMR research vessel G.O. Sars. IMR is one of the very few institutions in the world which possesses the detailed routine and scientific expertise on trawling technology, construction, working procedure and efficiency, exactly the know-how lacking in the freshwater science of inland countries in particular. IMR stands amongst world's leading institutions in the monitoring of marine fish stock and management of sustainable fisheries in the world ocean.

7. Technical and technological aspects of the project

Monitoring methods:

Current methods of fish stock monitoring in Czech reservoirs are lacking active capture methods in the open water (pelagic areas, volumes further than 5 m from the nearest bottom) of the reservoirs. Lack of active capture in the pelagial of the reservoirs is significant considering that the open water represents the largest parts of the volumes of Czech reservoirs (Fig. on the last page). Most of our information so far comes from the gillnets, beach seines, electrofishing, traps or fyke nets (all approaches applicable inshore), while only recently we have obtained the first sound information from the open water (Vašek et al., 2004, 2006, Kubečka et al., 2003). The true solution of the problem of active sampling of the open water is persistently shadowed by unknown behaviour of fish in the sampling zone of trawls and sound field of echosounders due to insufficient theoretical and practical know-how and financial sources.

On the basis of recent possibilities and knowledge, IHB has prepared temporary monitoring method originating from the European norm for sampling of fish by gillnets. (ČSN/EN 14757, IHB, 2006). This temporary method is only a compromise between our current possibilities and true monitoring needs, which require active sampling. The key sampling tool of the temporary method – the gillnets have inherent difficulties (see also Chapter 2) in quantifying the fish abundance (number of individuals per square area), are prone to size and species selectivity and saturation of the nets (Prchalova and Kubečka, 2004, Prchalova, et al., submitted). Moreover, the use of gillnets is rather problematical from the point of view of fish welfare. Sophistication of monitoring system with the emphasis on the use of active sampling gear (trawls, scientific echosounders) appears to be necessary if we need to monitor true composition of the fish stock. The development of trawling technology is also crucial for the progress in management of the fish stock in future.

The following gear will be purchased, tested and adopted for the new fish monitoring system:

Scientific echosounder, split-beam type (we took Norwegian product SIMRAD EK 60 as an example) working with the frequency 38 kHz with the nominal beam angle of the sonar cone at least 12 degrees is constructed for the fish stock monitoring by the vertical surveying. This Norwegian product become a 'world standard' in marine environment. The advantage of this system is larger sampling volume (at least four times higher than other echosounders available in CR), low sensitivity to the reverberation (coming from invertebrates and seston particles), low electronic noise and minimal absorption losses of ultrasound energy (Simmonds and MacLennan, 2005). Vertical acoustic surveying did not receive sufficient attention in CR so far. The importance of vertical surveying is expected to increase with the increase of water quality in the reservoirs (the less is the nutrient load, the higher is water transparency and the light and the fish penetrate deeper into the water, Drašík et al., submitted).

Trawls represent the sophisticated net system pulled in the best case by two pulling boats (Dahm a Steinberg, 1972, Kubečka et al. 2003). The trawl net is fished in a desired depth and in general, the trawl can be used for both scientific and commercial fishing. Over 80% of the world ocean catches come from trawling, while trawling in freshwaters is very poorly developed (see part 2.). The efficiency of trawls is influenced by a number of factors (water transparency, illumination, temperature, presence/absence of the bottom, fish species, trawl construction, speed of trawling etc., Godø and

Walsh, 1992). Current experience shows that in Czech conditions so called pelagic trawls (working with no bottom contact) have wider application (the bottom of Czech reservoirs is very uneven, most fish live in depth horizons above the bottom in the open water – Kubečka and Wittingerová, 1998, Vašek et al. 2004, Prchalová et al. 2008). The experience has also shown the need for distinguishing day and night trawls. 'Day' trawls tend to have very large opening (in the order of 1000m²) and can have very large mesh size (up to 40 cm; large mesh direct and chase fish into the cod-end of the trawl but do not capture the fish) in most of trawl body. In the very end of the trawl (called cod-end) the mesh size should be very small, about 1 cm for both 'day' and 'night' trawls. The 'night' trawl should have smaller dimensions (200-300 m²), but it should have significantly denser mesh, because the fish is less active during the night and would pass through large mesh. The above specifications are very preliminary as no one knows the best values for Czech conditions. The definitive values will be assessed on the basis of tests planned.

Trawl sonar (Norwegian Simrad catch monitoring system taken as example) monitors correct functioning of the trawl while fishing. It consists of two wireless sensors for bottom contact (the bottom contact of the pelagic trawl may cause hanging on some structure accompanied by serious damage), the hydrophone receiving the sensors signal, 'trawl eye' (special echosounder transducer monitoring the behaviour of the fish in the trawl mouth and also the vertical spread of the trawl) and the 'bridge monitor unit' displaying all the above information. Trawl sonar will ensure safe operation of the trawl and monitor the fish behaviour, which is not known at all at present.

Research vessel: The second trawling vessel is essential for paired trawling. The experiments of IHB with single boat trawling showed insufficient motoric dragging power. During single boat trawling, a substantial part of dragging power is wasted by 'otter boards' or trawl wings who keep the horizontal opening of the net (Dahm a Steinberg, 1974, Kubečka et al. 2003). Preliminary ideas about the second research vessel originate mainly from the service experience of the first Czech trawling vessel Ota Oliva (Kubečka et al. 2003). The vessel should be about 8 m long, equipped by the inboard diesel engine of roughly 150 kW, low pitch propeller with secondary nozzle, trawling deck at least 4 m long, covered space for the crew, electronic equipment, computers, hydraulically powered trawling drum and doubled steering (the possibility to steer from inside and the trawling deck). The vessel should be supplied together with the trailer for the road transportation between the reservoirs. If it is found during the project that the current research vessel Ota Oliva (48 kW) is too weak to serve as the second trawling vessel, there is the possibility to use the manipulation boat of the sapper troops of the Czech Army as the second pulling boat. There is no possibility to use army boat as the first trawling boat, because its deck has neither room for neither nets nor all other equipment.

8. Assessment of efficiency and sustainability of the project

The Project itself:

Current monitoring of the fish stock of the reservoirs is very insufficient. In 2008 there may start the monitoring of the reservoirs based on the temporary methods (IHB, 2006, mainly on the basis of passive gillnet sampling). Results of such monitoring will be apparently influenced by the inherent problems of the passive gillnet monitoring (see Chapter 2 in detail). The active monitoring system

proposed in this project will overcome the problems related to the passive sampling and will provide sounder results. Obviously better quality data will lead to better assessment of the ecological potential of the reservoirs and to better managerial decisions. Moreover, the use of active sampling will be more gentle to the fish sampled and can be reasonably cost efficient assuming that boat engine (not the manpower) will do the main sampling work. Replacing of gillnets by active gear will also reduce the net damage which is very high in multimesh gillnets. The new monitoring system for fish stock of the reservoirs will be summarized in the methodical booklet, which will be offered to all target groups (see chapter 3). The methodical system based on active sampling has a potential to become an official method for fish monitoring (thus to replace temporary methods, IHB, 2006). The largest organizations dealing with the fish in reservoirs in CR – the River authorities and Czech Angler's Union have already expressed their interests in the outcomes of the project (the letters of support are included). Also the Czech ministry of Environment, who organizes the monitoring of Czech waters for the WFD, has expressed its interest in results (letter in Czech included). All above organizations will utilize the project outputs for number of years. The equipment purchased and experience gained during the project will be used for a number of years beyond the project duration.

The successful use of trawls in Czech waters may also start a revolution in management of the reservoirs. Trawls have potential to fish large volumes of water using relatively little manpower. Currently, most other methods of fish capture are highly manpower demanding and this is the reason for generally very low application of direct fish capture in Czech reservoirs.

The equipment purchased:

The equipment purchased will be properly maintained by the IHB. The operating costs will be covered River Authorities through refundation of monitoring costs. The official service life expectancy of the echosounders and the vessel is ten years, the service of trawl nets is 5 years according to Czech Revenue Tax Act 586/1992Sb.. After finishing the project, all the equipment will be continuously used for the monitoring of the fish stock of Czech reservoirs. With respect to the Financial analysis of cash flow (Chapter 10) the project stands as economically sustainable. The market price of the monitoring covers fully the running costs of the project and ensures economical return of the investments.

For the case of unlikely lack of interest from the side of reservoir management (Chapter 12) the director of the Biological Centre issued a statement guarantying the sustainability of the project irrespective of the extent of contract work for the water authorities (document P10d).

Null variant of the project:

If the project would not be approved, the present state of reservoirs ecosystems would be either maintained or slowly deteriorating. The monitoring based on passive gear would probably start in 2008 anyway. Current passive gear monitoring would be more expensive and less accurate. Higher costs of the current approach is due to higher personal costs (taking of the fish catch from the gillnets is a laborious and time consuming process, processing of gillnet results also require time consuming corrections), higher investments in gillnet repairs and corresponding higher overheads. High survey costs and the market price on the cost level would significantly influence the applicant.

The progress of active sampling of the main reservoirs volumes (open water) would be very slow due to persistent lack of know-how and funds. Therefore the progress in monitoring methods and the quality of data collected would improve extremely slowly. The same applies to the management of the

fish stock of the reservoirs to achieve good ecological potential and improvement of the water quality through biomanipulation. However the members of the Fish Ecology Unit of IHB are convinced that the use of active sampling tools for fish monitoring represent the future of the monitoring and management of fish in the reservoirs and they would continue to gather the funds from all possible sources to facilitate the progress at much lower speed than if the project goes ahead.

9. Capital equipment

The project requires the purchase of the equipment necessary for the monitoring of fish stock in reservoirs. The sums in the following table come from preliminary quotations from various firms. The Capital items and services will be ordered from the supplier of the best offer according to the Czech law on public orders and supplies 137/2006 Sb

item	Price without VAT in CZK	Price without VAT in EUR
Research vessel incl. Of trailer for ground transport	2 735 000,-	95 962,-
Scientific echosounder	1 430 000,-	50 174,-
Trawl sounder	690 000,-	24 210,-
Day trawl	371 000,-	13 017,-
Night trawl	195 000,-	6 842,-
Total without VAT	5 421 000,-	190 205,-
Total with VAT (19 %)	6 450 990,-	226 344,-

The applicant's institution is paying VAT wherever applicable (no exceptions). According to the current regulations in the Czech Republic, there is no option for the applicant to claim VAT back. Thus the VAT must be considered as eligible expense of the project.

10. Analysis of cash flow

10.1. Budget*:

Budget article (incl. VAT)	In Kč	In EUR
1. Capital equipment (see. Chapter 9)	6 451 030,-	226 344,-
2. Labour (see Chapter 6.1)	2 164 651,-	75 950,-
3. Services	234 991,-	8 245,-
4. Administrative costs	64 127,-	2 250,-
5. Small equipment	159 549,-	5 598,-
6. Travel	566 999,-	19 894,-
7. Publicity	53 610,-	1 881,-
Total budget	9 694 957,-	340 162,-

*The detailed description and calculation of the project budget is a part of appendix „P2a.Budget Table“

10.2. Budget explanations:

Services. Boat maintenance requires mainly regular exchange of engine liquids (oil, antifreeze liquids), oil and cooling water filters, repair of any damages from the use of nets, navigation and mooring and care of a trailer. Also small alterations on board of the research vessel for net and echosounder usage will be inevitable. Next item is the repair and maintenance of the nets: trawls, which may be damaged in various ways (unequal dragging forces during hauls, contact with the bottom, contacts with boats and other structures), also the nets used for comparative catches (especially multimesh gillnets, purse seine are prone to tear & wear).

Capital equipment - Main Investment Items for the Project. These are main expenses, which are crucial for successful implementation of the project. The reasons for purchase are sufficiently explained in other chapters of the proposal and the prices are supplemented by pro forma quotations of selected manufacturers.

Purchase and Delivery of Supplies. The chapter contain data storage hardware for storing acoustic records (most likely external hard disc storage, the technical specification of these goods is changing very quickly, so the price is only the rough estimate). Proper positioning of both acoustic records and trawling trajectories is a natural requirement for good quality information. To achieve this, the middle class GPS sensor (usual accuracy 5 m) with external antenna will be purchased. Proper navigation at night and keeping predetermined tracks require the use of nautical compass. Proper processing of numerous fish catches need reliable portable scale for weighting fish. The holders (frame) of the sonar transducers enabling their orientation under water from the moving research vessel both horizontally and vertically with desired tilt, roll and pitch are essential for successful use of scientific echosounder. 'Trawling drum' is equipment essentially simplifying trawling operation during numerous trawling operations. Ropes for pulling the trawls are essential for trawl operations. Any use of electronic devices on board of research vessels is dependent on sufficient power supply to be provided by 12V accumulator batteries. Extensive fieldwork requires proper clothing of staff – rubber chest weiders, raincoats etc.

Administrative Costs. Include professional assistance with the project accounting and financial reporting.

Publicity costs. Every manuscript in English produced during the project must be anglicizing by a native speaker. Printing of methodological booklets on Fish monitoring is expected in the final year of the project. Special plaque acknowledging the crucial contribution of NFM to this project will be manufactured and placed to the honorary position on the bridge of the newly built research vessel.

Travel expenses. Per diem subsistence is calculated roughly according to Czech regulations (est. 170 CZk per full day for a person). Pulling heavy-duty trawls will require large fuel consumption. The hourly rate of the new vessel is not known in advance, so the figure 1000 I is the best possible extrapolation knowing the fuel consumption of weaker research vessel O.Oliva. During the project duration we expect three air journeys of HBI staff to Norway to consult trawl construction –, collection and processing of acoustic data and overall strategy of experiments. One air fare for one visit a year is planned. Several Czech partners will come for the 6th Ices symposium on Acoustics in Bergen, Norway, June 2008. The microbus for transportation will be provided by the University of South Bohemia (journey expenses not counted into current project). Per diem expenses of Czech partners in

Norway and Norwegian partners in the Czech Republic are calculated according to EU per diem rates (published on web address: http://ec.europa.eu/europeaid/work/procedures/implementation/common_documents/per_diems/perdiem_07_2007.pdf ; 230 Eur for the Czech Republic, 200 Eur for Norway).

Staff costs. Number of days required during all three years are calculated on the basis of fractions of full time jobs. These fractions are indicated in feasibility study and vary between 10 and 30%. When summed all staff cost together, the total personal costs represent 180% of one average salary. **The staff costs are not subject of VAT, so the costs without and with VAT are equal. All staff will be employed by special contract for a fraction of a full time job just for this project.** Social and Health Insurance (37% of the salaries) are calculated according to the regulations valid in the Czech Republic at a time of application.

VAT The applicant's institution is paying VAT wherever applicable (no exceptions). According to current regulations in the Czech Republic, there is no way for the applicant to claim VAT back. So the VAT must be considered as allowed expense of the project.

Norwegian partners agreed to provide their expertise, international travel and limited amount of time for the project free of charge.

All values given in the budget are calculated for the whole period of three years and are qualified cost estimates at the time of application. There may be small shifts between the items, but the total shifts between the categories 1.-8. (Table P2a) shall not be more than allowed amount (15%).

Project Cash-flow:

1. Expenses of the project during the economic lifetime of the Capital equipment - years 2008 - 2017 (EUR)

Years	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Capital equipment	226 344					23632				
Material costs and small equipment				5 859	6 152	6 460	6 783	7 122	7 478	7 852
Services		4 000	4 245	2 807	2 891	2 978	3 067	3 159	3 254	3 352
Travel expenses	6 500	6 894	6 500	6 365	6 556	6 753	6 955	7 164	7 379	7 600
Personal costs	23 000	27 000	25 950	45 051	47 304	49 669	52 152	54 760	57 498	60 373
Depreciation	1 838	3 509	3 509	3 509	3 509	6 109	8 767	8 767	8 767	8 767
Other operation costs (Publicity)	84	750	1 047	400	412	424	437	450	464	478
Administrative costs	750	750	750	15 998	16 706	18 098	19 540	20 356	21 210	22 105
Total costs	35 672	44 001	43 001	79 989	83 530	90 490	97 702	101 778	106 049	110 526

Economic lifetime of the capital equipment (number of years over which the assets are being depreciated according to Czech Revenue Tax Act) is 10 years (exception: the trawling nets, with lifetime of 5 years). In the year 2011 the routine monitoring with active gear is expected to start. The presented costs estimation is based on 10 monitoring surveys of medium-size reservoirs annually. Similarly, the forecast revenue presented in the following table, assumes the same number of monitoring surveys. According to the Ministry of Environment up to 40 Czech reservoirs could be assigned to be monitored on a regular basis by HBI over a three-year period. Depreciation of the capital equipment pursuant to the Tax law is decreased by expected project subsidies (the annual depreciation applies only to 15% of the project capital equipment's book value). In the year 2013 we expect to reinvest into night and day trawl nets. All costs and sales are indexed with average rate of inflation on the level of 3%. The material cost and personal cost are indexed with higher rate on the level of 5% to implement the potential increase of labour a fuel cost.

2. Revenue of the project in years 2008 – 2017 (EUR)

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Financial income for the monitoring activities				125 000	128 750	132 613	136 591	140 689	144 909	149 257
Project subsidies		221 151	34 418	33 568						
Total income		221 151	34 418	158 568	128 750	132 613	136 591	140 689	144 909	149 257

The total income stipulated above is generated from services provided at market levels for 10 monitoring surveys of medium-size reservoirs. We assume the project subsidies account for 85% of

the total project costs consisting of the capital equipment and operating costs incurred during the project period of 3 years.

3. Cash-flow of the project in years 2008 – 2017 (EUR)

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Financial Cash-flow	-	-	-	71 286	37 877	14 490	38 323	38 340	38 301	38 202
	260 178	180 659	5 074							

Over the project period the income is generated only by the subsidies on the level 85% of total costs. In the operating period the positive cash flow is generated by the applicant for providing services at market prices.

4. Indicators of investment efficiency (2008 - 2017)

Interest rate	5,28%
Net present value (EUR)	108 542
Internal rate of return (financial)	18,59 %
ROI	11,32%
Cost-benefit ratio	122%
Pay back period	6,76

The applied interest rate of 5,28% reflects the interest rate of government bonds increased by 2%. The resultant net present value is positive. The project supported by subsidies generates income to pay back the investment costs and moreover is able to capitalise invested resources by more than 5,28. The Internal rate of return reaches the level of 18,59% which is greater than the discount rate. The average profit return on investment stands at the level of 11,32%. The relation between project incomes and costs is greater than 100% with the pay- back period less than the employed equipment lifetime.

5. Detailed costs of a survey of average sized reservoir by the proposed monitoring system.

Monitoring activity	unit	No.of units	Unit price	Cost (EUR)
Material costs and small equipment	1 reservoir survey	10	586	5859
Services	1 reservoir survey	10	281	2807
Travel expenses	1 reservoir survey	10	636	6365
Personal costs	1 reservoir survey	10	4505	45051
Depreciation	1 reservoir survey	10	351	3509
sum of direct costs	1 reservoir survey	10	6359	63591
Overheads	1 reservoir survey	10	1590	15898
Total	1 reservoir survey	10	7949	79488

Explanations of items

Material and small equipment include mainly fuel consumption of the trawling and echosounding boat (diesel) and electroshocking device (over 75%), data storage media for acoustic data, ropes, batteries, torches, tapes, carabines, field cloth, printer cartridges for printing echogrammes and reports and other consumables. The services include repair and maintenance of boats, nets, electroshocker, transducer holders etc. Usual yearly boat maintenance costs about 1500 Eur (labour, wood, paint, engine oil, antifreeze fluid), the maintenance of transducer holders (500-1000 Eur according to the damage; labour, aluminium welding, tubing, steel wires, pulley replacement). Net damage depends on

the risk of unintentional hitting the bottom, when it happen, the repair costs could be in thousands Euro. Personal costs include 173 man-hours for field data collection and 255 man-hours for the processing of the data and writing the reports. Depreciation of the capital equipment is decreased by expected project subsidies (the annual depreciation applies only to 15% of the project capital equipment's purchase price). The overhead rate is currently set at BC HBI at 20% of the sum of all direct costs.

The data are calculated for one reservoir monitoring and then extended to 10 monitoring surveys of medium-size reservoirs, which is the pessimistic estimate of the market demand for monitoring.

11. Economical analysis

The following benefits of the project were demonstrated in the Feasibility study:

Increase of ecological potential of water reservoirs
Improvement of water quality and reduction of treatment costs
Decrease of eutrophication effects
New active methods of fish monitoring and management for the biomanipulation of water quality
Reduction of error risk at management of the fish of the reservoirs
Introduction of trawling technology in Czech Reservoirs
Improvement of the basic knowledge on biotic interactions in the water of reservoirs
Enhanced international reputation of Czech and Norwegian aquatic sciences
Increase of international rating of the Biology Centre ASCR resulting in potentially better access to future funding

The financial analysis of the benefits of the project is minimalistic. There are further economical effects in the above table, which are likely to bring much more benefits than assumed in financial analysis. However, the financial extent of the major benefits is difficult to estimate at the time of application, so it was decided to abandon uncertain calculations.

12. Risk analysis

Assumptions which must be fulfilled for the successful implementation of the project	Probability that the assumptions will be fulfilled (high, medium or low)	Impact on project implementation (which outputs, results or objectives are at risk)
Interest of reservoir owners in fish monitoring	Very high. Owners are requested by EU directive to carry out the monitoring	Very high probability of monitoring has stabilising effect on the cash flow
Implementation of the new monitoring system as official implementation system	High to medium Official acceptance of the new methodical system for monitoring is likely because IHB has been given the confidence of the Ministry of Environment CR while preparing the previous version of methods based mainly on passive methods.	If this assumption is not fulfilled, the direct impact on the ecological potential of the reservoirs nationwide would be reduced, but IHB would continue to use the active methods of monitoring in cooperation with managers of individual reservoirs. The monitoring improvement would happen on a local scale. .
Experienced team for active monitoring of the fish stock of Czech reservoirs.	Very high The team consisting of scientists of IHB, IMR and UJO was already consolidated, small changes may happen later with no harmful effect on the project outputs	Eventual small exchange of team members could slow down temporarily some activities but the overall strength of the teams ensures prompt rectification.
Efficient cooperation of the partners	Very high The partnership is built on long-term close cooperation	In case of partnership failure, IHB has a number of other professional contacts, which could help successful completion of the project. However the failure is extremely unlikely.
Successful implementation of tenders, purchasing of all necessary equipment	Very high Very high attention will be paid to the specification of public orders, conditions of purchase, technical parameters so the main criterium for the transparent final decision could be the price. The tender will be carried out with the assistance of a specialized firm so the possibility of procedural imperfection would be minimized.	The contractual documents for tenders will contain delivery and warranty periods, service conditions, agreed penalties, so in the case of equipment malfunction the above instruments will ensure repair or exchange of the goods. Minimal required warranty period would correspond to the project duration
Adaptation of know-how and skills by the project team	High The participation of Norwegian partners increases in a crucial way the success probability. Both Czech and Norwegian teams formerly managed to develop new sampling methods, so it is likely that their joint effort will be successful	In case of technical problems, any of the planned experiments can be repeated. Obviously, the repeated technical problems or unpredictable difficulties of fish capture could negatively influence active methods of monitoring.
Maintaining economic sustainability	Very high, as the project has significant practical and theoretical impact, the sustainability will be maintained from 3 sources (contractual work, research grants and institutional funding).	Biological Centre AS CR guaranteed to maintain the economical sustainability even in the event the Applicant will not have sufficient means to provide for expenses related to maintenance and operation of the assets

13. Final project evaluation on the basis of feasibility study

Based on results of Feasibility Study and the level of provided subsidies by the Norwegian financial mechanism, we conclude that the project is economically feasible. The investment has been evaluated with respect to economical efficiency considering static and dynamic indicators. The positive level of NPV demonstrates the sustainability of the project over its operating period. The internal rate of return of 18,6% proves the effective employment of the proposed subsidies. Without the subsidies the dynamic indicators would result in project's negative present value and the respective pay-back period would be 18,7 years. This period would be greater than the life time of the employed equipment. We conclude that the project realisation would not be feasible without the proposed subsidies.

The project further generates very important scientific and economical benefits, which are not captured in the project cash flow. Successful implementation of active monitoring methods will highly increase the quality of information on the fish stock of the reservoirs and will expand the possibilities of fish stock management using the active capture gear. The above-mentioned benefits are in a long-run more important than the financial outputs of the project.

The realisation of the project is associated with risk aspects listed in chapter 12. The applicant is ready to accept the possible risks and is prepared to provide the sustainability of the project with his own resources because of his high interest in the above-mentioned scientific and economic benefits of the project.

The platform of Norwegian FM provides an ideal solution of long-termed problem with implementation of active gear monitoring of fish stock in Czech Reservoirs: economical aid for purchasing and running the necessary hardware and the know-how from Norwegian physics and marine institutions, which are one of the most advanced in the world in using active methods of fish sampling.

Summary: The project can be recommended for financing by the Norwegian finance mechanism.

Quoted references:

Degerman, E., Nyberg, P., Appelberg M., 1988. Estimating the number of species and relative abundance of fish in oligotrophic Swedish lakes using multi-mesh gillnets. *Nordic Journal of Freshwater Research* 64, 91-100.

Drašík, V., Kubečka, J., Čech, M., Frouzová, J., Tušer, M., Jarolím, O. In press Better fish stock estimates in reservoirs: day or night acoustic surveys? Manuscript submitted to the Fisheries Research

Godø, O.R. & Walsh, S.J. 1992. Escapement of fish during bottom trawl sampling - implications for resource assessment. *Fisheries Research*, 13: 281-292.

Godø, O.R., Pennington, M. & Vølstad, J.H. 1990. Effect of tow duration on length composition of trawl catches. *Fisheries Research*, 9: 165-179.

HRBÁČEK, J., DVOŘÁKOVÁ, M., KOŘÍNEK, V. & PROCHÁZKOVÁ, L. (1961): Demonstration of the effect of the fish stock on the species composition of zooplankton and the intensity of metabolism on the whole plankton association. – *Verh. Int. Verein. Limnol.* **14**: 192–195.

Hrbáček, J., 1981: Produkční vztahy, výchozí struktura pro posuzování faktorů eutrofisace úrodných nádrží. (Production interactions, basic point for assessment of reasons for eutrophication of reservoirs). *Studie ČSAV*, 152pp.

Juza, T., Kubečka, J., 2007. Efficiency of three fry trawls to sample freshwater pelagic fry community. *Fisheries Research*, 85, 3: 299-304.

IHB, 2006: Metodika odlovů a zpracování vzorků rybích společenstev stojatých vod (Methods of sampling and sample processing for sampling of the fish of stagnant waters). Návrh Metodiky sledování pro rámcovou směrnici EU. 30 s (Methodical procedure for the monitoring of Czech waters), in Czech, 30p.

Kubečka, J., 1993, Succession of fish communities of Central and East European reservoirs. In: *Comparative Reservoir Limnology and Water Quality Management*. In: Straskraba, M., Tundisi, J.S., Duncan, A. (Eds.), Kluwer, Dordrecht., pp.153-168.

Kubečka, J., Seda, J., Matena, J., Vyhnaček, V., Hejzlar, J., 1995: Biomanipulation of Czech water supply reservoirs - summary of 18 years. *Vodní hospodářství 11-12/1995*: 374-376

Kubečka, J., Matěna, J., Peterka, J. 2003: Sampling of the fish stock of the open water of the reservoirs, *Vzorkování rybích obsádek úrodných nádrží. Vodní hospodářství (Water management)* 10/2003: 273-275.

Kubečka J., Matěna J., Čech M., Drašík V., Frouzová J., Hohašová E., Jarolím O., Jůza T., Kratochvíl M., Muška M., Peterka J., Prchalová M., Říha, M., Tušer M., Vašek M., 2007: How shall we study the fish stock of our large water reservoirs? In: Švátora, M. (ed.): *Proceedings of X Czech Ichthyological Society*. Prague, June 2007, ISBN 978-80-86561-82-0: 92-94 (in Czech with English summary).

Kubečka, J., Wittingerová, M. 1998. Horizontal beaming as a crucial component of acoustic stock assessment in freshwater reservoirs. *Fish. Res.* 35, 99-106.

Kurkilahti, M., 1999. Nordic multimesh gillnet - robust gear for sampling fish populations. PhD. Thesis, Helsinki, University of Turku, pp. 108.

Kurkilahti, M., Appelberg, M., Bergstrand, E., Enderlein, O., 1998. An indirect estimate of bimodal gillnet selectivity of smelt. *Journal of Fish Biology* 52, 243-254.

Mehner, T., Schulz, M., 2002. Monthly variability of hydroacoustic fish stock estimates in a deep lake

and its correlation to gillnet catches. *Journal of Fish Biology* 61, 1109-1121.

Olin, M., Malinen, T., 2003. Comparison of gillnet and trawl in diurnal fish community sampling. *Hydrobiologia* 506-509, 443-449. doi: 10.1023/B:HYDR.0000008545.33035.c4.

Olin, M., Kurkilahti, M., Peitola, P., Ruuhijärvi, J., 2004. The effects of fish accumulation on the catchability of multimesh gillnet. *Fisheries Research* 68, 135-147. doi:10.1016/j.fishres.2004.01.005.

Prchalová, M., Kubečka, J., 2004: Are percid fish overestimated by the gillnets? . IN: Proceedings of PERCIS III, The Third International Percid Fish Symposium, University of Wisconsin, Madison, USA, Printed: January 2004, edited by: T.P. Barry and J.A. Malison: 121-122.

Prchalová, M., Kubečka, J., Vašek, M., Peterka, J., Sed'a, J., Jůza, T., Říha, M., Jarolím, O., Tušer, M., Kratochvíl, M., Čech, M., Draštík, V., Frouzová, J., Hohausová, E. 2008.a Gradients of fish distribution in a canyon-shaped reservoir. Submitted to *Journal of Fish Biology*.

Prchalová, M., Kubečka J., M. Říha, R. Litvín, M. Čech, J. Frouzová, M. Hladík, E. Hohausová, J. Peterka, M. Vašek. 2008 b. Overestimation of percid fishes (Percidae) in gillnet sampling. Submitted to *Fisheries Research*.

Prchalová, M., Kubečka, J., Říha, M., Mrkvička, T., Vašek, M., Jůza, T., Kratochvíl, M., Peterka, J., Draštík, V., Křížek, J., in press. Size selectivity of standardized multimesh gillnets in sampling coarse European species. *Fisheries Research*, submitted.

Říha, M., Kubečka J., Sed'a J., Matěna J., Hladík M., Čech M., Draštík V., 2, Frouzová J., Hohausová E., Jarolím O., Jůza T., Kratochvíl M., Peterka J., Prchalová M., Tušer M., Vašek M. Long-term development of fish populations in the Římov Reservoir. Manuscript submitted to *Fisheries Management and Ecology*.

Seda, J., Kubečka, J., 1997: Long-term biomanipulation of the Římov reservoir, Czech Republic. *Hydrobiologia*, 345: 95-108

Seda, J., Hejzlar, J., Kubečka, J., 2000: Trophic structure of nine Czech reservoirs regularly stocked with piscivorous fish. *Hydrobiologia*, 429: 141-149.

Simmonds, E. J., MacLennan, D. N. 2005. *Fisheries Acoustics*, Blackwell, Oxford, 437 s.

Steinberg R; Dahm E, 1974: The use of two-boat bottom and midwater trawls in inland waters: experiences in the German fishery. FAO; EIFAC Symposium on Methodology for the Survey, Monitoring and Appraisal of Fishery Resources in Lakes and Large Rivers, Aviemore (UK), 12p.

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 canyon-shaped reservoir. *Intern. Rev. Hydrobiol.* 89, 352-362.

Vašek M., Kubečka, J., Matěna, J. and Sed'a J. 2006 Distribution, size and diet of 0+ fish within a canyon-shaped reservoir in late summer. *Intern. Rev. Hydrobiol.* 91: 178-194.

Vašek, M., Jarolím, O., Čech, M., Kubečka, J., Peterka, J., Prchalová, M., in press. The use of pelagic habitats by cyprinids in a deep eutrophic impoundment: Římov Reservoir, Czech Republic. Submitted to *Folia Zoologica*

Vašek, M., Čech, M., Draštík, V., Dušek, D., Hladík, M., Kubečka, J., et al. 2000: Diel fluctuations of fish catches taken by pelagic gillnets in the Římov Reservoir. In: Mikešová, J. (ed). Proceedings of IV. Czech Ichthyological Conf., Vodňany: 35-40.



Aerial photographs of two Czech reservoirs to be investigated (Lipno and Římov) showing large areas of the open water where active monitoring of fish by echosounders and trawls is required. © Dr. P. Znachor, IHB.

