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# A NOVEL METHOD FOR THE SIMULTANEOUS ASSESSMENT OF THE MORPHOLOGY AND FISH STOCK OF WATER HABITATS

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***Abstract***

*It is known that one way to acquire data on fish stocks is the fishfinder. It is also necessary to gather information of the morphology of the water and also that the spatial data on the fish stock is to be downloadable, retrievable* **.**
*A method that is fast, accurate and can be operated on the water can only be considered for the positioning of the fishfinder data, moreover the data are to be recorded for further processing. The equipment using GPS (Global Positioning System) concept is capable for this. Simultaneous use of the two equipment (fishfinder and GPS) plus the connected electronic data register would satisfy the need detailed above, and help the fisheries management with a new effective source of information*

**Keywords:** fish stock, water body, fishfinder

## INTRODUCTION

Proper management of fisheries require the best possible knowledge of the characteristics of the water body in question as well as that of the fish stock. The optimal utilisation of resources can not be done without these information, moreover false management decisions can be made due to lack of information, that can threaten the successful management in the future. Despite we are not fully aware of the precise effect of the environment and the behaviour of fish, it is known that several factors are affecting the successful fisheries management. The majors are:

- Fish stock (species- and age composition, spatial location by day and season, feeding behaviour, etc.)
- Feedstuffs (plant nutrients, feeds of plant and animal origin – e.g. plankton)
- Water quality, quantity
- Physical and morphological characteristic of the water body (bathymetry, depths, location and size of underwater vegetation and structures, flows, etc.)
- Climate (precipitation, wind, air pressure, radiation, etc.)

There is a need for several information on the water body and the fish stock that facilitate the conceptual management. One part of the information is available, while the other is not, or not deeply enough. The necessary data differ in characteristics, and can be obtained from different sources in different ways. This paper is dealing with how to obtain and use the information regarding the water bodies and fish stock (Stündl et al. 1999).

Fish production in inland waters are carried out in man-made (fish ponds and water reservoirs – aquaculture) and natural water bodies (rivers, lakes, oxbows - fisheries). The mayor groups of information regarding the water bodies and fish stock are as follows:

| | ***Man-made***<br>fish ponds and water reservoirs*:* | ***Natural***<br>rivers, lakes, oxbows*:* |
|---|---|---|
| ***Fish stock*** | - Stocked each year by plan<br>- rate of species and age composition is known<br>- spatial location predictable (around the feeders)<br>- full stock is harvested annually<br>- controlled fish growth (feeding scheme)<br>- up to 3-4 age groups | - number, rate and age composition of species is less known (even if stocked)<br>- stock can partly be harvested<br>- slower growth, year (weather) dependent weight gain,<br>- some age groups can be missing (due to unfavourable weather conditions in the breeding season) |

| | ***Man-made***<br>fish ponds and water reservoirs*:* | ***Natural***<br>rivers, lakes, oxbows*:* |
|---|---|---|
| ***Water body*** | - controlled water management (water level, quality)<br>- even and smoth or known bottom morphology<br>- controlled nutrient flow (manuring and feeding regime) | - partly controlled water management<br>- unknown morphology (or partly revealed by experience)<br>- no or little control over nutrient flow |

Moreover, these factors can be realised in a range of combinations. Equipment with which one can obtain rather fast and accurate information regarding the water bodies are available now, which can help management decisions. These equipment – when connected into a single system – can provide clear, easily manageable and up-to-date information.

It is known that one way to acquire data on fish stocks is the fishfinder. It is also necessary to gather information of the morphology of the water and also that the spatial data on the fish stock is to be downloadable, retrievable (Geospace, 1993).

A method that is fast, accurate and can be operated on the water can only be considered for the positioning of the fishfinder data, moreover the data are to be recorded for further processing. The equipment using GPS *(Global Positioning System)* concept is capable for this. Simultaneous use of the two equipment (fishfinder and GPS) plus the connected electronic data register would satisfy the need detailed above, and help the fisheries management with a new effective source of information **(STÜNDL et al. 1999).**

## MATERIALS AND METHODS

### *Fishfinder*

Simpler makes of fishfinders are now easily available today. They are made up of three major parts: transducer, processing and display unit, power source. The transducer provides information for the processing and display unit via sending high frequency (ultra)sound, and receiving the echo. The delay in the echo and the modifications of the returned sound contain data on:

- depth below transducer,
- bottom density
- size and features of underwater structures
- number and relative size of fish in the scanned area

Various transducers are operating in a range of frequencies. Lower (50-100 KHz) frequencies enable wider scanned area, but less accuracy, in contrary to higher (250-500 KHz) frequencies. Most of the time one transducer operates with more (e.g. 2 side and 1 central cone) or adjustable frequencies. The 3D display require 4 cones, and sacrifices accuracy and additional data (e.g. bottom density) for improved fish localisation. One bottleneck for the operation is shallow (1-5 m) water that the advanced fishfinders have minimum depth requirement, while simpler (for recreational use) have no output (ŐRLEY, 1994).

The central unit receive and process data gained from the transducer. The display is usually an LCD panel, indicating differently the various underwater objects by their acoustic features. The fish can easily be detected because of the very different density of fish flesh an the air in the swim bladder. (The flesh and water are not different from acoustic point of view). The size of the fish can be estimated from the signal caused by the size of swim bladder: the display can be in the form of various size arches or "crescents" (Raytheon, 1995).

Widely used recreational fishfinders display the current data in continuous flow, and not recording them. This enables only on-the-spot assessments, but for making complete survey of a given water body one need the whole range of data, classified by main groups (depth, underwater objects, vegetation, fish). For this reason a fishfinder is needed that can operate in shallow waters, and have a data output capability for the post-processing of the recorded data *(Figure 1)*

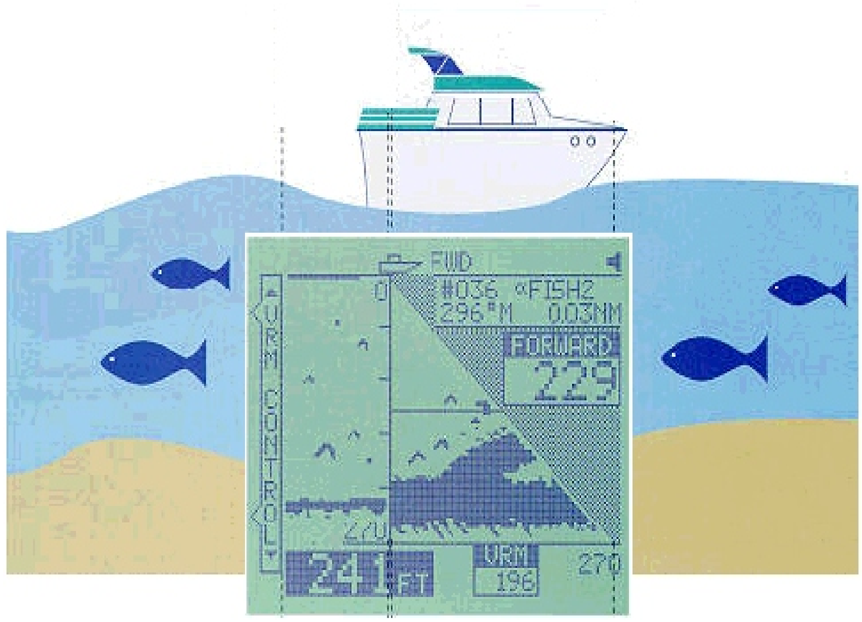


Fig 1. Operation and display concept of a fishfnder

***GPS (Global Positioning System )***

The USA Ministry for Defence started the development of a satellite-based navigation system in the late 1970's. This system containing 24 navigation satellites orbiting 20200 km off the Earth, enabling non-stop positioning (regardless of weather or other environmental factors) was in operation from the mid 1980's. In optimal situation 5-7 of these satellites are accessible, thus the positioning can accurately be made.

The concept is the same used in the geometry: the location of a point can be calculated from the distance and angle of two known points. This of course is for 2D measurements. Given the 3D space, 3 points (i.e. satellites are needed for the accurate measurement. For improved accuracy 4 satellites are necessary. The calculation is done by the GPS receiver from the orbit and time data with the help of built-in software. The latitude, longitude and elevation data can then be recorded for later use. Several means available in order to avoid significant inaccuracy, these are known as differential GPS

(DGPS) i.e. "debugging" the inaccuracies via post-processing of the data. (Timble, 1996)

### *Simultaneous use of GPS and fishfinder*

The connected use of the two equipment, and the recorded, processed and plotted data will provide new type information for the fisheries (Hockersmith and Peterson, 1997; Robins et al., 1998)

The system can be used where:

- the information on both fish and water body are missing (new fishing grounds),
- the available information is partial or inadequate (extensive grounds, prior to rent out or selling-buying fishing right),
- no former data on the fish stock is available (former recreational grounds), or
- existing data on the bottom characteristics are required (abandoned mining sites), etc.

Data gained from the survey and completed with stock assessment (samplings) the composition and amount of fish stock can be modified, as well as the maintenance, construction works connected to fisheries – in accordance with the management plan can be realised **(**Tóth, 2001**)**.

## RESULTS AND DISCUSSION

The method developed for the morphologic survey of the water areas is a fast, exact procedure (the performance is 4-5 ha/hour), which gives new, so far unknown data of any water areas (bed shaping, place of impediments, keeping, expansion of the cover of water plants), on the other hand, it creates the possibility of using GIS-based data maps and spatial informatics in the fishery (*Figure 2 and 3*). An example on the morphologic survey of an oxbow is shown on *Figure 4*.

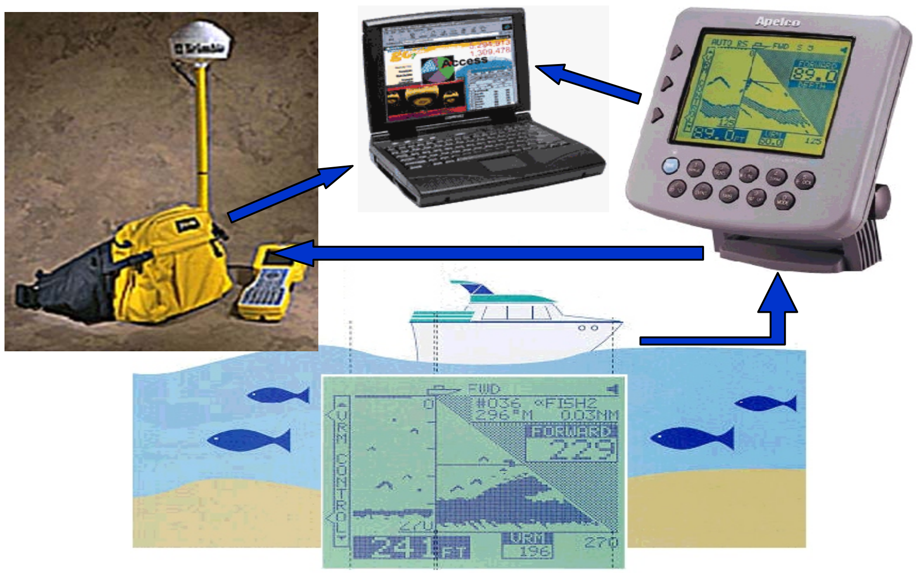


Fig. 2 . United Fish Stock and Bathymetric Monitoring System

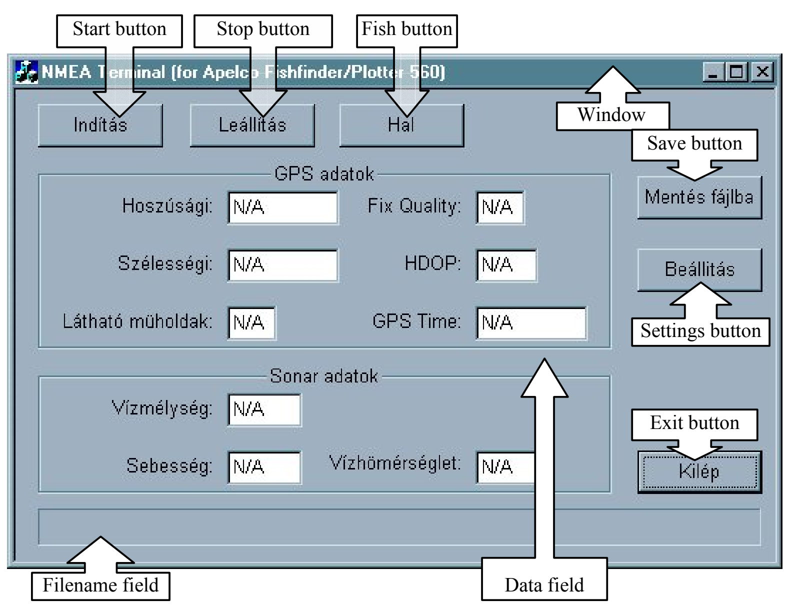


Fig. 3. Software for data download

The Fish Stock and Bathymetric Monitoring System can be a tool for fisheries management for the good management decisions, because it provides useful, previously existing data in a short period of time. These can be used for :

- stock and age classes exploitation,
- finding locations for fish harvesting, stocking and closed areas,
- construction of artificial spawning grounds, fish nurseries,
- creation of fish shelters,
- removal of mud and excess vegetation
- protection or modification of water bed,
- removal of underwater objects, structures,
- modification of flow pattern,
- continuous monitoring of water bed change,
- construction of artificial fish-shelters, etc.

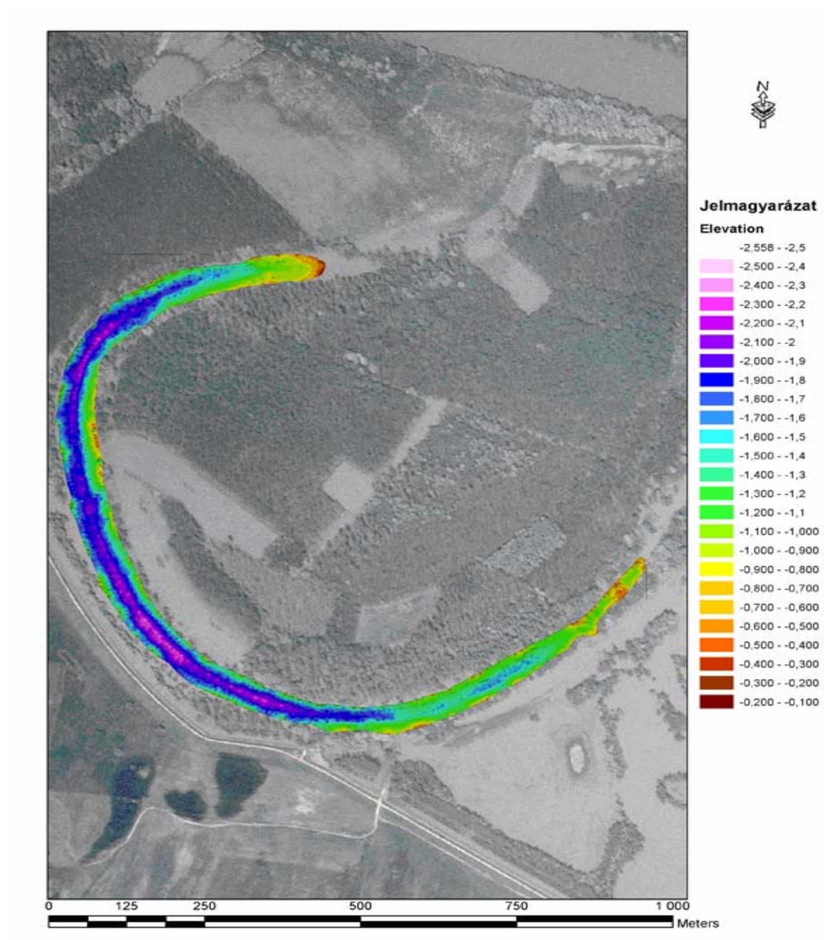


Fig. 4 Morphologic survey with colour scale (Marótzugi Oxbow )

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