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PILOT UNDERWATER VISUAL CENSUS STUDY IN A BULGARIAN SUB-MEDITERRANEAN RESERVOIR

ABSTRACT

In order to test the suitability of underwater visual census method in freshwater basins, it was applied and compared with standard sampling methods - gill nets, as well as questionnaires concerning the fish fauna's composition in Stoikovtsi dam (SW Bulgaria). The number of registered species per method was established as: questionnaires > underwater counting > gill nets. The reliability of questionnaires is uncontrolled, whereas underwater counting is nature friendly and permits the calculation of standard values as specimens per unit area, in addition to gill nets, where only CPUE can be estimated. Habitat preference and other specific features can be established, in addition to classical methods (gill nets). The major limitations of underwater counts in fresh waters are turbidity and the diver's experience.

Key words: *underwater counting, diving, fish fauna, fresh water, dam lake*.

INTRODUCTION

Underwater visual census (UVC) methods have been used extensively in fish studies of population dynamics, ecology and management (Harmelin-Vivien *et al*., 1985) as well as monitoring (Jones *et al*., 2011). Such surveys have mainly been performed to census a wide range of demersal species that are taken by shallow water fisheries on coral reefs (Russ, 1985, Watson and Ormond, 1994; Jennings and Polunin, 1996).

UVC has been already also applied in fresh waters for various purposes (Turner and Mackay, 1985; Mayo and Jackson, 2006).

Main monitoring sampling method In Bulgaria concerning lentic water ecosystems and according to the national legislation - Ordinance H-4/14.09.2012 are gill nets; fyke nets are rarely used. In some cases, resource limitations (e.g. time, cost, and availability of proper specialists) may lead to survey designs that do not meet all the requirements of an effective monitoring program. Moreover, common fish sampling methods in lakes often have disadvantages (e.g. gill nets and long lines are not nature friendly, electrofishing is effective near the shore etc.). UVC has also disadvantages: the researchers have to be well trained; otherwise the failure to notice individuals increases. (Sale and Sharp, 1983; Watson and Quinn II, 1997). The proper speed (Lincoln Smith, 1989) and size estimation (Bortone and Mille, 1999; Harvey *et al*., 2002) also represent important issues. The method is not applied in Bulgarian lentic waters, due to various factors: trained divers and legislation.

The aim of the current study is to approbate if UVC is applicable in a medium altitude Bulgarian reservoir with average visibility, and compare the results with two alternative sampling methods.

MATERIAL AND METHODS

Study area

Stoikovtsi (West Aegean Basin Directorate) represents one of the the biggest reservoir in Blagoevgrad region, SW Bulgaria with length 570 m and volume $13.22*10^6$ m^3 – EU code BG4ST500L013 (Fig. 1). It collects the water from three semi-dry rivers, Klisurska, Leshnichka and Drenovska. Its water surface is 1.13 km^2. It can be assumed as a closed freshwater system, since water releasing is not practiced for at least two decades.

The study was performed with standard underwater visual belt transect survey methods (Brock V., 1954; Brock R.,1982), during the period April-August 2015. Additional multi mesh gill nets and questionnaires to anglers were used to clarify the fish fauna in the reservoir. Nine areas were investigated by a single transect each, in order to obtain data from multiple habitats (Fig 1). Each transect was 100 long with variable width according to transparency. Prior to conducting the study, preliminary diving activities were performed in order to identify major habitat types and representative locations for transects. A scuba diver swam each transect at a slow speed and identified all fishes visible to species level from surface to about 10 m depth. The observed specimens were determined and the data recorded underwater.

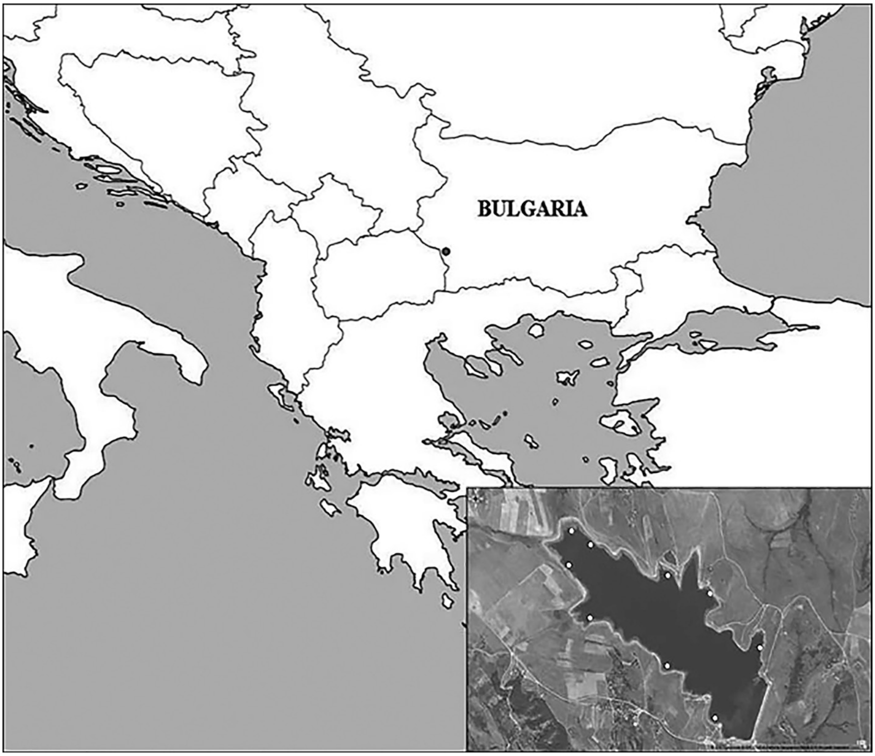

Figure 1. Stoikovtsi reservoir (SW Bulgaria) and selected sampling stations for pilot underwater visual census study.

RESULTS AND DISCUSSION

5 species were registered by the aims of UVC method in Stoikovtsi reservoir, in addition 4 with gill nets. The questionnaires showed that anglers recognize 11 species inhabiting this dam the lake (Table 1). Four of them are difficulty detectable, due to different reasons, mainly their lower population density in the concrete system (*Oncrhynchus mykiss, Salvelinus fontinalis, Cyprinus carpio* and *Silurus glanis*). The status of salmonids is unclear, since they do not reproduce in the dam lake and stockings have been performed before some years. The carp and welsh inhabit deeper sectors mainly, where the method is not effective due to the decreased visibility. Compared with gill net sampling, one more species was registered - a single juvenile *Tinca tinca* was noticed, otherwise unknown for the system. The questionnaires given to anglers point out 10 species in the system; nevertheless their reliability is uncontrolled.

Table 1. Recorded fish species in Stoikovchi dam (SW Bulgaria) according to different sampling techniques.

Fish species	Gill net	UVC	Questionnaire
Oncorhynchus mykiss Walbaum, 1792	-	-	+
Salvelinus fontinalis Mitchill, 1814	-	-	+
Cyprinus carpio Linnaeus, 1758	-	-	+
Carassius gibelio Bloch, 1782	+	+	+
Ctenopharyngodon idella Valenciennes, 1844	-	-	+
Esox lucius Linnaeus, 1758	-	-	+
Tinca tinca Linnaeus, 1758	-	+	-
Pseudorasbora parva Temminck & Schlegel, 1846	+	+	+
Lepomis gibbosus Linnaeus, 1758	+	+	+
Alburnus alburnus Linnaeus, 1758	+	+	+
Silurus glanis Linnaeus, 1758	-	-	+

An essential issue for bias represents the fish behavioral changes in response to divers too (Kulbicki, 1998). Omni- and herbivores usually are hiding, but predators can be attracted or pressed back by a diver's presence if previously affected. In Stoikovtsi reservoir, the established fish did not show altered behavior, affected by the diver's presence.

The results can be transformed as ind/area unit, since transect length and number per species are known, in addition to other sampling methods, measuring CPUE (Table 2). Habitat preference can also easily be registered.

Concerning UVC research in fresh waters, turbidity is the main factor determining success; the survey has to be performed when algae bloom is not taking place, as well as early in the morning. In Stoikovtsi the visibility is varying from 5-8 m in the shallows, up to about 1 m at 10 m depth. Species varying detectability could also bias the results (Willis, 2001) but this is also characteristic of some other conventional monitoring lake methods (Table 2). Weighting pros and cons, it can be concluded, that monitoring lakes - natural and artificial- by a single method does not contribute the most accurate data probably; UVC method in some cases could show to better results. Its parameters have to be further tuned, in view to the concrete abiotic and biotic factors in Bulgarian freshwaters.

Table 2. Main sampling techniques in lentic waters and their main characteristics.

	nature friendly	time consuming	results output	Bias possibility
beach seine	yes/no	no	ind/area	only shallow parts; not pelagic species
traps/fykes	yes	yes	CPUE	not all demersal territorial species/not pelagic species
long lines	no	yes	CPUE	predators/big cyprinid species mainly
gill nets	no	yes	CPUE	not all demersal territorial species
hydroacoustics	yes	yes	ind/area	poor species determination; little or no sampling capability near bottomand surface; potential bias associated with target-strength uncertainties
boat electrofishing	yes	no	ind/area	only shallow parts; not all demersal territorial species
underwater counting	yes	no	ind/area	double counts in turbid water; wrong estimation of big shoals; not relevant in deepest sectors

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