

## ECOLOGICAL, ECONOMIC AND SOCIAL PARAMETERS OF RECREATIONAL FISHING ON THE RESERVOIR OF AOS RIVER

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### EKOLOŠKI, EKONOMSKI I SOCIJALNI PARAMETRI REKREATIVNOG RIBOLOVA NA AKUMULACIJI REKE AOS

#### *Apstrakt*

U cilju prikupljanja podataka o rekreativnom ribolovu sprovedeno je anketiranje ribolovaca na akumulaciji reke Aeos u severozapadnoj Grčkoj. Upitnik je obuhvatio pitanja o demografiji, alatima koje koriste za pećanje, uslovima za ribolov, opremi, ciljnim vrstama, intenzitetu odlaska u ribolov, ribolovnom naporu, sezonama, podacima o ulovu. Prikazani rezultati ukazuju da rekreativni ribolov na tom području ima potencijal za razvoj turizma i poboljšanje socioekonomskog uticaja u čitavom regionu. Ribolovci imaju sve izraženiju svest o životnoj sredini. Šaran je trenutno vrsta koja se najviše lovi i koja održava ovu aktivnost, a ukazuje da će ova vrsta moći opstati i na duže ukoliko dodje do promene klimatskih uslova i ukoliko protok bude smanjen kao posledica globalnog otopljanja i kompeticije sa drugim korisnicima. Rukovodeći se rezultatima u ovom radu koji ukazuju na potencijal za razvoj ribolovnog turizma i povećanje ekološke vrednosti ovog područja, upravljači područjem bi trebalo da razmotre mogućnosti poribljavanja na području akumulacije koju formira brana na reci Aeos. Konačna preporuka za uspešno upravljanje ribolovom na području hidroelektrane treba da bude bazirana na kombinovanju parametara koji uključuju ekonomske, ekološke i ribarstvene podatke.

*Ključne reči: reka Aoos, hidroelektrana, rekreativni ribolov, anketiranje*  
*Keywords: Aoos River, hydroelectric dam, recreational fisheries, survey*

## INTRODUCTION

Freshwater ecosystems, including artificial dams provide a range of services including recreational fisheries. In fact, recreational fishing in freshwaters is a major economic activity in developed countries (Arlinghaus et al., 2014; Lothrop et al., 2014). Recreational fishing is popular in the countries of EU, with participation levels varying from 1% of the population in the south to over 30% in northern ones (Rangel & Erzini, 2007). Hydroelectric dams provide a range of potential usages and economic developments, including fisheries (Jackson & Marmulla, 2001). The management of reservoirs involves the construction of fish passage and the restocking measures (Baumann & Stevanella, 2012; McGinnis, 1994), creating opportunities for recreational fishing activity and economy. The motivation of fishermen and public may be influenced by several parameters, including considerations of ecological restoration and protection of native fish species (Novaes & Carvalho, 2011). The Aoos River is 260 km long, 70 km length, located within the Greek borders. The river has a large hydroelectric dam near its springs, producing 103 MWh annually. The regional economy is characterised by agricultural production, but exhibits prospects for tourism (Andreopoulos et al., 2015). The aim of the study was to collect data on fish catch, fishing effort, species composition and preferences, demographic data of the fishermen and their attitudes and awareness of fisheries management parameters of the aquatic ecosystem of the river Aoos reservoir.

## MATERIALS AND METHODS

A survey was carried out on a weekly basis over a period of one month in order to collect fisheries data about recreational fishing on the reservoir of Aoos hydroelectric dam in NW Greece. The questionnaire was distributed, completed and collected at the site (n=22). Fishing effort was estimated on the basis of the number of fishermen and hours spent in fishing. The survey included questions regarding preferences for target species, frequency of fishing trips, fishing effort, season and catch. Data were analysed with SPSS version 10.1.

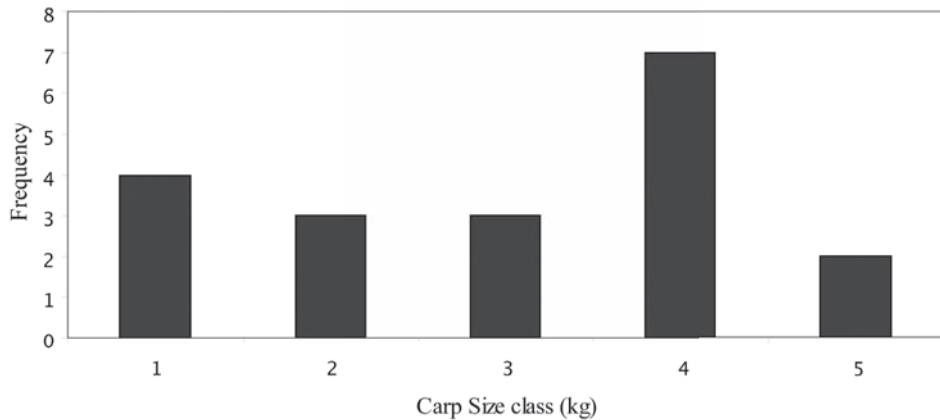
## RESULTS AND DISCUSSION

The majority of the surveyed recreational fishermen on Aoos reservoir were between 30-40 years old, were educated up to secondary education level and were visiting the reservoir at least every fortnight. They reported that they did not fish during the winter and spring at the reproductive period of trouts and carps respectively. There are several factors which can motivate and satisfy recreational fishermen, may have goals for specific species and size of fishes, but also may get a significant level of satisfaction from the whole fishing experience including the travelling, socializing and catch (Beardmore et al., 2011; Carlin et al., 2012). Surveys can provide useful information about fishing effort, fish catch and target species. The fishing effort of recreational fishermen can be estimated by the length of time (in the present work measured in hours) spent for fishing (Jenkins & Morais, 1971).

Fish catch can be measured according to total weight of fish captured (Deines et al., 2013). These two parameters and other fisheries data can be used for fisheries statistics and fisheries management (Deines et al., 2013). In the present study, all of the surveyed recreational fishermen were using fishing rods and their target species was carp (*Cyprinus carpio*). They were fishing for more than eight hours per day (mean  $7.63 \pm 1.12$  hrs), 2.4 times per month, capturing more than five carps per fishing session with frequently reporting size above 3 kg (Fig. 1). The Ratio of means estimator (R1, mean catch per angler divided by mean effort per angler) was  $0.38 \pm 0.21$  (Table 1). They presented increased environmental awareness, as all reported that pollution and illegal fishing is currently compromising the aquatic ecosystem of Aaos reservoir. As the carp is considered as neither a non native species nor endangered, the fishermen did not hesitate to target this species for their recreational fishing activity. The size of carp captured ranged between 1 and 5 kg. Increasing fishing effort resulted in increased total amount of catch (Fig. 2). The age of the carp caught ranged from 1 to more than 6 years. Regression analysis between the fishing effort and total catch indicated that catch increased with the fishing effort ( $r^2=0.801$ ,  $p<0.05$ ). There was no significant effect of fishing effort on the fish size caught. The results reveal that the carp is the main target species, while catch rate of trout and other species was extremely low, indicating the relative high abundance of the carp in the reservoir of Aaos River.

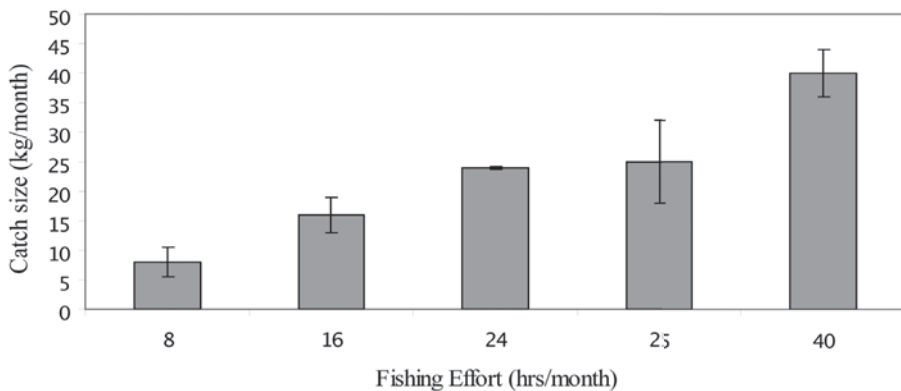
**Table 1.** Descriptive statistics of fishing effort and fish catch of carp in Aaos reservoir. R1: Ratio of means estimator (monthly mean catch per fisherman divided by mean effort per fisherman). Fish caught: Average fish catch (kg), length of fishing session (hours per month and day), and catch per unit effort (CPUE) of the surveyed recreational fisherman.

	(R1)	Average fish catch (kg) per month	Average length of time spent in fishing per month	Average fishing effort (hrs/day)	Average CPUE (Catch per unit effort: fish catch/hour)
MEAN	0,38	19,39	17,74	7,63	2,55
SD	0,21	10,41	9,86	1,12	1,37
MIN	0,21	10,41	9,86	1,12	1,37
MAX	0,38	19,39	17,74	7,63	2,55



**Figure 1.** Frequency distribution of caught carp size (kg) in Aaos reservoir.

Carp is extremely tolerant and could sustain fisheries even with reduced water flow rates as expected (Leontaritis & Baltas, 2014) and could be a candidate for possible future restocking plans. Recreational fishing activity may not necessarily rely on a particular species. They may be equally satisfied if other fish species are available. Catch rate per effort is also an important parameter which can influence the motivation and satisfaction of recreational fishermen (Beardmore et al., 2011; Carlin et al., 2012).



**Figure 2.** Fishing effort (based on carp) per month per fishermen in Aaos reservoir.

## CONCLUSIONS

The data presented herein, indicate that the recreational fishing provides a potential for tourism development increasing the socio-economics impacts of the region. This view should be considered by the local stakeholders as sustainable method of development in the region. The reservoir of Aaos constitutes a significant element of the ecological value of the region (Andreopoulos et al., 2015). The result of the survey indicates that recreational fishermen have increased environmental awareness, consequently they constitute a significant group of consumers of the ecological value which characterises the region. Although

the carp is a non native species, it is currently main prey for fishing in the reservoir. Planners should take into account the possibility of restocking fish in Aaos reservoir, based on the present results which support the increasing socio-economic impacts of recreational fishing and the ecological value of the region. The final decision for management of Aaos reservoir should be based on a combination of economic, ecological and fisheries data.

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#### REFERENCES

Andreopoulos, D., Damigos, D., Comiti, F., Fischer, C. (2015): Estimating the non-market benefits of climate change adaptation of river ecosystem services: A choice experiment application in the Aaos basin, Greece. *Environmental Science & Policy*, 45: 92-103.

Arlinghaus, R., Beardmore, B., Riepe, C., Meyerhoff, J., Pagel, T. (2014): Species-specific preferences of German recreational anglers for freshwater fishing experiences, with emphasis on the intrinsic utilities of fish stocking and wild fishes. *J Fish Biol*, 85(6): 1843-1867.

Baumann, P., Stevanella, G. (2012): Fish passage principles to be considered for medium and large dams: the case study of a fish passage concept for a hydroelectric power project on the Mekong mainstream in Laos. *Ecological Engineering*, 48: 79-85.

Beardmore, B., Haider, W., Hunt, L., Arlinghaus, R. (2011): The importance of trip context for determining primary angler motivations: are more specialized anglers more catch-oriented than previously believed? *North Am J Fish Mana*. 31: 861-879.

Carlin, C., Schroeder, S.A., Fulton, D.C. (2012): Site choice among Minnesota Walleye anglers: the influence of resource conditions, regulations and catch orientation on lake preference. *North Am J Fish Mana*. 32: 299-312.

Deines, A.M., Adam Bee, C., Katongo, C., Jensen, R., Lodge, D.M. (2013): The potential trade-off between artisanal fisheries production and hydroelectricity generation on the Kafue River, Zambia. *Freshwater Biology*, 58: 640-654.

Jackson, D.C., Marmulla, G. (2001): The influence of dams on river fisheries. *FAO Fisheries technical paper*, (419): 1-44.

Jenkins, R.M., Morais, D.I. (1971): Reservoir sport fishing effort and harvest in relation to environmental variables. *Reservoir fisheries and limnology*. American Fisheries Society, Special Publication, 8: 371-384.

Lothrop, R.L., Hanson, T.R., Sammons, S.M., Hite, D., Maceina, M.J. (2014): Economic impact of a recreational Striped Bass fishery. *North Am J Fish Mana*. 34(2): 301-310.

Leontaritis, A.D., Baltas, E. (2014): Hydrological analysis of the Aaos-Voidomatis Hydrosystem in Greece. *Austin Journal of Hydrology*, 1: 8-14.

McGinnis, M.V. (1994): The politics of restoring versus restocking salmon in the Columbia River. *Restoration Ecology*, 2(3): 149-155.

Novaes, J.L.C., Carvalho, E.D. (2011): Artisanal fisheries in a Brazilian hypereutrophic reservoir. *Brazilian Journal of Biology*, 71: 821-83.

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.