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Testing the reliability and construct validity of a simple and inexpensive procedure to measure the use value of recreational fishing

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There is currently much interest in measuring the economic benefits of recreational fisheries: (a) to defend the sector *per se*, (b) to estimate environmental damage and (c) to improve recreational fisheries management decisions (Arlinghaus, Mehner & Cowx 2002). Because of the inherent difficulty in transferring benefit estimates from one particular location to another, there is an urgent need to value as many recreational fisheries as possible (Arlinghaus *et al*. 2002). In this respect, the survey-based contingent valuation (CV) method has been recommended (e.g. Hudgins & Malvestuto 1996) and used to measure total economic value (TEV; i.e. the sum of use and non-use values) of recreational fishing or fisheries resources (e.g. Navrud 2001). However, there is an ongoing controversy about the reliability of the CV method (Carson 2000). The lack of consensus on standard CV procedures and the potential biases associated with it demand that every CV survey must be designed, implemented, interpreted and reported carefully (Mitchell & Carson 1989). The most pressing need for widespread application is, how to reduce the costs of CV surveys while still maintaining a high degree of reliability (Carson 2000). Therefore, extensive application of the CV method will only be possible in recreational fisheries, if the CV procedures are simple, inexpensive and reliable. This applies because public bodies charged with the management of recreational fisheries often lack personnel with sophisticated economic and econometric skills, and funding to finance large scale valuation projects (Arlinghaus *et al*. 2002).

The most straightforward way of estimating both the benefits generated by angling in local, regional and national economies (economic impact), and also the benefits of the current resource use experienced by an individual angler [net economic value (NEV) or consumer surplus (CS)], is to first ascertain total expenditures (economic impact) and then ask respondents in an open-ended question to estimate the maximum amount over and above those expenditures that they would be willing to pay before they chose to stop angling (e.g. Pollock, Jones & Brown 1994). The latter is a relatively simple approach to estimate willingness-to-pay (WTP – an estimate of NEV or CS) and seems suitable in recreational fishing studies because, in contrast to users of public goods such as clean air or biodiversity, anglers (1) know what their recreational fishing experiences are about, i.e. the good to be valued is well defined and hypothetical, and information bias and scope effects should be minimal, (2) are used to paying for part of the 'quasi public good' angling and thus there is no need for a rather abstract payment vehicle and (3) the series of questions on expenditure make anglers recall and think about how much more money he or she would be willing to pay, which should enhance the accuracy of the elicited maximum WTP values (Hudgins & Malvestuto 1996). Combining open-ended question formats with off-site angler contact methods such as mail or telephone surveys results in a simple and inexpensive CV study.

However, environmental economists have sometimes criticized open-ended question formats and non-personal contact methods as being unreliable (e.g. Mitchell & Carson 1989; Arrow, Solow, Leamer, Portney, Radner & Schuman 1993). Irrespectively, the higher costs of in-person contact methods and the sophisticated econometric skills needed to analyse other question formats such as binary discrete choice formats (e.g. Mitchell & Carson 1989) limit their applicability to recreational fisheries. Nevertheless, every published CV study should contain a reliability

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test to judge the quality of the WTP estimates (Carson 2000). In contrast, some recreational fishing valuation papers using open-ended question formats and non-personal angler contact methods do not document a reliability test within the (scientific) publication (e.g. Peirson, Tingley, Spurgeon & Radford 2001; Toivonen 2002), although the researchers might have checked their results for reliability before publishing. Reliability (i.e. an indication of reproducibility and stability of a measure; Carson, Flores & Meade 2001) can be tested most easily by obtaining a respectable correlation ($r^2 \geq 0.15$) when regressing WTP on a set of independent variables (Mitchell & Carson 1989). Furthermore, if the significant independent variables used are those suggested by theory, regression analysis can also be used to demonstrate construct validity, which is the degree that WTP truly measures the theoretical construct (here NEV or CS) under investigation (Mitchell & Carson 1989). This short note reports a test on reliability and construct validity of a simple and inexpensive CV survey procedure using a mail survey and an open-ended question format to demonstrate the usefulness of this approach and stimulate CV studies in recreational fisheries.

In 2000/2001, a mail and internet survey was conducted among carp anglers living in Germany (see Arlinghaus & Mehner 2003, for details of method). The economic questions started with three detailed queries about annual variable, fixed and holiday expenses on various items. Afterwards, carp anglers were faced with the following open-ended WTP question to estimate NEV or CS over and above real expenditure which amounted to a mean of 5490 € angler^{-1} yr^{-1} (see Arlinghaus & Mehner 2003 for expenditure data):

> The last three questions have provided information about your annual expenses on your hobby. However, angling may be worth more to you than the pure annual expenses expressed in monetary values. Think for example about your benefits derived from your angling experience in general or for example from relaxation. Unfortunately, it is very difficult to measure and compare the benefits of anglers, e.g. the answer 'angling is very valuable for me' is not comparable among anglers. In order to estimate your personal value of the angling experience, we therefore want to go on a circuit and ask you hypothetically: what is the maximum amount that you would be willing to invest annually *over and above* your current annual expenses before you would stop angling. Please consider that you have only your annual income available.

This question format mainly estimated the use value of carp angling (cf. Navrud 2001). The aim of referring: (a) to the self-reported annual expenses of the previous questions; and (b) to the budget constraint was to minimize strategic exaggerations. Furthermore, the wordings of the question made the angler think of additional benefits of angling which were not embraced by real expenditure alone. Lastly, by introducing the valuation question and indicating the difficulty of comparing individual benefits among anglers, the burden of the respondent, refusal rate and protest bids were thought to be reduced.

A stepwise backward multiple linear regression model was used to investigate reliability and construct validity of the WTP amounts as a dependent variable (cf. Mitchell & Carson 1989). The multidimensional theory of angling specialization (reviewed by Hahn 1991) suggests that more highly specialized anglers are emotionally more involved with the activity and thus should experience higher benefits from angling. Therefore, a positive relationship between the degree of angler specialization and the WTP amounts was hypothesized (see Table 1). According to economic theory, income and number of people per household were hypothesized to correlate with WTP because the financial budget and the distribution of income among household members should have a significant influence on WTP (positive for income, negative for people per household). On the other hand, higher numbers of anglers per household were thought to indicate that angling plays a major role in the lifestyle of the household. Therefore, a positive relationship to WTP was assumed (see Table 1). To improve understanding of the factors contributing to WTP, nine motivation sub-dimensions of carp angling (see Arlinghaus & Mehner 2003 for details) were also included as single independent variables into the regression model.

Because of item non-response or refusal to answer the WTP question (protest answer), 8.6% of the 710 questionnaires returned were excluded from the data set. In addition, annual WTP amounts >5113 € (10 000 DM) were considered exaggerations and were deleted from the analysis ($n = 15$). Four per cent of the responding anglers indicated a WTP of zero either because they thought their angling expenses had reached a maximum or were not able to invest more money. These zero values were included in the analysis because they reflected true use value. Based on an adjusted sample size of 634 responses, the descriptive

Table 1. Results of stepwise backward multiple linear regression of several independent variables on willingness-to-pay (WTP; dependent variable) of carp anglers living in Germany. Only the significant variables ($P < 0.05$) are shown

Independent variable	Standardized coefficient	SE	P -value	Effect	
				Predicted	Empirical
Constant	1095.77	225.12	< 0.000		
Gross annual income (€)	0.220	0.003	< 0.000	+	+
Age (years)	−0.167	6.98	0.003	?	–
People per household	−0.089	36.57	0.049	–	–
Angler per household	0.074	76.10	0.049	+	+
Completed apprenticeship (yes = 1, no = 0)	0.103	93.25	0.020	?	+
Specialization*	0.229	13.27	< 0.000	+	+
Social motive†	−0.124	44.09	0.005	?	–

*Index of angling specialization: the higher the index, the more specialized is the angler on carp fishing. The following metric variables were standardized to a z-score (mean = 0, SD = 1): extent of time devoted exclusively to carp fishing, frequency of carp angling, investment in angling, years of carp angling experience, travel distance to preferred water, fish catch. These variables were summed to a specialization index together with the following two dichotomous variables which indicate centrality of angling in the angler's lifestyle: organization in angling club (1 = yes, 0 = no) and specific angling holidays which were undertaken (1 = yes, 0 = no).

†Index of importance of a carp angler attached to the motive of social gathering with friends at the waterside: the higher the index, the more important is the social component of angling. Eight other motivation sub-dimensions were insignificant: importance attached to environment and escape, novelty, trophy fish, experience a fight with the fish, catching fish, consuming fish, public merits and other motivations. The motivation sub-dimensions were created by factorial analysis with principal component extraction and varimax rotation of 25 motivation items (see Arlinghaus & Mehner 2003). Single motivation factor scores were calculated by summing the individual item scores. Then the motivation indices were calculated by standardizing the values to a z-score.

$r^2_{adj} = 0.154$, $F = 10.80$, df = 8 (regression); 474 (residuals), $P < 0.001$, Durbin–Watson = 0.176.

analysis revealed a mean WTP of 881 ± 40 (SE) € angler^{-1} yr^{-1} and a median of 511 € angler^{-1} yr^{-1}. The 5% trimmed mean was 751 € angler^{-1} yr^{-1}. These values greatly exceeded the mean annual WTP values of anglers in the Nordic countries (Toivonen 2002) reflecting the high level of involvement of the carp angler segment (cf. Arlinghaus & Mehner 2003). The mean WTP per angling trip in carp fishing that usually lasts for more than 24 h (Arlinghaus & Mehner 2003) was estimated at 15.6 € trip^{-1}.

The multiple regression model (Table 1) was consistent with theoretical considerations indicating construct validity. The percentage of variance of WTP values explained by the independent variables achieved the reliability threshold level of $r^2 = 0.15$ (Mitchell & Carson 1989). The hypothesis that more specialized carp anglers attach a higher value on fishing, was verified by the model. Furthermore, the variables income, people per household and angler per household behaved as predicted. According to the regression model, younger people indicated higher WTP amounts. Age has often been found to have a negative effect on WTP (Carson *et al.* 2001). This suggests that carp angling benefits younger anglers in particular. The negative effect of the social motive on WTP in carp angling may be explained by the special characteristics of this highly specialized angler segment. For carp anglers fishing is not as much a vehicle to have social contacts at the waterside as compared with less specialized anglers (cf. Arlinghaus & Mehner 2003). Instead, more activity specific components of the angling experience such as mastering challenges, satisfying novelty and adventure needs, and catching trophy fish are more important (i.e. crucial) motives for carp anglers (Arlinghaus & Mehner 2003). Therefore, carp anglers attaching less importance on social motives may be the most deeply involved and committed anglers among carp anglers, and may benefit more and state higher WTP values as compared with those anglers attaching high importance on the social side of angling. The interpretation of a single significant influence of one motivation sub-dimension and one education variable (apprenticeship) remains rather difficult. However, it indicates that sociological measures such as motivations, attitudes and satisfactions may improve the predictive value of CV studies in recreational fishing.

To conclude, CV studies to measure the use value of recreational fisheries using open-ended question formats and mail or telephone contact methods can yield reliable and valid benefit estimates. However, because of the debate about the usefulness of CV studies, the conservative benefit estimates should be taken. Open-ended questions usually result in lower, i.e. more

conservative, WTP values than binary discrete choice questions (Carson 2000), which were recommended by Arrow *et al*. (1993). As arithmetic means are particularly sensitive to extreme WTP values, median WTP or 5% trimmed means are recommended as measures of central tendency in open-ended question formats. Nevertheless, all CV studies published in the literature should include tests on reliability and validity. Further studies are necessary to identify key variables that explain the variance of WTP estimates. Here, attitudes and other sociological measures may be a useful alternative to ordinary sociodemographic variables. This can improve understanding of angler behaviour and ultimately recreational fisheries management.

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