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The Relationship between Personal Commitment to Angling and the Opinions and Attitudes of German Anglers towards the Conservation and Management of the European Eel Anguilla anguilla

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ARTICLE

The Relationship between Personal Commitment to Angling and the Opinions and Attitudes of German Anglers towards the Conservation and Management of the European Eel *Anguilla anguilla*

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Abstract

In response to the dramatic decline of the European eel *Anguilla anguilla* population, the European Union member states developed eel conservation programs. To facilitate program development, a thorough understanding of eel angler perceptions about the degree of the current eel decline, their potential contribution, and their perceptions about the ways forward is important. In 2007, we sent a self-administered mail questionnaire to 640 anglers living in northeastern Germany asking them about a range of eel conservation and management issues. Respondents were segmented according to their degree of eel angling commitment. We tested a range of hypotheses, including whether highly committed eel anglers would feel greater concern about the eel decline than less committed anglers. In contrast to expectations, all identified angler groups had experienced a similarly pronounced eel decline. While high-centrality eel anglers were found to be somewhat more concerned with the decline, they exhibited less willingness to limit current eel angling effort than other anglers to help conserve eels. Highly committed eel anglers also rated the potential contribution of the recreational eel harvest as less important a contributor to the current state of the eel population than did less involved anglers. These findings can be explained by the greater resource dependency of highly committed anglers in light of the belief that recreational harvesting is not a significant issue for eel conservation. We conclude that the evaluation of fisheries conservation and management by differently committed anglers is affected by their perception of contributing to stock declines, the consumptive nature of the fishery, the dependency on the resource to meet experience preferences, and the degree to which potential regulations are perceived as threatening access to a fishery with a limited number of acceptable substitutes.

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The panmictic, catadromous European eel *Anguilla anguilla* population (Als et al. 2011) has dramatically declined in recent years (ICES 2010). Today, the European eel is considered to be outside safe biological limits (ICES 2010). Various oceanic and continental factors are discussed as causes, each with varying degrees of empirical or conceptual support (e.g., Dekker 2008, 2009; ICES 2010). For example, changing oceanic conditions may have impaired the nutrient conditions for eel larvae, as well as the survival rate during the transport towards the Gulf Stream, thereby reducing import of glass eels to European coasts (Friedland et al. 2007; Bonhommeau et al. 2008; Durif et al. 2011). During the continental life phase in freshwaters and coastal areas, the eel population is thought to be negatively affected by factors like overexploitation, pollution, disease, predation and habitat loss (Dekker 2008, 2009; ICES 2008). Although the proximate causes of the alarming decline of eels throughout Europe are not fully understood, conservation actions are urgently needed (Dekker 2009).

Various political initiatives have been undertaken towards conserving the eel population. For example, in 2007, the European eel was listed by Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) to control international trade outside Europe. In the same year, the European Union (EU) implemented a European eel regulation (EC 2007) that forced each Member State to develop its own eel conservation management plans by the end of 2008. The goal of this regulation was to increase or maintain the escapement of the migrating and mature silver eel development stage at a level of 40% or higher than an anthropogenically unaffected state (EC 2007). As a possible tool to achieve this goal, the stricter regulation of recreational eel harvesting was suggested (EC 2007). In this context, studying how various eel angler groups feel about possible eel recreational fishing regulations was warranted to effectively design regulations that minimize stakeholder conflict and provide the greatest potential for socially and biologically, successful fisheries policies (Dorow et al. 2009, 2010). Here, we extend these earlier studies by investigating the full range of opinions and attitudes of anglers concerning causes and consequences of the contemporary eel decline.

Recreational specialization (Bryan 1977) provides a general framework for understanding between-angler variance in cognition (e.g., values, beliefs, attitudes) and behavior. This theoretical framework facilitates the exploration of the diversity among anglers through the segmentation of participants into meaningful subgroups along a continuum from general interest and low involvement to specialized interest and high involvement (Bryan 1977; Ditton et al. 1992; reviewed in Scott and Shafer 2001). With changing specialization, angler values, preferences, attitudes, personal norms, and ultimately, behaviors are expected to predictably and consistently shift (e.g., Bryan 1977; Ditton et al. 1992; Scott and Shafer 2001). Specialization by anglers should therefore influence fisheries-directed and fish population-directed opinions, attitudes, and management preferences, which should also be reflected in angling-related behaviors, such as fishing media use, choice of target species and sizes, and harvesting decisions (Bryan 1977; Ditton et al. 1992). The prevailing empirical evidence supports this view by revealing that anglers differing in degree of specialization also vary in their attitudes, management preferences, and behaviors towards fishing (e.g., Chipman and Helfrich 1988; Fisher 1997; Sutton and Ditton 2001; Arlinghaus et al. 2007). For example, Chipman and Helfrich (1988) showed that highly specialized anglers were more likely to prefer total catch-and-release policies, as well as to favor restrictive harvest regulations, than were less specialized anglers.

Specialization of anglers is a complex, multi-dimensional construct characterized by at least three key subdimensions, namely the behavioral dimension, the cognition-related skill and knowledge dimension, and an affective dimension related to the centrality of fishing in one's lifestyle (Scott and Shafer 2001). Degree of specialization of anglers has been measured by either employing relatively simple, categorical, self-classification scales designed to capture all of the above-mentioned subdimensions in a narrative way (e.g., Needham et al. 2009) or with the help of quantitative indices designed to measure selected subdimensions on the same subjects. These quantitative indices have then been used either alone (e.g., Ditton et al. 1992) or in combination (Chipman and Helfrich 1988; Fisher 1997; Hutt and Bettoli 2007) to index an angler's degree of specialization and to subsequently test hypotheses about the relation of specialization to a range of dependent variables, such as angling motives and media use (e.g., Ditton et al. 1992; Fisher 1997; Hutt and Bettoli 2007). However, despite numerous recreational fishing studies using the recreation specialization framework, agreement on the operationalization of the multidimensional concept has not been reached (e.g., Scott and Shafer 2001; Arlinghaus and Mehner 2005; Oh and Ditton 2008). No subdimensions of specialization is likely to fully capture all facets of the concept as originally described by Bryan (1977), and correlations found using subdimensions may or may not relate to the overall concept of specialization. Therefore, confusion over the meaning and relevance of angler specialization exists among the research and management community, causing uncertainty over how to reliably measure it. One way out of this dilemma is to focus on a subset of the three identified subdimensions to assess angler involvement with fishing and the consequence of this involvement for angler cognitions and behaviors (Scott and Shafer 2001). One of the candidate subdimensions relates to commitment. A strong personal and behavioral commitment indicates that a specific leisure activity, such as fishing, is a central life interest, reflecting high personal involvement and psychological attachment to it (Kim et al. 1997; Scott and Shafer 2001).

Against this background, the centrality-to-lifestyle construct (Kim et al. 1997) indicates the extent to which a participant's lifestyle is connected to a specific leisure activity such as recreational fishing (Sutton and Ditton 2001; Sutton 2003; Dorow et al. 2010), allowing one to operationalize the degree to which angling is central to anglers' lives. This construct combines

personal and behavioral commitment aspects in one scale (Kim et al. 1997). Because of the close connection between centrality-to-lifestyle and social-psychological involvement into a leisure activity (Kim et al. 1997), it is theoretically sound to assume that high-centrality anglers are more specialized in the spirit of Bryan (1977), thereby exhibiting greater resource dependency than low-centrality anglers (Ditton et al. 1992). This may then relate to a greater concern for conservation of the resource base (Ditton et al. 1992; Sutton and Ditton 2001). Consistent with this assumption, degree of centrality was found to correlate positively with self-perceived ecological and fisheries knowledge level about fisheries resources (Li et al. 2010), and several empirical studies in recreational fishing have shown the relationship of centrality-to-lifestyle and conservation-oriented attitudes and behaviors of anglers, such as increasing support for restrictive harvest regulations involving mandatory catch-and-release of all or selected size-classes for more committed anglers (e.g., Sutton and Ditton 2001; Hutt and Bettoli 2007). However, heightened concern for the status of the European eel population and acceptance of tighter regulations for conservation fisheries of interest shall only occur if access to the resource is guaranteed (Dorow et al. 2010). Indeed, some studies in consumptive-oriented (i.e., harvest) fisheries have found that committed anglers may exhibit less rather than more willingness to accept constrained harvesting (Wilde and Ditton 1999; Dorow et al. 2010) or limited access to the resource (Salz and Loomis 2005; Dorow et al. 2010) to conserve fish stocks. Therefore, the degree to which high-centrality anglers accept regulations and are willing to constrain personal behavior is expected to be dependent on trading the benefits of fishing against the personal costs of fish conservation.

To further explore the relationship between angler commitment and their understanding, opinions, and attitudes toward fisheries conservation and management, we investigated various European eel conservation and management issues as perceived by anglers differing in eel angling commitment. Previously, it was shown, using discrete choice experiments in the same angler population, that various eel angler groups exhibited pronounced differences in their willingness to tradeoff fishing regulations (e.g., minimum size limits, daily bag limits, and temporal effort controls) against eel catch prospects; high-centrality anglers were less accepting of overly strict regulations than fishers who were involved only casually (Dorow et al. 2010). In addition, eel anglers are, on average, willing to accept modest eel angling regulations (e.g., some modest increase in minimum-size limits or a modest decrease in bag limits) provided other potential sources of eel mortality (e.g., hydropower, commercial fishing) are jointly addressed in integrated management programs (Dorow et al. 2009). Here, we extend these studies by examining how differently committed eel anglers perceive the reasons for the current eel decline and how they judge their personal contribution to it. In contrast to the studies by Dorow et al. (2009, 2010), we use traditional opinion-type survey methods to provide answers to our study objective. To identify heterogeneity within the angler population in terms of their perceptions about eel management we applied the concept of centrality-to-lifestyle as an index of personal commitment to the eel population. In accordance with predictions from the angler specialization framework (e.g., Bryan 1977; Ditton et al. 1992; Salz and Loomis 2005; Oh and Ditton 2006, 2008; Morgan and Soucy 2008), we hypothesized that highly committed anglers should be more aware than less involved anglers of the target fish species decline and be more informed about underlying biological reasons. Because eel populations in Europe are in sharp decline across most catchments, we also expected committed eel anglers to have also perceived the contemporary eel decline as greater than did less avid eel anglers. Further, committed anglers typically have more mediated interactions (Ditton et al. 1992). Consequently, we expected high-centrality eel anglers to have had greater exposure to media coverage of the current eel decline. Finally, we expected committed anglers to be less willing to sacrifice future consumptive use of the local eel subpopulations than would less committed anglers because of the absence of acceptable substitute species and scientific evidence attributing recreational eel harvest to the eel decline (Dorow et al. 2010).

METHODS

Study area and the recreational eel fishery.—The study was conducted with anglers fishing in the German state of Mecklenburg-Vorpommern, located in northeast Germany. European eels are found along the coast and in all flowing and most standing freshwaters of Mecklenburg-Vorpommern, and are exploited by commercial and recreational fisheries (Winkler et al. 2007; Dorow and Arlinghaus 2011). In the surveyed region, eels are rated highly for their consumptive value (Dorow et al. 2010), where almost every legal sized eel (minimum size limit of 45–50 cm, raised to 50 cm in 2009) is retained. The current daily bag limit across the state is usually three eel per day, but this varies with the fishing rights holder. A seasonal closure of eel harvesting from December to February was implemented in Mecklenburg-Vorpommern in 2009. Eels are mainly targeted at night, and eel anglers usually take short trips with a mean duration of 8.9 h (SE = 1.06). Eels are often targeted jointly with other species such that eel effort represents a fraction of the rods deployed. On average, mean per-trip effort targeting eels is 4.8 h (SE = 0.24). Around 50% of the resident anglers in Mecklenburg-Vorpommern targeted eel at least once during a given year's fishing season (Dorow et al. 2010). In 2006–2007, the total recreational eel take in Mecklenburg-Vorpommern amounted to about 187 metric tons compared with about 136 metric tons taken by commercial eel fishing (Dorow and Arlinghaus 2011).

Eel angler survey.—Our 15-page self-administered mail questionnaire survey quantified the heterogeneity in how anglers, who fished in Mecklenburg-Vorpommern in 2006–2007, perceived various eel conservation and management aspects. To segment the respondents into subgroups, we measured personal and behavioral commitment to eel fishing, using the concept of

centrality to lifestyle (Kim et al. 1997; Sutton 2003). Higher centrality to lifestyle reflects greater importance of European eel angling for self-expression and increased affinity with eel as target species. From the published centrality-to-lifestyle scale applied to recreational fishing by Sutton (2003), we selected a subset of the original items (four of nine) and slightly reworded and translated them for use in a context of eel angling (e.g., "I find that a lot of my life is organized around eel fishing"). This was done to increase its saliency for the target population and to reflect cultural particularities of the German public because the pretest revealed some reservations about the wording of the original item list. Five original items that were not considered in our application were replaced by four self-developed statements that highlighted the intensity with which eel is targeted by the respondents (e.g., "Eel is only bycatch when I target other fish species") or the impact of hypothetical restrictions of eel fishing for lifestyle quality (e.g., "Stricter eel angling regulation would definitely reduce my overall angling quality"). Anglers were asked to evaluate each item of the final eight-item scale on a five-point Likert agreement scale ranging from 1–5, where 1 is strongly agree and 5 is strongly disagree.

A number of dependent variables measuring the perceptions, beliefs, and attitudes of anglers towards the eel decline, the underlying reasons, and the appropriate way forward were assessed. Regarding the perception of the eel decline, anglers were asked if they received media information about the decline in the year 2006. Further, anglers were asked to indicate the year in which they personally caught the most eels in their angling career. Respondents were then asked about any perceived eel decline since this record year; they assessed that on a five-point scale (strongly decreased to strongly increased eel populations). Anglers who indicated that the eel stock had declined were further asked to rate the degree of the perceived decline (as a percentage) since the self-reported record angling year. These questions about the perceived eel decline were designed to measure whether anglers perceived a current eel decline in agreement with biological data indicating a sharp reduction to 1–7% of the maximum recruitment in the 1970s (ICES 2008).

To investigate angler perceptions about causes for the decline, respondents evaluated nine items on a five-point scale (no influence to very strong influence on the eel population). Currently discussed factors contributing to the current eel decline including oceanic (e.g., climate change) and continental factors (e.g., hydropower, commercial and recreational fishing; ICES 2007, 2008; Dekker 2009) were included. Furthermore, we were especially interested in how anglers perceived their own potential to negatively impact the eel population by harvesting. To this end, we constructed three items, each displaying a different degree of impact by the recreational eel fishery on the eel population in the study region (e.g., "Recreational eel harvest in Mecklenburg-Vorpommern is not related to the Europe-wide eel decline").

Finally, we were interested in the perception of the need for eel conservation measures and the appropriate way forward. The anglers' general perception of the necessity of eel conservation efforts was measured by asking if there is a need for an eel conservation program in Mecklenburg-Vorpommern. Furthermore, anglers were asked to evaluate five items designed to measure their general perception of the conservation need in greater detail using a five-point Likert agreement scale as described before (e.g., "Eel should be better protected in Mecklenburg-Vorpommern because it is an important native fish species"). We also assessed angler's perception about the appropriate way forward in terms of implementation of successful and acceptable conservation measures aimed to increase the number of migrating silver eels. To this end, anglers first rated statements (five-point Likert agreement scale) about possible regional management measures, including stricter eel angling regulations. Second, to investigate the anglers' perception about the adequate institutional level for the implementation of an eel conservation program, the participants were also asked to rate the effectiveness of different executive levels extending from the European scale to acting on the local waterbody level (five-point scale from highly ineffective to highly effective).

The questionnaire was mailed along with a personalized cover letter and an incentive (lanyard keychain) to 640 randomly chosen active anglers fishing in Mecklenburg-Vorpommern. After the mail-out in mid-January 2007, one reminder telephone call 2 weeks later was used to encourage participation. All surveyed anglers were also participants in a 1-year diary study (Dorow and Arlinghaus 2011). Thus, basic socio-demographic and recreational fishing data were gathered for every surveyed angler. These data were utilized to compare the angler segments regarding general and eel-specific behavioral commitment characteristics (e.g., targeted eel trips) and for comparison between respondents and nonrespondents to test for potential nonresponse bias (see Dorow et al. 2009; for details).

Statistical analysis.—To identify segments of anglers differing by eel angling commitment, the centrality of eel angling items were subjected to principal component analysis (using varimax rotation) to detect the factor structure of the scale. A reliability analysis was then used on all items, loading heavily on each factor to justify creation of an eel angling centrality scale; this was based on the item means of each factor (considering item nonresponse), a Cronbach's alpha >0.7 reflecting a satisfactory internal reliability (Cortina 1993). Factor analysis resulted in an expected one-factor solution (i.e., one dimension of eel angling centrality), explaining 55% of the observed variance (Table 1). By applying a Ward hierarchical cluster analysis on the eel angling centrality-scale factor score, we defined three clusters of eel anglers, which differed in their degree of eel angling centrality. Differences in the rating of the centrality dimension (using the mean score of the eel angling centrality scale) and the rating of all individual items forming the dimension for eel angling centrality were subsequently tested among the three clusters using one-way analysis of variance (ANOVA) and appropriate posthoc tests (Tukey for homogenous variances, Dunnett-T-3 for heterogeneous variances, variance

TABLE 1. Eel angling centrality scale and contrast among three eel angler segments (low, medium, and high centrality). Also provided are measures of behavioral commitment towards angling in general and eel fishing in particular. Different letters indicate statistically significant differences between the angler centrality-group means.

Variable	Low centrality ($N = 100$)		Medium centrality ($N = 180$)		High centrality ($N = 112$)				
	Mean	SE	Mean	SE	Mean	SE	F	df	P
Centrality of eel angling fishing scale									
Eel angling centrality scale mean score[a] (Cronbach's $\alpha = 0.89$)	4.2 z	0.04	3.1 y	0.05	2.1 x	0.04	396.5	391	<0.001
My interest in eel angling is rather low[a]	2.1 z	0.08	2.8 y	0.06	3.9 x	0.11	126.3	374	<0.001
Eel angling restrictions would not bother me because eel does not mean a lot to me compared with other fish species[a]	2.0 z	0.08	3.0 y	0.09	4.3 x	0.08	211.9	377	<0.001
Eel is only bycatch when I target other fish species[a]	2.0 z	0.08	3.0 y	0.09	4.3 x	0.08	152.7	375	<0.001
When targeting eel I use mostly one specific method with specific bait	4.1 z	0.11	2.8 y	0.08	1.9 x	0.07	141.5	361	<0.001
Compared with other anglers, I consider myself to be somewhat an expert in eel angling	4.4 z	0.07	3.7 y	0.06	2.9 x	0.08	94.8	371	<0.001
Other fishing methods or fish species don't interest me as much as eel angling	4.2 z	0.07	3.2 y	0.05	2.1 x	0.06	266.9	378	<0.001
I find that a lot of my life is organized around eel fishing	4.6 z	0.05	3.8 y	0.05	2.8 x	0.08	179.2	376	<0.001
Stricter eel angling regulation would definitely reduce my overall angling quality	4.2 z	0.08	3.1 y	0.07	1.8 x	0.09	193.0	377	<0.001
Behavioral commitment[b]									
Number of angling trips (per year)	20.6 zy	1.63	19.7 z	1.19	27.8 y	2.64	6.0	312	<0.05
Number of eel angling trips (per year)	1.2 z	0.29	2.3 z	0.37	8.1 y	1.18	27.9	312	<0.001
Number of eels caught (per year)	1.1 z	0.33	2.0 z	0.39	8.3 y	1.48	21.4	312	<0.001
Number of eels retained (per year)	0.9 z	0.28	1.7 z	0.34	6.9 y	1.32	19.1	312	<0.001
Eel retention rate (%)	78.1	7.27	85.8	3.5	83.0	5.24	0.4	133	0.70
Mean total angling effort (h) on a trip day with eel as a targeted species	7.1	1.06	8.5	1.64	10.0	1.84	0.5	163	0.59
Mean eel-specific effort (h) on a trip day with eel as targeted species	4.0 z	0.47	4.2 zy	0.26	5.6 y	0.44	4.51	163	<0.05
Importance of eel									
Importance of eel as a target species[c]	4.0 z	0.09	3.2 y	± 0.07	2.0 x	0.07	138.3	387	<0.001

[a]Answered on a five-point scale: 1 = strongly agree, 2 = agree, 3 = neutral, 4 = disagree, and 5 = strongly disagree. To construct the combined centrality index, the first three items were inverse-coded, a low mean score indicating high eel angling centrality.

[b]Values were calculated based on the information provided by respondents completing a 1-year diary study (Dorow and Arlinghaus 2011).

[c]Scale: 1 = most important, 2 = second-most important, 3 = third-most important, 4 = one species among others, and 5 = not a targeted species.

homogeneity tested using Levené tests). The resulting three angler groups were further compared regarding a number of alternative variables related to revealed behavioral commitment (e.g., fishing frequency) and demographic characteristics to validate the segmentation approach.

To detect significant differences between the three angler groups regarding their perception of the various eel conservation and management issues, all items were compared via ANOVA and appropriate posthoc tests as described above for quasi-metrical variables (i.e., rating scales); chi-square analysis

was used for categorical variables. In all tests, statistical significance was assessed at $\alpha = 0.05$. All analyses were conducted with SPSS 11.0 (SPSS Inc., Chicago, Illinois).

RESULTS

In total, 392 completed questionnaires were returned, resulting in a response rate of 61%. No significant differences between respondents and nonrespondents existed regarding age, monthly income, educational level, importance of angling and angling experience. However, nonrespondents, on average, fished less frequently (mean = 23.1 trips/year, SE = 2.2) than respondents (30.8 trips/year, SE = 2.4), suggesting some level of avidity-bias in our survey, but his should not affect the validity of any among-angler group contrasts.

Angler Segmentation

Our eel angling centrality index was characterized by high internal reliability (Cronbach's $\alpha = 0.89$; Table 1). By means of Ward cluster analysis, three eel angler segments were identified, which were labeled low-centrality eel anglers ($N = 100$, 25.5%), medium-centrality eel anglers ($N = 180$, 45.9%) and high-centrality eel anglers ($N = 112$, 28.6%). As expected, the three eel angler groups significantly differed in their evaluation of the average centrality of eel fishing index ($F = 396.5$, df = 391, $P < 0.001$), as well as all eight individual items of the centrality index (Table 1). For example, high-centrality eel anglers more strongly disagreed with items emphasizing general eel angling involvement (e.g., "My interest in eel angling is rather low") than did medium-centrality and low-centrality eel anglers. Similarly, on positively worded items measuring the degree of eel angling commitment (e.g., "I find that a lot of my life is organized around eel fishing"), high-centrality eel anglers expressed significantly greater agreement than the other two groups. Accordingly, high-centrality eel anglers can be safely assumed to be characterized by a higher commitment to eel angling than medium-centrality eel anglers, low-centrality eel anglers showing the lowest degree of personal bonding to eel angling and to eel as a target species.

As expected, the three angler segments also differed regarding various measures of revealed (i.e., actual not just stated) behavioral commitment and the importance of eel as a fisheries resource (Table 1). For example, angler groups differed in their angling frequency in general and eel angling behavior specifically during the angling season between September 2006 and August 2007. Generally, high-centrality eel anglers fished more often and also fished significantly more frequently for eels than did the other two groups (Table 1). High centrality eel anglers also valued the importance of eel as a targeted species significantly higher than the other two angler groups ($F = 138.3$, df = 387, $P < 0.001$). High-centrality eel anglers also captured and retained more eel per year than the other anglers, indicating their greater eel fishing successes. However, the average very high eel retention rate (mean = 83.3%, SE = 3.0) was not significantly different among angler segments, reflecting the consumptive nature of eel recreational fishing in the study region. The identified angler segments exhibited no differences regarding the overall effective angling duration for angling trips targeting eel (Table 1). However, high-centrality anglers directed a greater proportion of time to targeting eel during eel trips than did low-centrality anglers ($F = 4.51$, df = 163, $P < 0.05$). Overall, the segmentation approach based on the centrality of eel angling was supported by various additional measures of behavioral eel angling commitment and the importance of eel as the target species, but all anglers, independent of centrality levels, were found to be highly harvest-oriented fishers.

In terms of demographics, high centrality eel anglers (40.6 years, SE = 1.4) were found to be significantly ($F = 6.9$, df = 391, $P < 0.05$) younger than low-centrality (47.6 years, SE = 1.4) and medium centrality eel anglers (46.0 years, SE = 1.2). Among the eel angler groups no significant differences were found in average household income ($\chi^2 = 8.8$, df = 10, $P = 0.55$) and educational levels ($\chi^2 = 6.4$, df = 10, $P = 0.78$).

Perceptions of the Eel Decline and Reasons

About 60% of all anglers surveyed stated they had been exposed to media information about the current eel decline during the year of 2006, and there were no statistical differences in media exposure among angler segments (low centrality = 65.7%, medium centrality = 59.0%, high centrality = 68.5%; $\chi^2 = 2.94$, df = 2, $P = 0.23$). Similarly, most members of each of the three angler segments indicated their personal eel record year to have been in the period 1986–1990 (mean value for low-centrality eel anglers = 1986, SE = 1.78; medium centrality = 1990, SE = 1.25; high centrality = 1990, SE = 1.07), and no significant differences among angler segments emerged ($F = 1.94$, df = 212, $P = 0.15$). All anglers also shared perspectives about the eel stock since the record year, the vast majority (>90%) indicating a decline or even a strong decline of the eel population ($\chi^2 = 5.89$, df = 4, $P = 0.21$). The magnitude of the eel decline in Mecklenburg-Vorpommern was also perceived similarly by all surveyed angler groups, ranging from an average 66.0% (SE = 3.08) less eel since the record year for low centrality anglers, followed by a perceived decline by an average 57.0% (SE = 2.01; medium centrality) and 58.9% (SE = 2.22; high centrality; $F = 2.67$, df = 215, $P = 0.07$).

In terms of perceptions about possible reasons for the current eel decline, the angler population held relatively consistent views about the most prominent drivers of impact on eel (Table 2). On average across all angler segments, and in ascending order of perceived importance, the following reasons were important and received average scores exceeding the scale's midpoint of 3: destruction of migrating ways, commercial fishing in the study region, eel predation by cormorants *Phalacrocorax carbo*, and commercial fishing on glass eels outside the study region. All angler segments perceived eel harvest by recreational fishing to have the lowest impact, followed by parasite infections, reduced glass eel production through climate change, and pollution and contamination (all average scores < 3; Table 2). Perceptions about most impact factors

TABLE 2. Recreational angler perceptions of the possible reasons for the decline of European eels in Mecklenburg-Vorpommern (M-V) on a five-point scale (1 = no influence, 2 = minor influence, 3 = medium influence, 4 = strong influence, and 5 = very strong influence). Different letters indicate statistically significant differences in mean perceptions among angler segments.

Eel angler centrality group (N)	Mean perception score ± SE	Distribution by angler perception (%)		
		No influence + minor influence	Medium influence	Strong + very strong influence
Eel harvest by recreational fishery (overall mean ± SE = 2.0 ± 0.04; $F_{367} = 2.70$, $P = 0.07$)				
Low (93)	2.1 ± 0.08	73.2	20.4	6.5
Medium (166)	2.0 ± 0.07	79.5	15.1	5.4
High (109)	1.9 ± 0.07	88.1	9.2	2.7
Parasite infections (overall mean ± SE = 2.3 ± 0.05; $F_{287} = 0.1$, $P = 0.91$)				
Low (60)	2.3 ± 0.10	66.6	25.0	8.3
Medium (132)	2.2 ± 0.07	62.9	30.3	6.9
High (96)	2.3 ± 0.10	74.0	13.5	12.5
Reduced glass eel production due to climate change (overall mean ± SE = 2.4 ± 0.06; $F_{303} = 1.32$, $P = 0.27$)				
Low (72)	2.4 ± 0.13	61.1	25.0	13.9
Medium (136)	2.5 ± 0.09	50.0	32.4	17.7
High (96)	2.3 ± 0.11	57.3	27.1	15.6
Hydropower use (overall mean ± SE = 2.8 ± 0.07; $F_{314} = 4.10$, $P < 0.05$)				
Low (78)	2.6 ± 0.12 z	51.3	30.8	17.9
Medium (137)	2.7 ± 0.10 zy	42.2	33.6	24.1
High (100)	3.0 ± 0.12 y	38.0	21.0	41.0
Pollution and contamination (overall mean ± SE = 2.8 ± 0.06; $F_{349} = 0.08$, $P = 0.92$)				
Low (87)	2.9 ± 0.12	44.8	25.3	29.8
Medium (158)	2.8 ± 0.09	45.0	25.9	29.2
High (105)	2.8 ± 0.11	43.8	29.5	26.6
Destruction of migrating ways (overall mean ± SE = 3.3 ± 0.06; $F_{356} = 2.32$, $P = 0.10$)				
Low (90)	3.0 ± 0.12	35.6	27.8	36.7
Medium (157)	3.3 ± 0.10	28.0	21.7	50.4
High (110)	3.4 ± 0.11	21.8	27.3	50.9
Commercial fishing in M-V (overall mean ± SE = 3.7 ± 0.05; $F_{350} = 0.77$, $P = 0.46$)				
Low (88)	3.8 ± 0.10	7.9	25.0	67.1
Medium (158)	3.7 ± 0.08	14.0	22.2	64.0
High (105)	3.8 ± 0.10	14.3	19.0	66.7
Predation by cormorants (overall mean ± SE = 3.9 ± 0.06; $F_{363} = 1.13$, $P = 0.32$)				
Low (93)	3.9 ± 0.12	14.0	21.5	64.5
Medium (166)	3.9 ± 0.09	15.0	16.3	68.7
High (105)	4.1 ± 0.10	9.5	17.1	73.3
Commercial fishing outside M-V (e.g., glass eel fishery; overall mean ± SE = 4.2 ± 0.06; $F_{314} = 2.73$, $P = 0.07$)				
Low (75)	4.2 ± 0.12	6.7	9.3	84.0
Medium (142)	4.1 ± 0.10	11.2	12.7	76.1
High (98)	4.4 ± 0.10	7.2	5.1	87.7

did not differ significantly among the angler segments, with one notable exception. High-centrality eel anglers perceived the impact of hydropower significantly more strongly than low-centrality eel anglers ($F = 4.10$, df = 314, $P < 0.05$).

Overall, angler segments were similar in their perceptions about recreational eel fishing contributing to eel population decline (Table 3). In general, anglers did not perceive themselves as contributing significantly to the decline. For example, over 70% of all anglers agreed with the item that "Recreational eel harvest in Mecklenburg-Vorpommern is not related to the European-wide eel decline," with no significant differences between the angler segments present ($F = 0.97$, df = 383, $P = 0.38$).

TABLE 3. Degree of angler agreement with three statements relating recreational eel fishing to the current stock decline in Mecklenburg-Vorpommern on a five-point scale (1 = strongly agree, 2 = agree, 3 = neutral, 4 = disagree, and 5 = strongly disagree). Note that in the percentage distribution the category "agree" includes scores 1 and 2 and the category "disagree" includes scores 4 and 5. Different letters indicate statistically significant differences in mean evaluations among angler segments.

Eel angler centrality group (N)	Mean perception score ± SE	Distribution by angler agreement (%)		
		Agree	Neutral	Disagree
Recreational eel harvest in M-V is not related to the Europe-wide eel decline (overall mean ± SE = 2.1 ± 0.05; $F_{383} = 0.97$, $P = 0.38$)				
Low (99)	2.2 ± 0.10	69.7	19.2	11.1
Medium (173)	2.1 ± 0.08	75.1	12.1	12.7
High (112)	2.0 ± 0.10	77.7	9.8	12.5
Because of the several thousand eel anglers in M-V eel overfishing on the local scale is possible (overall mean ± SE = 3.4 ± 0.06; $F_{377} = 4.58$, $P < 0.05$)				
Low (95)	3.3 ± 0.12 zy	28.4	21.1	50.5
Medium (172)	3.2 ± 0.09 z	33.1	18.6	48.3
High (111)	3.6 ± 0.10 y	17.1	22.5	60.4
Tighter eel angling regulations are necessary to prevent eel overfishing by anglers (overall mean ± SE = 3.5 ± 0.06; $F_{380} = 6.31$, $P < 0.05$)				
Low (97)	3.4 ± 0.12 zy	24.7	23.7	51.5
Medium (172)	3.3 ± 0.09 z	29.7	20.9	49.4
High (112)	3.8 ± 0.11 y	18.8	15.2	66.1

Similarly, around half of each angler segment disagreed with the items "Because of several thousand eel anglers in Mecklenburg-Vorpommern eel overfishing on the local scale is possible" and "Tighter eel regulations are necessary to prevent eel overfishing by anglers" (Table 3). In contrast to the first statement, significant differences in the evaluation of the overfishing aspect ($F = 4.58$, df = 377, $P < 0.05$) and the need of stricter angling regulation ($F = 6.31$, df = 380, $P < 0.05$) existed between the angler segments. Here, high-centrality eel anglers expressed significantly higher disagreement to both statements. Because of the significant differences on these two statements, we concluded that eel anglers characterized by a higher eel angling centrality evaluated the potential contribution of recreational eel take less dramatically than did less involved anglers. Furthermore, the idea that stricter regulatory policies for recreational eel fishing are needed was, on average, rejected by all angler segments. This rejection was more pronounced in the high-centrality segment.

Perceptions of Eel Conservation Needs and Strategies

When investigating the perception of anglers for eel conservation (Table 4), all angler segments disagreed with the statements that "The current discussion about the eel decline and the eel conservation in Mecklenburg-Vorpommern is exaggerated" (average score >3). However, high-centrality anglers more strongly disagreed with it than did the other two groups ($F = 6.92$, df = 375, $P < 0.05$). About 70% of all anglers, irrespective of their eel angling commitment level, thought that "Eel should be better protected in Mecklenburg-Vorpommern, because it is an important native fish species," and more than 80% of all surveyed anglers believed that "Without an effective eel management program the risk of a nonuseable eel stock in the future exists in Mecklenburg-Vorpommern." Around 95% of all surveyed anglers of each segment agreed with the statement that "As anglers we should do everything possible so that future generations can fish for eel in Mecklenburg-Vorpommern." Angler segments varied more in their evaluation of the item "If a native fish species like the eel is endangered anglers should reduce targeting effort on such species," indicated by average agreement levels across angler segments that were more close to the neutral category (Table 4). Most importantly, high-centrality anglers, on average, disagreed with this statement, and the difference in the disagreement level was significant compared with the two other angler groups ($F = 18.78$, df = 383, $P < 0.001$). This indicated that while high-centrality eel anglers were more concerned with the current eel decline (i.e., holding less belief in the current eel decline being exaggerated), they exhibited less willingness to modify current eel angling effort than did other anglers.

Anglers overwhelmingly (93%) agreed on the necessity of implementing an eel conservation program, and all angler segments shared this perspective (agreement by low-centrality eel anglers = 91.8%, medium centrality = 92%, and high centrality = 95.4%; $\chi^2 = 1.44$, df = 2, $P = 0.14$). When presented with a series of statements designed to assess angler opinions about suitable approaches to increase the eel population, angler groups also shared opinions on a number of issues but disagreed on aspects related to eel stocking and reduction of angling effort (Table 5). In particular, all angler segments agreed, on average,

TABLE 4. Degree of angler agreement with statements about their attitudes toward eel conservation issues in Mecklenburg-Vorpommern on a five-point scale. See the caption to Table 3 for additional information.

Eel angler centrality group (N)	Mean perception score ± SE	Distribution by angler agreement (%)		
		Agree	Neutral	Disagree
The current discussion about the eel decline and the eel conservation in M-V is exaggerated (overall mean ± SE = 3.4 ± 0.06; $F_{375} = 6.92$, $P < 0.05$)				
Low (93)	3.3 ± 0.11 z	23.7	30.1	46.2
Medium (172)	3.3 ± 0.08 z	25.0	29.1	45.9
High (111)	3.7 ± 0.10 y	13.5	22.5	64.0
Eel should be better protected in M-V because it is an important native fish species (overall mean ± SE = 2.1 ± 0.04; $F_{382} = 0.22$, $P = 0.80$)				
Low (97)	2.2 ± 0.09	72.2	20.6	7.2
Medium (174)	2.1 ± 0.06	74.7	19.5	5.7
High (112)	2.2 ± 0.09	73.7	17.9	8.9
Without an effective eel management program the risk of a nonuseable eel stock for the future in M-V exists (overall mean ± SE = 1.9 ± 0.04; $F_{377} = 0.79$, $P = 0.46$)				
Low (96)	1.9 ± 0.07	80.2	18.8	1.0
Medium (171)	1.9 ± 0.06	84.8	12.9	2.3
High (111)	1.8 ± 0.07	83.8	15.3	0.9
As anglers we should do everything possible so that future generations can fish for eels in M-V (overall mean ± SE = 1.6 ± 0.03; $F_{384} = 2.31$, $P = 0.10$)				
Low (99)	1.6 ± 0.06	98.0	0.0	2.0
Medium (174)	1.7 ± 0.05	96.0	2.9	1.1
High (112)	1.5 ± 0.06	95.5	3.6	0.9
If a native fish species like the eel is endangered, anglers should reduce targeting effort on such species (overall mean ± SE = 2.7 ± 0.06; $F_{383} = 18.78$, $P < 0.001$)				
Low (98)	2.3 ± 0.11 z	73.5	9.2	17.3
Medium (175)	2.7 ± 0.08 y	50.9	24.6	24.6
High (111)	3.2 ± 0.10 x	31.5	26.1	42.2

with the statements that a substantial cormorant reduction as well as a reduction of the commercial eel fishery would raise the number of silver eels substantially (Table 5). Further, all segments generally favored the idea that reducing the influence of hydropower would increase the number of migrating eels (Table 5). Overall, the statement "Stocking programs provide the chance to increase the number of migrating eel" received the highest support (89.3%), and agreement with this statement was significantly stronger by highly committed eel anglers than the least committed group ($F = 4.75$, df = 384, $P < 0.05$). Opinions also differed significantly among angler groups related to the item "Tighter eel angling regulations would lead to an increasing number of migrating eel." On average, anglers disagreed with this idea, but high-centrality anglers disagreed significantly more strongly than low-centrality eel anglers ($F = 9.65$, df = 376, $P < 0.001$).

Anglers were finally asked about the appropriate scale for implementing conservation actions for eels (Table 6). While all organizational levels from the EU level to the local level were perceived, on average, as effective means for the implementation of eel conservation programs, the average perceived effectiveness exhibited the highest scores for acting locally, and the lowest scores for acting at the EU level. There were no significant differences among eel angler segments on this question.

DISCUSSION

We initially assumed that anglers characterized by high levels of personal bonding to their target species should be more aware about declines and vulnerabilities of their favorite fisheries resources (Bryan 1977; Ditton et al. 1992; Morgan and Soucy 2008). Further, these more committed anglers typically have a greater degree of media use (Ditton et al. 1992). Consequently, we expected high-centrality eel anglers to have been exposed to a greater extent to the current European eel decline through various media channels. These expectations were not strongly supported in our study because all surveyed angler groups reported similar exposure to media reports about the eel decline. Moreover, all angler segments, on average, shared the same period for their personal eel record year (1986–1990) and had

TABLE 5. Degree of angler agreement with statements about possible ways to increase the number of migrating eels in Mecklenburg-Vorpommern on a five-point scale. See the caption to Table 3 for additional information.

Eel angler centrality group (N)	Mean perception score ± SE	Distribution by angler agreement (%)		
		Agree	Neutral	Disagree
More eels could migrate if the cormorant population were substantially reduced (overall mean ± SE = 1.9 ± 0.05; $F_{376} = 9.65$, $P = 0.24$)				
Low (96)	1.9 ± 0.10	82.3	11.5	6.3
Medium (171)	1.9 ± 0.07	77.2	15.8	7.0
High (110)	1.7 ± 0.08	84.5	10.9	4.5
Stocking programs provide the chance to increase the number of migrating eels (overall mean ± SE = 1.8 ± 0.04; $F_{384} = 4.75$, $P < 0.05$)				
Low (97)	2.0 ± 0.07 z	88.7	7.2	4.1
Medium (176)	1.9 ± 0.05 zy	84.7	13.6	1.7
High (112)	1.7 ± 0.06 y	94.6	4.5	0.9
Reducing the commercial eel harvest would positively influence the migrating eel stock (overall mean ± SE = 2.1 ± 0.05; $F_{382} = 1.96$, $P = 0.14$)				
Low (99)	2.1 ± 0.09	72.7	20.2	7.1
Medium (172)	2.2 ± 0.07	62.2	29.1	8.7
High (112)	2.0 ± 0.09	72.3	19.6	8.0
A reduction of the influence of hydropower would increase the number of migrating eels (overall mean ± SE = 2.6 ± 0.05; $F_{337} = 0.53$, $P = 0.59$)				
Low (81)	2.6 ± 0.09	39.5	50.6	9.9
Medium (153)	2.6 ± 0.07	41.2	44.4	14.4
High (104)	2.5 ± 0.09	48.1	42.3	9.6
Tighter eel angling regulations would lead to an increasing number of migrating eels (overall mean ± SE = 3.3 ± 0.05; $F_{376} = 9.65$, $P < 0.001$)				
Low (97)	3.0 ± 0.10 z	36.1	29.9	34.0
Medium (169)	3.3 ± 0.07 z	20.1	34.9	45.0
High (111)	3.6 ± 0.09 y	17.1	22.5	60.4

experienced a similarly dramatic reduction of the eel population and catches since their personal maximum in the late 1980s. While we initially also expected highly committed anglers to be more concerned about the vulnerability of their target resource (e.g., Ditton et al. 1992; Oh and Ditton 2006), we found limited support for this prediction in eel anglers. In fact, all angler types exhibited similar concerns about the current eel decline. The only difference was the significantly more pronounced belief by high-centrality anglers that the current eel decline is not being exaggerated. The same exposure to the current eel decline and the similar perception about the severity of the current population decline across all eel angler groups possibly reflects the unique characteristics of this species, its great importance for the angler community, and extensive publicity about the eel resource in the study region. This may have facilitated a similar information level about the current eel crisis, independent of level of angler involvement in eel angling.

The similarly perceived degree of eel decline since the historical maximum in the 1980s suggested that eel angling catches of all eel angler types tracked natural population dynamics and historical stocking levels. As eels grow for an average 8–10 years in the study region (ICES 2010) to reach the angler's preferred size of 50–60 cm (Dorow et al. 2010), the stated personal eel record period indeed corresponded well with high natural eel recruitment indices (Dekker 2008) and the high levels of supportive stocking in the late 1970s (ICES 2005, 2007). These aspects likely resulted in abundant eel stocks in the late 1980s and early 1990s. Sharing the same period for the personal eel record year and the exposure to media about the eel decline, probably explains further why all eel angler segments, irrespective of the eel angling-centrality level, perceived a similar need for eel conservation measures. However, the extent of perceived decline in catches (on average 60%) did not fully correspond with the sharp eel recruitment decline by 95–99% compared with the historical maximum recruitment in the 1970s (ICES 2008). This might be explained by intensive eel stocking activities in the last 30 years conducted by commercial and recreational fisheries in the study region. These stocking activities might have maintained larger

TABLE 6. Angler perceptions of the adequacy of the implementation of eel conservation programs in Mecklenburg-Vorpommern at different management levels on a five-point scale (1 = highly ineffective, 2 = ineffective, 3 = barely effective, 4 = effective, and 5 = highly effective). Note that in the percentage distribution the category "ineffective" includes scores 1 and 2 and the category "effective" includes scores 4 and 5.

Eel angler centrality group (N)	Mean perception score ± SE	Distribution by angler perception (%)		
		Ineffective	Barely effective	Effective
Mgt: European (overall mean ± SE = 3.2 ± 0.07; $F_{363} = 2.36$, $P = 0.10$)				
Low (192)	3.0 ± 0.12	28.2	41.3	30.4
Medium (166)	3.3 ± 0.10	22.8	34.3	42.8
High ($N = 106$)	3.4 ± 0.13	24.6	25.5	50.0
Mgt: national (overall mean ± SE = 3.4 ± 0.06; $F_{360} = 1.79$, $P = 0.17$)				
Low (93)	3.2 ± 0.11	21.5	32.3	46.3
Medium (161)	3.4 ± 0.08	16.1	30.4	53.4
High (107)	3.5 ± 0.10	14.0	32.7	53.2
Mgt: German state (overall mean ± SE = 3.7 ± 0.05; $F_{366} = 1.51$, $P = 0.22$)				
Low (92)	3.6 ± 0.10	14.1	20.7	65.3
Medium (169)	3.7 ± 0.08	10.0	24.3	65.7
High (106)	3.8 ± 0.09	8.5	19.8	71.7
Mgt: river basin (overall mean ± SE = 3.8 ± 0.05; $F_{362} = 0.27$, $P = 0.76$)				
Low (91)	3.8 ± 0.09	8.8	18.7	72.5
Medium (165)	3.8 ± 0.08	11.0	19.4	69.7
High (107)	3.9 ± 0.09	8.4	16.8	74.7
Mgt: local, individual water body (overall mean ± SE = 3.9 ± 0.05; $F_{372} = 0.16$, $P = 0.85$)				
Low (94)	3.9 ± 0.10	10.6	20.2	69.2
Medium (169)	3.9 ± 0.08	10.1	16.6	73.4
High (110)	3.9 ± 0.09	9.1	15.5	75.5

stock sizes than would have been existing naturally, and these stocking-maintained stock sizes might also bias the catch and harvest expectations of anglers (van Poorten et al. 2011).

Irrespective of their actual targeting behavior of eel relative to other fish species, all surveyed eel anglers shared similar perceptions about the main underlying reasons for the current eel decline; they mainly focused on commercial fishing, predation by cormorants, and mortality at hydropower turbines. The latter impact source was, however, more strongly emphasized by high-centrality anglers than low-centrality anglers, possibly reflecting their greater concern with habitat loss and destruction of migration pathways affecting the eel population. Interestingly, compared with other factors inducing eel mortality, anglers evaluated their own contribution to the contemporary eel decline as negligible, despite removing more eel annually than commercial fisheries in the study region (compare Dorow and Arlinghaus 2011) and elsewhere (Baisez and Laffaille 2008; ICES 2008). Furthermore, high-centrality anglers voiced the strongest protest against hypothetical constraints on eel fishing effort as a tool to help the eel population recover. Aggregated annual landings data by either commercial or recreational fisheries obviously do not provide a causal link between fishing mortality and the decline of the eel population at the European level (compare arguments in Arlinghaus and Cooke 2005), but they show that mortality levels of recreational anglers and commercial fisheries are at least of similar magnitude in the study region (Dorow and Arlinghaus 2011). Therefore, recreational harvesting has at least a comparable impact on the eel stock as that of commercial fishing in reality, yet all eel angler groups we surveyed attached a greater relative impact to commercial rather than recreational eel fishing. This finding might relate to the lack of awareness among anglers about the full range of eel mortality sources in the study region (Dorow et al. 2009) or be caused simply by scapegoating. Indeed, most of the German media coverage emphasizes commercial fishing of glass eels outside Germany or cormorant predation as key factors for the current eel decline, and the potential role of recreational eel harvesting is typically not featured or marginalized. Instead, the doubtless positive contribution of recreational fishing towards eel conservation in selected catchments as effected by investments into catchment-based stocking is emphasized in the German media. It is a common psychological pattern of humans aimed at reducing cognitive dissonance (Reed and Parsons 1999; Arlinghaus 2005) by searching for alternative explanations for a feature that causes internal discomfort (here, the eel decline). In this context it is cognitively easier to identify alternative impact sources (e.g., commercial fishing, cormorant predation) rather than to focus on the potential for being personally accountable for the eel decline through

recreational harvests. In light of the perceived low degree of recreational harvesting impacts on eels among the surveyed anglers (relative to other sources), the negative attitudes towards constraints on eel fishing effort by anglers expressed in our results constitute a cognitively plausible solution, and thus make sense from the perspective of anglers. Because eel anglers did not perceive themselves contributing to the eel decline, there seems no cognitive need for accepting personal restrictions to help the stocks recover. Because highly commitment anglers perceived a particularly low level of angling impacts on eels, their greater disagreement with eel angling effort controls is also plausible.

Irrespective of the underlying reasons for the eel decline, the surveyed anglers generally held strong opinions about appropriate ways to conserve eels by enhancing stocking and controlling cormorant predation, commercial fishing mortality, or eel mortality at hydropower turbines. There was stronger support for elevated eel stocking among the more committed eel anglers, which agrees with earlier work on greater prostocking norms among more committed anglers in Germany (Arlinghaus and Mehner 2005). The likely reasons are the greater dependence of committed eel anglers on securing the future of the stock and maintaining the stock in selected catchments by stocking of glass eels or grown-out eels from aquaculture facilities; both apparently stand out as an easy solutions to the problem (compare van Poorten et al. 2011). Our findings generally also agree with results from choice-based surveys applied in the same study region regarding preferred management tools to conserve eels (Dorow et al. 2009), in that eel anglers prefer regulation of other real or perceived sources of eel mortality before initiating tight regulations of recreational fishing. This does not mean, however, that eel anglers are not willing to tolerate some moderately stricter harvest regulations than those in force today, and in fact, anglers do prefer moderate restrictions and dislike the absence of recreational fishing regulations because anglers like to contribute their share to the integrated eel conservation program (Dorow et al. 2009, 2010). In fact, support among the surveyed angler population for integrated conservation policies in which recreational fishing and other potential mortality sources on eel are jointly considered is overwhelming and reaches values exceeding 90% (Dorow et al. 2009).

According to our study, integrated eel conservation programs would be perceived as particularly valuable at a local scale. With the European eel population constituting a panmictic population (Als et al. 2011) affected by multiple nations and stakeholders (Ringuet et al. 2002; Dekker 2009), it is doubtful whether a local-level approach will achieve its intended objectives because such an approach does not cover the complex eel life cycle (Dekker 2009). Note that our study showed that eel anglers did not disagree with a national or even European-scale approach for the implementation of eel conservation and management programs; rather they exhibited stronger agreement with local-level actions than with a regional, national or European approach. Indeed, local-level fisheries management has several advantages to offer such because of the reduced number of stakeholders to consider in the decision-making process and the attendant reduced transaction costs. Additionally, acting locally provides the advantage that the decision-making process becomes more transparent to the anglers than does decision-making at a higher organizational level. Therefore, from the anglers' perspective, local eel conservation programs that are tailored to meet national or international objectives are likely the preferred option. These attitudes are in line with the actual process of the European eel regulation (EC 2007) that prescribes general goals and leaves member states to regionally decide on the suitable options to reach the general goals and objectives.

Overall, we found evidence of a slightly more pronounced awareness of the contemporary eel decline among more committed eel anglers, but at the same time we found decreased willingness for personal restrictions among the more involved anglers. Two reasons are likely to explain this finding. First, the vast majority of the anglers surveyed did not perceive angling to contribute substantially to the eel decline, and second, highly committed anglers are particularly dependent on the eel resource to meet their life-style expectations. Therefore, any overly strict regulations that do not align with preferred fishing behavior would be causing high levels of utility and welfare loss and therefore be disliked, even if they could contribute to eel conservation (Dorow et al. 2010). In the case of eel fishing in Germany, the preferred option of high-centrality anglers is to consume eel. Any regulations that constrain such harvesting behavior strongly, such as too restrictive size or bag limits, are thus not favored by highly committed anglers (Dorow et al. 2010). Additionally, there is a lack of potential substitute species for eels, which further increases the dependency on the eel resource by high-centrality eel anglers. Therefore, pronounced aversion to effort reductions can be expected among high-centrality anglers because they have more to lose than less involved anglers (Dorow et al. 2010). Aversion among more committed anglers against effort controls has been previously reported in other angler populations (Chipman and Helfrich 1988; Salz and Loomis 2005; Hutt and Bettoli 2007) and has also been reported in discrete-choice modeling results from eel anglers in Germany (Dorow et al. 2010).

In contrast to many studies that have reported a greater willingness among more involved anglers to accept tighter harvest regulations to a greater extent than less involved anglers (e.g., Fisher 1997; Oh and Ditton 2006; Hutt and Bettoli 2007), highly committed eel anglers appeared to strongly dislike implementing traditional management tools such as minimum-size limits (Dorow et al. 2010). The reason for this seemingly counterintuitive finding is the highly consumptive nature of German eel recreational fishing, which contrasts with less-consumptive fisheries. For example, increasing the degree of mandatory catch and release by increasing minimum-size limits harms the utility experienced by consumptive eel anglers. Therefore, regulations restricting harvest in nonconsumptive fisheries are preferred by more committed anglers (e.g., some trout angler populations

in the USA, Bryan 1977), while the same tool inflicts a large loss of welfare to highly committed consumptive anglers, such as eel anglers in Germany (Dorow et al. 2010). Therefore, in the case of highly consumptive eel anglers, committed anglers do not necessarily accept tighter traditional harvest regulations to the extent that less-involved eel anglers do (Dorow et al. 2010).

Our work shows exceptions to the often-reported positive relationship between the commitment level of anglers and their acceptance of management tools aiming to reduce fishing mortality (e.g., total catch-and-release, Bryan 1977; Ditton et al. 1992; Oh and Ditton 2006; Arlinghaus et al. 2007). These exceptions are especially likely when personal access to the resource is threatened, as in the case of effort controls (Salz and Loomis 2005; Dorow et al. 2010) or when restrictive harvest regulations oppose the main fishery attributes valued by the highly committed anglers (e.g., fish harvest). Acceptance of tight harvest regulations will ultimately depend on the target species and their singular importance, the consumptive orientation of anglers and their perceptions of the degree to which angling contributes to a threatened status of a species.

In the case that recreational eel angling regulations are selected to reduce the anthropogenic impact on the eel population, our study implies that managers shall carefully tailor communication strategies to various eel angler segments to avoid conflict and increase their acceptance of management actions. Our results presented here and by Dorow et al. (2010) suggest that high-centrality eel anglers are likely to most strongly oppose any highly restrictive eel angling regulations. Additionally, eel anglers are likely to react with an inelastic effort response to the implementation of common harvest and effort controls that would cause large welfare losses (Dorow et al. 2010) with limited reduction in recreational eel fishing mortality (Beardmore et al. 2011). Therefore, regulation planning in eel fishing constitutes a complex issue, with various tradeoffs to be considered. Managers are reminded that the eel stewardship of highly committed eel anglers is crucial for the success of local eel management plans because more avid eel anglers contribute substantially and disproportionally to the overall fishing mortality (Dorow et al. 2010). Furthermore, high-centrality eel anglers may serve as role models for less-committed angler groups (Salz and Loomis 2005). Consequently, the active support of highly committed eel anglers for any form of eel conservation and management is important; hence garnering their support for any form of regulation is paramount. Accordingly, managers must ensure that the recreational fishing community understands the rationale behind management decisions and the expected conservation benefits (Decker and Krueger 1999). Restricting eel angling without any management regulation directed to other eel mortality source will result in pervasive conflict (Dorow et al. 2009) because the contemporary angling community does not believe recreational harvesting to be of any major relevance to the current state of the eel stock.

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