American Fisheries Society Symposium 49:105–122

Social Barriers to Sustainable Recreational Fisheries Management Under Quasicommon Property Fishing Rights Regime

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Abstract.—When debated publicly, the challenge to reconcile fishery resource use and resource conservation is often only discussed with regard to marine commercial fisheries. Recreational fisheries are often not considered despite their high social and economic importance across the industrialized world. This paper addresses key obstacles to the reconciliation of fishery resource use and resource conservation with respect to freshwater recreational fisheries management under quasicommon property regimes of Central Europe. It is argued that it is crucial to understand the human dimension of fisheries. Nine human dimensions related obstacles operating either at the societal level or at the level of individuals (or groups of stakeholders) were identified and are briefly summarized. These include: (1) lack of social priority; (2) lack of integrated approaches; (3) lack of cooperative institutional linkages; (4) lack of systems thinking; (5) lack of research and monitoring; (6) lack of shared values and dominance of stereotyped perceptions; (7) lack of consideration of the demand side of fish-angler interactions; (8) lack of self-criticism among angler lobbyists; and (9) lack of self-criticism among individual anglers. Potential solutions to overcome the identified obstacles are presented. It is concluded that although an understanding of the biological and ecological dimensions of recreational fisheries remains at the heart of any effort towards sustainability, the success of recreational fisheries management crucially depends on the human dimension. If some of the elements presented in this review are considered, the prospect for reconciliation of resource use and resource conservation in traditional recreational fisheries management will be enhanced.

Introduction

Society must seek ways to govern fisheries systems without causing irreversible losses of biodiversity, biomass and aquatic ecosystem resilience (Folke et al. 2002). To achieve this goal, fisheries researchers and managers need to develop strategies to manage seemingly irrational fisher behavior (Roslin 2002; Sullivan 2003) and maintain the economic, social and ecological benefits healthy fisheries provide (Arlinghaus et al. 2002). All this must be achieved in the face of uncertainty caused by global climate change, human population trends, competing habitat and water demands, and the expressed desire for a future world of diverse aquatic ecosystems (Ludwig et al. 1993; Folke 2003). The golden rule of natural resource management in general should be to retain critical types and ranges of natural variation in ecosystems (i.e., man-

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agement should facilitate existing processes and variation rather than altering or trying to control them) (Holling and Meffe 1996; Carpenter and Gunderson 2001) or rebuild entire aquatic ecosystems and food webs if they have been degraded by human activities (Pitcher 2001). This task should be pursued by integrating most, if not all, stakeholders and using all types of available information (ecological, economic, political, and sociocultural) in decision making to achieve goals and objectives established for fish resources (Costanza et al. 1998; Krueger and Decker 1999; Arlinghaus et al. 2002).

When debated publicly, the challenge to reconcile fishery resource use and resource conservation is often only discussed with regard to marine commercial fisheries. Recreational fisheries, which in most industrialized societies and particularly in freshwater ecosystems of the temperate regions have long represented the major use of aquatic wildlife (Welcomme 2001; Arlinghaus et al. 2002) are often not considered. For example, recent review papers dealing with the sustainability of world's fisheries (Pauly et al. 2002), the state of the world's fisheries resources (Hilborn et al. 2003) or the future for fisheries (Pauly et al. 2003) largely omitted any commentary on recreational fisheries and almost did not cite any relevant work on noncommercial fishing. This is partly the result of the limited research efforts on recreational fisheries in freshwater as compared to marine commercial fisheries (Arlinghaus et al. 2002). On the other hand, the great socioeconomic and ecological dimension of recreational fisheries (see Arlinghaus et al. 2002; Arlinghaus 2004a, 2004b, for references and discussion) may often remain unnoticed because marine commercial fisheries are highly visible in the media, while recreational fishing is a regionally dispersed activity with millions of people exploiting hundreds or thousands of different fish stocks (Cox 2000; Post et al. 2002). However, fishing activity of any kind, whether commercial or recreational, has the potential to negatively affect fisheries resources and entire aquatic ecosystems (McPhee et al. 2002; Cooke and Cowx 2006). It is expected that freshwater recreational fisheries can collapse much in the manner that commercially exploited species such as Atlantic cod *Gadus morhua* already has worldwide, at least in areas with high angling effort and mortality (e.g., near densely populated centers) (Schindler 2001; McPhee et al. 2002; Post et al. 2002). As a consequence, the normative concept of sustainable development equally applies to both commercial and recreational fisheries (Arlinghaus et al. 2002). Recreational fisheries should increasingly be discussed and studied in plane with commercial marine fisheries in an effort to be put on a path to reconcile fishery resource use with conservation. Particularly in densely-populated countries of Central Europe, there is an urgent need for concerted efforts to prevent and reduce ecosystem degradation—as well as conservation of freshwater fish and fisheries as renewable common pool resources or entities in their own right—to move towards sustainability (Arlinghaus et al. 2002). Against this background, recreational fisheries and its traditional management must recognize that conservation of the resource is one of the essential domains of natural resource management (Leopold 1933). There is no need for a "new" player in the arena of applied ecosystem management called conservationists. Instead, what are needed are practitioners of traditional resource management to become conservation biologists (Aplet et al. 1992).

This paper will argue that the key to reconciliation of recreational fisheries with conservation values is to understand the human dimension of fisheries because wildlife management today is "90% people, and 10% natural resource management" (e.g., Decker et al.

2001). Thus, this article from the human dimension perspective discusses key obstacles to reconcile recreational fisheries management (RFM) with conservation. This discussion is intended to increase awareness of the topic among (mostly biologically trained) fisheries researchers and managers, and should help to develop strategies to overcome the identified constraints. Hence, this paper focuses not only the main obstacles to reconcile recreational fisheries with fishery resource conservation, but also on potential solutions (see Table 1 for an overview). Emphasis is placed on the private property system of fishing rights in Central Europe where the duty to manage fishery resources lies in hand of private fishing rights holders and not within public agencies as for example in North America (Nielsen 1999; Arlinghaus et al. 2002). This distinction is needed as different property-rights regimes have a substantial influence on the probability of overexploitation of common-pool-resources such as fisheries (Hardin 1968; Feeny et al. 1990).

Property of Recreational Fishing Rights

In Central Europe, ownership of freshwater fishery resources is usually dependent on ownership of land adjacent to the water body. There are also traditional fishing rights that have survived since the Middle Ages, where feudal kings and land barons declared themselves owners of the land (and hence the fishery resources) (Wolter et al. 2003). Today, fishing rights can be purchased or leased from fishing rights (i.e., land) owners. In the latter case, the person or the group (e.g., an angling club or an angling organization) that leases the fishing rights for a certain time period also have the duty to manage the fishery resources without causing harm to the entire ecosystem. This duty is formulated in fisheries legislation and nature conservation laws and by-laws. Legislation is enforced by public agencies either at the national or federal-state level. Thus, the Central European recreational fisheries systems can be characterized as joint community-federal state cooperative management regimes (cf. Pinkerton 1994). That is, government and federal states at the public RFM level set the larger institutional framework (e.g., fisheries laws). Fishing rights holders (e.g., an angling club) or more generally angling communities at the private RFM level then implement and plan local management. They can also enforce, supplement and complement state-wide regulations (e.g., by local angling club rules). Therefore, fishing rights in Central Europe are private entities. However, in recreational fisheries the fishery resources are typically jointly used by all anglers belonging to a club or purchasing a license by paying a fee to the fishing rights holder (e.g., a commercial fisher). Thus, recreational fishery resources usually exhibit quasi-common properties within the realm of private fishing rights (cf. Feeny et al. 1990). For example, within the community of an angling club, even if outsiders are sometimes excluded (e.g., other anglers willing to enter a private angling club), access rights to the fishery resources for the purpose of angling are equal to all club members. Mostly, however, clubs are not restricted by a certain amount of memberships. Hence, access rights are equal to all anglers willing to purchase a license.

Within the quasicommon property rights system of inland fishing in Central Europe, in recreational fisheries there are three types of common-pool-resources. Such resources are characterized by the difficult or very costly possibility to exclude users and a rivalry in consumption (Berkes et al. 1989; Ostrom 1990). The latter means that joint use involves sustractability of the resource (i.e. one unit consumed by one user is not available, at least temporarily to another). Common-pool-resources in recreational fisheries include fish

Table 1. Overview of human dimensions obstacles limiting the reconciliation of traditional recreational fisheries management and resource conservation under quasi-common-property regimes in Central Europe. Obstacles are grouped according to the level (either societal or individual scales) they are acting on. Some consequences and potential solutions mentioned in the text are also presented.

Obstacle	Consequences	Potential solutions
	Societal scale	
Lack of social priority	interests of anglers rarely considered by water and ecosystem managers	thorough evaluation of the socioeconomic benefits of angling on regional and national scales
	fishery stakeholders not involved in consultation processes	offensive lobbying based on "hard scientific data"
	diffucult or impossible to attract developments for fishery development	proactively seeking input in water and ecosystem management
Lack of integrated approaches	socially suboptimal management solutions	rehabilitate ecosystem structure and function on larger scales
	often disruption of ecosystem structure and function	create win-win situation for all stakeholders
Lack of cooperative institutional linkages	severe intrasectoral and intersectoral conflicts	facilitation of structured communication
	nonsustainable management measures	top down expert advice
		management plans
Lack of systems thinking	understanding of system's behavior rudimentary	shift in thinking
	short-sighted management	incorporate anglers in system-analytical studies and communication results
	shifted perceptions	
Lack of research and monitoring	invisible declines of fish stocks	educate about overfishing
	reduced ability to reacte appropriately	cooperative research, funding for long-term monitoring
	black-box management	precaution

Table 1. Continued.

Obstacle	Consequences	Potential solutions
	Individual or group scale	
Lack of shared values and dominance of stereotyped perceptions	inter- and intrasectoral conflicts	foster common values such as fairness and justice
	low level of cooperation and mutal acceptance	facilitate face-to-face interactions, sometimes facilitator may be needed
	consumer attitude, free-riding behavior	
Lack of consideration of the demand side of fish-angler interactions	homogenising angling quality on regional scales	active adaptive management
	overexploitation	partially limiting angler effort, first indirectly by "soft paths"
	low angler satisfaction levels on regional scales	
	management impossible	protected areas
Lack of self-criticism among angler lobbyists	unawareness about potential negative impacts	increase communication of research results about positive/negative impacts
	low awareness to be partly responsible for declining fish stocks	convince anglers to meet their own targets by more restrictive regulations
	low level of environmental concern	facilitate personal experiences
	support of nonsustainable management measures	reduce fear against new approaches

stocks, fishing sites and catchability of fish (Policansky 2001, 2002), the latter due to the increasingly more difficult recapture of previously caught-and-released fish (Raat 1985). Although overexploitation of such common-pool-resources is much more likely under open-access (Hardin 1968) than under common-property regimes (Feeny et al. 1990), Hardin (1998) noted that degradation of the resource is inevitable as long as effective management is not in place. Thus, tragedy of the commons phenomena are also likely to occur in recreational fisheries in both open-access and common-property situations. However, anglers as other fishing communities (Feeny et al. 1990; Ostrom 1990) should have the

ability to develop resource preserving institutions (i.e., ways of organizing angling systems), for example by monitoring resource use or devising resource conserving informal (i.e., voluntary) institutions. But to achieve this self-regulating system, several obstacles have to be overcome to reconcile RFM with resource conservation. Some of the most important barriers that limit the development of sustainable RFM strategies will therefore be discussed below. It is important to note, however, that the following is the subjective opinion of the author and does not necessarily reflect the true situation all over Europe. The list of social barriers is therefore subjected to further change in future as more information becomes available.

Obstacles to Reconcile Recreational Fisheries with Conservation

Barriers to reconcile recreational fisheries goals with conservation operate at two different scales; either at the societal level or at the level of individual stakeholders (or groups of stakeholders). Therefore, in the following these two divergent scales are treated separately (cf. Table 1). However, it is important to realize that some obstacles are interrelated, mutually reinforcing each other and are therefore difficult to categorize.

Societal Scale

Lack of Social Priority

The multipurpose nature and use pattern of freshwater ecosystems has created a climate in developed societies in which recreational fisheries suffer in the face of economically and socially higher priorities such as agriculture, hydro-electric power production, navigation and flood prevention – activities that often contradict conservation of biodiversity and fishery resources worldwide (Dynesius and Nilsson 1994; Collares-Pereira et al. 2002; Wolter and Arlinghaus 2003). This lack of public acceptance, inter alia, results from the rarely assessed socioeconomic importance of recrea-tional fisheries (Arlinghaus et al. 2002; Arlinghaus and Mehner 2003a). Therefore, recreational fisheries are often given low priority in any consultation process and it is difficult to attract investments for development of a fishery (Cowx 2002). The result is that nonfishery stakeholders such as water management authorities rarely, if at all, solicit the input and consider the interests and demands of fishery stakeholders leading to management actions that are often detriment to ecosystem structure and function (Cowx 2000). This calls for thorough socioeconomic evaluation of recreational fisheries and fish resource conservation at local, regional and national scales to ensure that these values are well represented in all development activities concerning freshwater ecosystems (Arlinghaus et al. 2002; Arlinghaus and Mehner 2003a). Moreover, fishery stakeholders should constantly try to increase their input by proactive instead of reactive lobbying based on "hard scientific data."

Lack of integrated approaches.—Increasing pressures on and multiple uses of freshwater ecosystems (Jackson et al. 2001; Schindler 2001) dictate that recreational fisheries and resource conservation can no longer be treated in isolation (Cowx 1998; Arlinghaus et al. 2002). Therefore, an integrated approach to aquatic resource management is required spanning all stakeholders potentially affected by that management action (Decker et al. 1996). Integrated management is characterized as management across scientific disciplines, stakeholder groups and considering, at least in concept, future generations (Costanza et al. 1998). Such approaches are currently rarely pursued in traditional RFM (Arlinghaus et al. 2002). The most important reason is that many fishery agencies and private fishing rights

holders responsible for management of an extensive and diverse array of recreational fisheries often do not have adequate human and financial resources (and political power) for monitoring either the fishery or the fish stocks supporting the fishery (Post et al. 2002; Pereira and Hansen 2003). Furthermore, freshwater fishery resources are strongly dependent on nonfishery activities such as land-use changes and water management activities (Arlinghaus et al. 2002). The inability of RFM to alter nonfishing activities affecting fishery resources, inter alia, has led in the past to focus on single-species management of recreationally valuable fish stocks (Arlinghaus et al. 2002). This has been mainly achieved by stocking practices of hatchery-reared fish, translocation of fish species across catchments and introductions of exotics, which today is perhaps the greatest concern regarding conservation of genetic, species and community biodiversity of freshwater fish (Meffe 1992; Arlinghaus et al. 2002; Myers et al. 2004). Worldwide, however, degradation of the environment and loss of fishery habitat are the preeminent barriers for the sustainability of inland fisheries (FAO 1999). This is particularly relevant in densely-populated countries of Central Europe (Arlinghaus et al. 2002). Rehabilitation of ecosystem structure and function and the associated fishery resources is therefore a goal that fishery and conservation stakeholders should pursue together in an integrated approach to create true win-win situations for all stakeholders (Pinkerton 1994). This is necessary as large-scale environmental engineering or habitat rehabilitation techniques need a full consultation with water resource managers and environmental experts (Arlinghaus et al. 2002). However, if anglers and fishery managers cannot carry out complex aquatic ecosystem rehabilitation and restoration projects independently, conservation and traditional RFM can hardly be reconciled. The reasoning behind this statement is that the most sustainable management strategy to conserve fishery resources in the long-term (i.e. habitat rehabilitation on larger scales) usually lies outside the domain of traditional RFM. Thus, there is no scale-matching of problem causing and problem solving institutions.

Lack of Cooperative Institutional Linkages

As was already mentioned above, public fisheries authorities and private fishing rights holders are often politically too weak to take effective actions to deal with policy problems in RFM. Many problems affecting fishery resources and conservation in general, can only be addressed by nonfishery bodies such as water management agencies. However, there is seldom a structured communication demanded formally (e.g., a by-law) between water or nature conservation agencies and fisheries agencies before actions are taken (Raat 1990; Welcomme 2001). Moreover, in many recreational fisheries systems traditionally management takes place locally without approval of or advice on management plans by experts trained in ecology or sociology. For example, in Germany many angling clubs as fishing rights holders expand the legal state-wide regulations such as minimum-size limits without scientific evaluation of the biological and social effects of such measures, and enforcement of regulations is inadequate, at best (McPhee et al. 2002). Other examples include that most stocking events take place without a priori appraisal of the ecological and evolutionary risks or social and economic cost and benefits (Arlinghaus et al. 2002). Evaluation of such stocking practices is rarely conducted such that RFM becomes an oxymoron. Lack of institutional linkages and communication, however, is not only prevalent between fishery and nonfishery stakeholders intersectorally, but can also be found intrasectorally, (e.g. in an angling club where the private fishery managing board seldom incorporates inputs from the anglers). There are

also often not well-developed institutional linkages between angling clubs and public fishery authorities. Thus, in some European countries such as in Germany and The Netherlands, the local RFM remains more or less in the hands of angling clubs and organizations, which are often not well or not at all trained in fisheries science or conservation biology (Walder and van der Spiegel 1990). However, legislation is changing, at least in Germany, where fishing rights holders have to set up management plans that then have to be approved by experts in public authorities. This is a promising way forward. In an attempt to reconcile conservation with resource use, local community-driven recreational fishery management may need some kind of top-down expert advice, productive communication, education and control to better manage "unsustainable knowledge" of (often voluntary) private fisheries managers. However, it is doubtful whether public fishery authorities may be able to accurately validate hundreds of management plans in their jurisdictions given limited human resources available.

Lack of Systems Thinking

Although RFM is highly complex involving uncertainty, information gaps and the correlations between slow (e.g., evolution, habitat change) and fast (e.g., fish stock development, angler responses) variables, voluntary fishery managers of angling organizations in Central Europe often do not accept that some of their traditional management practices are partly unsustainable. This may result from their limited scientific background and the typical lack of exposure to scientific findings. In fact, RFM has traditionally been sectoral in orientation (Arlinghaus et al. 2002). However, recreational fisheries as socio-ecological systems are itself only nested elements of aquatic ecosystems, society, and ultimately the biosphere. Therefore, the sectoral approach has run its course and should be substituted by a system approach, at least from an academic standpoint (Arlinghaus et al. 2002). Nonetheless, given the complexity of all socialecological systems, including recreational fisheries, it is often difficult for fishery (and other) stakeholders and managers to see and understand the larger picture of the system as a whole and be aware of processes occurring at scales larger and longer than their own experience (Post et al. 2002). In practice, most people are overtaxed to make reasonable decisions given complex, uncertain and slowly changing (time lag between cause and effect) processes of dynamic socioecological systems (Dörner 1996; Folke et al. 2002; Folke 2003). Thus, they tend to focus on local conditions and short-term solutions (Fehr 2002). This problem is not unique to recreational fisheries, but is a common and central feature of the whole sustainability debate (Folke 2003). This is difficult even for scientists, and is much more difficult for fishery stakeholders and other "laypeople" not trained in systems thinking. The solution to overcome this problem is to incorporate fishery stakeholders in scientific, system-analytical studies and communicate results in an understandable manner. In this respect, traditional ecological knowledge can be extremely useful for fishery researchers. This necessitates that researchers and managers foster the intellectual input of anglers (e.g., Olsson and Folke 2001). However, over the generations, expectations about what a healthy fish community or an "natural" aquatic ecosystem constitute may shift towards lower optima, i.e. anglers, researchers and managers may perceive a degraded status of the aquatic ecosystem and the impoverished fish stocks as being the natural state and may use this perception to define conservation or management targets (Pauly 1995; Arlinghaus and Mehner 2003b).

Lack of Research and Monitoring

Post et al. (2002) stated that there were few documented instances of declines in fish stocks

that could clearly be attributed to recreational fisheries. At the same time, however, the authors identified four high profile fisheries that showed evidence of angling-induced declines in Canada. These declines were largely unnoticed by the angling public, a characteristic that may be widespread in recreational fisheries (Schindler 2001; Sullivan 2003) as long-term monitoring of thousands of regionally highly dispersed fish stocks is lacking (Cox 2000; McPhee et al. 2002). It has also repeatedly been shown that angling exploitation can force the length- and age-frequencies of fish populations towards smaller and younger fishes, in particular under minimum-size-limit regulations and high harvest levels (e.g., Goedde and Coble 1981; Anderson and Nehring 1984; Olson and Cunningham 1989). To increase our understanding of angler behavior and the effects of angling activities on the ecology and evolutionary biology of fish stocks, long-term monitoring programs coupled with rigorous experimentation of regulations are needed (active adaptive management, Pereira and Hansen 2003). At the moment, funding for such applied research is limited and the private property systems of Europe necessitate the willingness of fisheries owners to allow such research to take place. Research initiated by fishing rights holders is practically nonexistent. Consequently, there is limited basic and applied research to guide management, which severely reduces the system's ability to correspond appropriately to the demands set by the sustainability concept (Aas 2002; Arlinghaus et al. 2002). Furthermore, many of the modern management concepts (e.g., human dimensions research on the diversity of angler subgroups) are often not accepted as being critical for management (Ditton 1996; Arlinghaus 2004a). Nonetheless, the scope for cooperative initiatives between academic professionals and private fishing rights owners is huge, if the awareness of the necessity to apply scientific rigor to day-to-day management is increased and funding is made available. In the face of incomplete scientific facts to aid RFM, decisions and actions should be taken with precaution.

Individual and Group Scale

Lack of Shared Values and Dominance of Stereotyped Perceptions

Recreationally valued species are often at the heart of management efforts by fishery stakeholders. That utilitarian bias in wildlife management in general has profoundly affected the public perception of the wildlife management profession and has created strong barriers to public support for fishery and wildlife agencies (Decker et al. 2001) because the extractive use of wild living resources is often opposed by those who object to the killing or collecting of fish on ethical and moral grounds (Hutton and Leader-Williams 2003). Confusion and strong conflicts arise, in part at least, because of the different visions or worldviews of use, conservation and management under the umbrella of sustainable development. For example, conservation biologists often only consider ecological sustainability, whereas consumptive/extractive stakeholders often emphasize the socio-economic domain of the sustainability concept. In the past decades, there has been a gradual shift away from traditional wildlife values that emphasize the use of wildlife for human benefit towards wildlife conservation and protection (Manfredo et al. 2003). Thus, one of the greatest challenge for recreational fisheries taken place in freshwater ecosystems characterized by multiple uses and high degree of anthropogenic degradation (Vitousek et al. 1997) is to make sound management decisions to ensure viable recreational fisheries are compatible with esthetic and nature conservation values in the 21st century (Arlinghaus et al. 2002). Only if all stakeholders respect and at least try to understand each other based on values such as

justice and fairness, can RFM and conservation be reconciled at larger scales. However, this might be very difficult as stereotyping may for example result in a view among anglers that conservation per se is authoritarian and threatening. Alternatively, stereotypic attitudes among conservationists may lead to the perception that anglers are *always* a threat to the protection of aquatic ecosystems (Stoll-Kleemann 2001). This stereotyping can reduce the potential for cooperation to extremely low levels or inhibit it at all and encourage group processes of social identity (Stoll-Kleemann 2001). Stereotypical thinking within angler groups can also lead to increased free-riding and tragedy of the commons phenomena if certain anglers consider other anglers in a stereotypic sense as "not belonging to their group," aggravating rivalry in consumption. Stereotypic thinking can also occur in angler-fishery manager interactions if the manager does not achieve or is not willing to integrate the anglers in the process of decision taking and perceives anglers as laypeople not able to contribute to resource management. The angler may then develop a feeling of frustration, which will often result in rule breaking behavior and the development of a "consumer attitude" (e.g., the attitude that a certain amount of fish has to be taken out of the water to balance the fishing license cost). Again, the result will be that overfishing is more likely on larger scales with potential detrimental impacts on fishery resource conservation. The overcoming of this lack of shared value systems acting at different levels in RFM is particularly difficult, as once developed values and beliefs are notoriously resistant to change (Manfredo et al. 2003). Managers are envisaged to provide a productive environment for face-to-face interaction and facilitate conflict resolution processes to achieve mutual acceptance. Sometimes a facilitator may be needed to achieve this aim.

Lack of Consideration of the Demand Side of Fish-Angler Interactions

Modern anglers are highly mobile, potentially shifting effort, angling mortality and other impacts at regional scales if angling quality declines (Carpenter et al. 1994; Johnson and Carpenter 1994; Walters and Cox 1999; Cox and Walters 2002; Cox et al. 2002; Lester et al. 2003). Until now, most RFM decisions are made on a case-by-case basis wherein quality on individual fisheries is assumed to be independent of management actions and fishery dynamics elsewhere (Cox et al. 2003). However, dynamic relationships between anglers and angling quality seem to be the rule rather than the exception. Two general types of fish-angler dynamics are conceivable. First, fish populations can respond to fishing impacts and fisheries management actions (e.g., stocking, regulations), and second, anglers may respond by functional and numerical responses to changes in the abundance of fish, in the quality of the angling experience per se or in regulatory schemes (e.g., Beard et al. 2003). Recreational fisheries management has traditionally concentrated on the supply side of this dynamic relationship (fishing quality), with a tacit assumption that the demand side (angling effort) will somehow be self-regulating (Walters and Cox 1999; Cox and Walters 2002; Post et al. 2002). However, under conditions of low to moderate access costs (e.g., time, energy, money) and particular under open or quasiopen-access, anglers will regionally shift angling effort, hence mortality from "bad" to "good" fishing waters (Walters and Cox 1999; Cox et al. 2002, 2003; Post et al. 2002; Arlinghaus 2004a, 2004b). This can result in declining fish stocks on regional scale and in a competitive situation from which recreational species might not recover when angling effort and mortality declines (Walters and Kitchell 2001; Post et al. 2002, 2003). Moreover, angler satisfaction may be severely reduced in the long term, with poten-

tially detrimental effects on the environmental concern of anglers in the case of dissatisfaction (see Arlinghaus and Mehner 2005). To overlook dynamics between prey (fish) and predator (angler) on regional scales may ultimately lead to serious losses in total socioeconomic benefits (Cox et al. 2003). One possible solution is active management of angling effort/mortality, which is rarely pursued by contemporary RFM (Pereira and Hansen 2003). Partial control of angling effort (and indirectly angler harvest and mortality) in waters needing protection may take place by direct access restrictions, increases of access cost (time, money), lottery systems of access, annual rotating access schemes (e.g., between angling club members), license price increases, implementations of total allowable angling effort (e.g., days) schemes, or a combination of the options. However, it is by far more advisable to first try to change angler behavior indirectly, e.g. by soft paths (education, zoning etc.) instead of implementing more restrictive regulations aiming at controlling angler directly (Arlinghaus 2004a). Other strategies may include the implementation of large-scale protected areas that receive none or only limited angler effort to help species to recover. However, as Walters and Cox (1999) noted, fishery managers are typically hit from all sides when they suggest effort limitation. However, opposition by anglers may quickly die away if quality increases become evident (Walters and Cox 1999).

Lack of Self-Criticism Among Angler Lobbyists

Ecological impacts of angling are cumulative and can be substantial, whereas there is a tendency for consideration of impacts in isolation, if at all (McPhee et al. 2002). Usually, there is the public or political perception that recreational fishing is more a benign activity than commercial fishing (Kearney 1999; Cooke and Cowx 2006). Recreational fishing lobbyists have been successful in focusing public and political attention on other impacts such as commercial fishing in the past or cormorant predation in the present. In some countries such as in Australia, recreational fishing has not come under close scrutiny from conservation groups (McPhee et al. 2002). However, in other countries such as in Germany there is a fierce debate between fishery and nature conservation and animal welfare groups surrounding potential negative impacts of RFM actions such as stocking or angling practices such as catch-and-release fishing (Aas et al. 2002; Arlinghaus 2004b). Both trends, however, stimulate one outcome at the level of fisheries lobbying: angling impacts are attenuated or not accepted, and research to analyze potential ecological or evolutionary effects of selective angling mortality is not being funded by angling organizations. Instead, research is funded that analyses the economic benefits of recreational fisheries, and the results are used to lobby about the (indeed overwhelming) socioeconomic importance of angling (cf. Arlinghaus 2004b). From the political perspective, this procedure is understandable and by no means immoral. However, if not even the angling lobbyists and the angling media try to inform their constituencies about the potential negative effects of selective angling expoitation, awareness, and environmental concern among anglers will very likely not develop. The implication is for fisheries researchers to increase communication with angler organizations and angler media to inform about all aspects of the activity, including the negative effects of certain angling practices such as biological and evolutionary effects of selective angling mortality, lethal and sublethal effects of catch and release or the effects of excessive nutrient inputs by groundbaiting (cf. Arlinghaus et al. 2002; Cooke and Cowx 2006).

Lack of Self-Criticism Among Individual Anglers

An awareness among anglers of the potential of angling exploitation or RFM practices to

negatively affect fish populations and a feeling of responsibility is paramount to serve as an antecedent to change angler behavior directly or indirectly comply with more restrictive regulations (Fulton et al. 1996; Arlinghaus and Mehner 2005). For many years since the seminal paper of Dunlap and Heffernan (1975), it was assumed that simply the involvement in angling leads to increased environmental concern, because people are exposed to instances of ecosystem deterioration, thus creating a commitment to the protection of habitats, cultivating an esthetic taste for a natural environment, and fostering a general opposition to environmental degradation. Although this assumption seems reasonable and was often uncritically cited as an "ecological benefit" of recreational fishing (e.g., Kearney 1999), empirical results were weak, at best (see Theodori et al. 1998; Tarrant and Green 1999; Bright and Porter 2001 and references therein for details). Available evidence to date suggests that the environmental concern of anglers appears high if their environmental attitudes are solicited about very general ecological aspects (e.g., the limited nature of fishery resources per se, the equal rights of animals and plants and humanity or the moral justification that humankind is allowed to rule over nature; Gill et al. 1999; Arlinghaus 2004b). Some angler populations are aware of the possibility that angling can overharvest fish stocks (Schramm et al. 1999). However, a recent study from Germany (Arlinghaus 2004b) indicated that the majority of the anglers surveyed agreed or strongly agreed that the balance of aquatic ecosystems is strong enough to cope with angling impacts. Less than half of the anglers surveyed indicated that they would be willing to change current behavior for the protection of aquatic ecosystems. Most anglers thought that their learning and observational capabilities will result in fish stocks not being overfished. Therefore, at least some angler populations show a low level of self-criticism and critical self-reflection about the potential effects of their own behavior. The consequence of the low awareness among angler to be part of the problem of declining fish stocks (Reed and Parsons 1999), inter alia, can result in lack of support of more restrictive regulations (cf. Arlinghaus 2004a for discussion and references). If regulations are in direct conflict with fishing practices that are familiar and enjoyed, optimistic biases about the risks of overfishing (cf. Weinstein 1982) may ultimately result in low support of conservation goals. For managers the challenge ahead is to convince anglers about ways to meet their own targets by conserving the resource. Opposition to conservation goals may occur because of little experience with the ecosystem management concept, which may be perceived by anglers as an untested theory or threat to continued enjoyment of the activity (Jacobson and Marynowski 1997). To overcome this situation, anglers need to be included in the process of fishery and ecosystem management decision making. However, the angling public is often in a "show me" mood and does not necessarily trust people in authorities, whether scientists or government and agency officials (Smith et al. 1997). Accepting angling impacts as crucial for sustainability will very likely only occur if personal experiences are gained as many anglers tend to rely on personal experiences or knowledge of peers that are known and respected.

Prospect with Emphasis on the Human Dimension

Fish and aquatic ecosystems in general exist with or without human intervention; but the fishery resource and the goal of conservation of these resources is a human construct. Consequently, many obstacles to reconcile conservation with recreational fisheries discussed above are human dimensions issues. Although

an understanding of the biology, ecology, and evolutionary dimension of fish stocks exploited by fisheries and the rebuilding of ecosystem structure and function remains at the heart of any effort to achieve sustainability, we should be reminded that solutions to this crucially depend, inter alia, on appropriate angler behavior, effective institutions (see Ostrom 1990 for details), stakeholder (in particular angler) involvement in decision making, productive communication, environmental education, facilitation of bottom-up processes, consideration of angler diversity in their human dimensions, precaution, active adaptive management systems designed to "learning by doing," and harmonization of divergent world views (Arlinghaus 2004a). All of these are human dimensions issues that are rarely fully addressed in RFM (at least in Central Europe) in which managers have traditionally relied on information from the biological sciences, if at all. However, it makes little sense to develop and test human dimension understandings in recreational fisheries, if managers are either not adequately trained and prepared to make use of fundamental insights, or even worse, reject their applicability (Ditton 1996; Wilde et al. 1996; Sharp and Lach 2003). The consequence of the lack of knowledge about human aspects of RFM is the possibility that myths, personal views, and the opinions of strong interest groups guide management decisions in this arena, replacing or circumventing scientific knowledge.

For the near-term, it is doubtful that anglers/angling clubs or more generally fishing rights holders or fishery agencies will be able to properly address all these challenging issues surrounding sustainable RFM alone. It is a matter of societal values whether is it judged necessary to increase management efforts and investments of funds and human resources related to RFM on a broader scale to allow that RFM is able to better address the multiple levels demanded by the sustainability concept (cf. Forsgren and Loftus 1993; Fisher et al. 1998; Epifanio 2000). Unfortunately, in many parts of Central Europe the idea of sustainable RFM is still in its infancy somewhere between the innovators and early adopters stage according to the adoption-diffusion theory (cf. Decker and Krueger 1999). In the case the early majority or late majority stages will be achieved, i.e. it is agreed societal value to manage for sustainability in recreational fisheries, it might be advisable to increasingly involve experts in practical management of recreational fisheries (e.g., by extension services of public agencies supporting anglers or fishing rights holders in general) that are trained in interdisciplinary scientific disciplines (and not only in biology, limnology or ecology). This is necessary, as complete devolution of management to angling communities may not be appropriate in Central European RFM (cf. Feeny et al. 1990). It therefore makes sense for the public hand to continue to play a role in resource conservation. Thus, shared governance of state regulations coupled with user self-management may be a viable option (Feeny et al. 1990). Such comanagement could capitalize on the local knowledge and long-term self-interest of anglers, while providing coordination with relevant uses and users over a wide geographic area at potentially lower transaction (e.g., policy compliance and enforcement) cost. What is needed as agents of change in management approach and understanding are "barefoot managers" (taken from the barefoot ecologist advocated by Prince 2003) as holistic sociobiological, ecological-evolutionary thinkers. Their role will be to motivate and empower anglers to research, monitor, and manage their own localized fishery resources. For each new angler community and fishery stock, the starting point for a "barefoot manager" will be the application of data less management, gleaning local knowledge (Olsson

and Folke 1998), reading the comparative literature, offering basic information to anglers, and recommending sensible rule-of-thumb management (Prince 2003) including the human dimension. This type of advisor role is well developed and accepted in the agricultural sector, but almost nonexistent and even frowned upon, in (recreational) fisheries (Prince 2003).

Thinking longer term, many traits of RFM systems in Central Europe provide excellent conditions for effective natural resource management. For example, well-defined access rights are conditions for environmentally sound management because the tragedy of the commons is less likely to occur (Hardin 1968). Moreover, the small-scale structures in European recreational fisheries embedded in quasi-common property together with the fact that the participation in angling is less dependent on high physical yield as compared to commercial fisheries constitute beneficial prerequisites for reconciling conservation with resource use. This increases the hope that the "race for fish phenomena" may be less pronounced in recreational fisheries as compared to open-access commercial fisheries. Lastly, the small-scale structures in recreational fisheries systems also increase the probability of regular interaction between anglers, which is one condition for resource conserving (informal) institutions to evolve (see Feeny et al. 1990; Ostrom et al. 1999; Dietz et al. 2003; Fehr and Fischbacher 2003 for details). To achieve this, anglers' and other stakeholders' abilities to perceive, understand, and act must be developed if we are to approach sustainability (Ludwig 2001). However, it is a utopian view to assume that reconciliation of recreational fisheries and conservation will progress quickly and immediately. There are severe constraints to recreational fisheries development originating from outside the fishery that will not be circumvented and resolved in the near future. A shift in approach and thinking might sometimes be needed to reconcile conservation and use values in freshwater RFM. Before this becomes reality, it is important to note that anglers or RFM in general are not guilty that sustainable management approaches are sometimes lacking. This is a societal problem and results from the traditional way by which fish resources are managed. In fact, voluntary fisheries managers at the private level in Central Europe are often highly active, willing to improve fisheries management and have contributed to effective management in many cases. However, lack of financial and operational power, limited research in particular as regards the human dimension, limited communication across scientific disciplines and between stakeholders and a high degree of ideologically driven conflicts between nature conservation and animal welfare on the one hand and fishery stakeholders on the other hand can produce deleterious outcomes and suboptimal conditions that do not reward the tremendous efforts of anglers and private fisheries managers.

Acknowledgments

Comments by Steven J. Cooke and Thomas Mehner on an earlier manuscript version helped to describe the content in a more concise way. I also thank two referees for their encouraging comments.

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