

# A Property Rights-Based View on Management of Inland Recreational Fisheries: Contrasting Common and Public Fishing Rights Regimes in Germany and the United States

KATRIN DAEDLOW\*

*Department of Biology and Ecology of Fishes  
Leibniz-Institute of Freshwater Ecology and Inland Fisheries  
Müggelseedamm 310, Berlin 12587, Germany*

and

*Division of Resource Economics, Faculty of Agriculture and Horticulture  
Humboldt-Universität zu Berlin, Philippstrasse 13, Haus 12, Berlin 10115, Germany*

T. DOUGLAS BEARD, JR.

*U.S. Geological Survey, National Climate Change and Wildlife Science Center  
Mail Stop 301, 12201 Sunrise Valley Drive, Reston, Virginia 20192, USA*

ROBERT ARLINGHAUS

*Department of Biology and Ecology of Fishes  
Leibniz-Institute of Freshwater Ecology and Inland Fisheries  
Müggelseedamm 310, Berlin 12587, Germany*

and

*Inland Fisheries Management Laboratory, Humboldt University of Berlin  
Philippstrasse 13, Haus 7, Berlin 10115, Germany*

*Abstract.*—In this paper, we describe and contrast the features of common and public fishing rights regimes in inland recreational fisheries management, using Germany as an example of a common property rights regime and the United States as an example of a public property rights regime. The German case is further distinguished into a common property rights regime at the regional level in “East Germany” (conducted by angler associations) and at the local level in “West Germany” (conducted by angling clubs). Comparisons are done using established concepts from property-rights theory and common-pool resource literature followed by a discussion of strength and weaknesses of sustainable resource management for the different property-rights regimes examined. The strengths of common property rights regimes, particularly if on a small scale such as in West Germany, include good possibilities for controlling angling effort, fostering traditional ecological knowledge, and developing emotional attachments to local fisheries. Moreover, the high level of anglers’ involvement in local decision making facilitates intensive communication among anglers and between anglers and managers, which may result in timely conflict resolution, commitment to rules, and peer pressure towards rule compliance. Strengths of public property rights regimes for inland recreational fisheries, as in the United States, include a high professional standard for conducting monitoring and stock assessment activities along with the ability to develop a landscape perspective for recreational fisheries management. This facilitates scale matching to solve problems based on science-based planning of regulations and management intervention, which may better avoid the pitfalls of “one-size-fits-all” policies. Irrespective of the governance system in place,

\* Corresponding author: [katrin.daedlow@agrar.hu-berlin.de](mailto:katrin.daedlow@agrar.hu-berlin.de)

a risk of pronounced rivalry among users for access to common-pool resources, such as fish stocks within defined boundaries of either state, angler association, or angling club waters, remains. This highlights the need for continued enforcement of rules and regulations along with continued communication with stakeholders. This is particularly challenging in large-scale management systems, as in East Germany and the United States. Our paper forms a basis for further research on recreational fisheries governance to identify suitable property-rights regimes for specific cultural, social, and ecological settings.

## Introduction

Recreational anglers constitute the major user of fish stocks of most inland waters in industrialized societies (Arlinghaus et al. 2002). The potential influence of recreational anglers on fisheries resources seems to be underestimated in many areas of the world (Post et al. 2002; Cooke and Cowx 2006; Lewin et al. 2006). Intensive recreational fishing mortality is known to affect fish population abundance and size and age structure (Coleman et al. 2004; Lewin et al. 2006). In addition, anglers can impact fish populations through ecologically harmful stocking practices with genetically maladapted fish, introduction of nonnative fish, and disturbance of habitats (Post et al. 2002; Lewin et al. 2006, 2008; Cowx et al. 2010). Moreover, the growing scarcity of once-abundant fish stocks causes distributional conflicts among anglers and other users or stakeholders (e.g., commercial fishers or conservationists; Aas and Ditton 1998; Arlinghaus 2004, 2005, 2006a; Ditton 2004). In ecological terms, however, anglers are not only a source of potentially undesirable change of fish populations, but are also among the most important advocates for the preservation and enhancement of fish resources and have positively contributed to fish population conservation globally (Bate 2001; Granek et al. 2008; Cowx et al. 2010).

To manage the potential for stakeholder conflicts and management dilemmas associated with the common-pool resource nature of many renewable natural resources, such as fish (Ostrom 1990, 2005; Ostrom et al. 1999; Dietz et al. 2003), varying resource governance structures, such as private, common, or public fishing rights regimes, have been implemented in many countries worldwide (Young 1999; Hilborn et al. 2005; Hoel and Kvalvik 2006). Even though many fishing-rights regimes still produce an overexploitation of fish populations

or effect other ecological and social issues such as inequitable access to resources and distributional conflicts (Begossi 1998; Kearney 2001; Edwards 2003; Almlöv and Hammer 2006; Yandle 2007), some form of property rights on fisheries resources or implementation of other form of harvest rights (e.g., appropriation rights for parts or the entire resource stock) is seen as important to manage recreational and other fisheries for sustainability (Ostrom et al. 1999; Hilborn et al. 2005; Costello et al. 2008). To better understand the various features as well as strengths and weaknesses of existing recreational fisheries property rights regimes, a comparative approach contrasting the United States and Germany is presented in this paper.

## Property Rights Regimes and Agents of the Governance Structure

Any form of use or access rights to natural resources such as fisheries is defined in the present paper and elsewhere (Demsetz 1967; Libecap 1989; Hanna et al. 1996) as "property rights." Property rights are assigned to individuals or groups of people who acquire different rights or duties associated with the property rights of natural resources. For example, property rights holders can have harvest rights and, at the same time, be responsible for resource management, including execution and enforcement of fisheries regulations. In some situations, fishing rights normally, but not automatically, include holding the resource owner accountable for maintaining a sustainable resource stock (Bromley 2009). Other people interested in access to fish stocks obtain, usually from the property-rights holders, restricted rights, such as access and withdrawal rights to the resource (e.g., by anglers buying permits). These permits are usually not connected with the responsibility of resource management. Thus, property-rights holders, such as private people, fishing associations, or the state,

govern the use of fish stocks (i.e., decide and contract on recreational fisheries management) and can be defined as agents or organizations of the governance structure (Williamson 2002).

Vatn (2005) distinguishes between four different property-rights regimes associated with natural-resource use such as fisheries: (1) private (individual) property; (2) common property, which is private property of a group of people (Bromley 1991); (3) public (state) property; and (4) open access (no property rights assigned). Depending on the property-rights regime, owners of fishing rights make decisions individually (1) or collectively (2, 3) about recreational fisheries management. Except open access, all property rights regimes can be identified for recreational fisheries in Germany in inland waters, but private property of fishing rights by a group of people (hereafter referred to as "common property" for simplicity) is the most salient form (e.g., when angling clubs and associations are the fishing-rights holders). In the United States, public property rights regimes exists for almost all inland waters; private property (individual or common) of inland waters occurs only rarely in some fee-based fishing ponds on private land and in other limited situations.

All property-rights regimes can be classified into five categories, each connected to particular rights and duties related to natural resource management and use (Schlager and Ostrom 1992):

- Access—the right to enter a defined physical area and enjoy nonsubtractive benefits (e.g., enjoying the waterside nonextractively).
- Withdrawal—the right to obtain resource units or products of a resource system (e.g., catch fish, divert water).
- Management—the right to regulate internal use patterns and transform the resource by making improvements (e.g., stocking of fish).
- Exclusion—the right to determine who will have access rights and withdrawal rights and how those rights may be transferred (e.g., selling angling permits).
- Alienation—the right to sell or lease management and exclusion rights.

Hereafter, we apply these five categories to characterize property-rights regimes in Germa-

ny and the United States for recreational fisheries in inland waters.

### Germany

Fishing rights in inland waters, which are all waters in the territory of Germany, are automatically assigned to ownership of the body of water and possibly sold or leased out to third parties (e.g., commercial fisheries, angling clubs, and associations). Fishing rights unrelated to the ownership of water bodies through heritage since the medieval times when land barons declared themselves owners of fisheries resources (Wolter et al. 2003) also exist. These fishing rights are called autonomous fishing rights and they are commonly found today on larger water bodies (e.g., large river systems) in some regions of Germany. They often result in the coexistence of multiple fishing rights holders on the same body of water, some of which have only restricted fishing rights (e.g., for particular gear types, Wolter et al. 2003). Typically, however, ownership of the water body guarantees fishing rights, which includes alienation and all four subordinated rights (exclusion, management, withdrawal, and access) to fisheries management and use (Table 1). Owners of fishing rights are either public or private entities. Waters of major public interest, such as large rivers for transportation or freshwater storage reservoirs for the provision of drinking water, are generally held under public ownership (e.g., on state or federal level) and are governed by public authorities. For other inland waters such as many natural lakes and gravel pits, or smaller rivers and brooks, ownership is often held either by municipalities, cities, private individuals, or nongovernmental organizations. Yet in almost all situations, fishing rights are leased out or sold to commercial and recreational fisheries stakeholders. Fishing rights are usually transferred from water body owners by contract for 12 years to fisheries-rights holders, such as angling clubs, angler associations, or commercial fishing enterprises, who take over exclusion, management, withdrawal, and access rights of the fish stocks. In Germany, angling clubs and angler associations are the dominant private fishing rights lease holders of freshwater fisheries resources (Arlinghaus 2004, 2006a), and as a group of people, they constitute a common

*Table 1.*—Five categories of property-rights bundles (Schlager and Ostrom 1992) applied to property rights regimes in inland waters in East and West Germany and the USA. The description summarizes the prototypical situation, but exceptions exist. NGO = nongovernmental organization.

Property rights categories	Property rights holders	Stakeholder
<b>West Germany</b>		
• Alienation	Water owners	Public (federal, state, municipalities) Private (individuals, NGOs, etc.)
• Exclusion • Management	Fishing rights holders	Angling clubs (common property)
• Withdrawal • Access	License and permit holders <sup>a</sup>	Members of angling clubs and all people issuing permits
<b>East Germany</b>		
• Alienation	Water owners	Public (federal, state, municipalities) Private (individuals, NGOs, etc.)
• Exclusion • Management	Fishing rights holders	Angler associations (common property)
• Withdrawal • Access	License and permit holders <sup>a</sup>	Members of angler associations and all people issuing permits
<b>USA</b>		
• Alienation	Water owners	The public
• Exclusion • Management	Water owners	State agencies on behalf of the public (public property)
• Withdrawal • Access	License holders <sup>a</sup>	Licensed anglers

<sup>a</sup> Note that in Germany, anglers need both a public angling license from state authorities that is pending passing an angling examination and a private angling permit from the fishing rights holder to be allowed to access and withdrawal fish in inland waters. In the USA, anglers only need to obtain a public angling license from state fisheries authorities to get access and withdrawal rights to waters under the license.

property rights regime. Individual anglers buying fishing permits from fishing-rights holders obtain only access and withdrawal rights (e.g., for one fishing season) and are not connected with management or exclusion rights.

Obtaining fishing rights depends on several prerequisites in Germany. Accordingly, before being able to lease a fishing right, the interested parties (e.g., commercial fishing enterprises or legal entities for recreational fisheries such as angling clubs and associations) have to prove to the fisheries authorities that the individual (commercial fishing enterprises) or leading member(s) of angling clubs and as-

sociations has conducted some sort of appropriate fisheries-education program (e.g., fisheries apprenticeship, attendance of seminars on fisheries management). This shall demonstrate their appropriate qualification for the execution of fisheries-management actions. There can also be supplementary prerequisites for obtaining fishing rights. For example, in some German states, before being allowed to lease a fishing right, angling clubs and associations have to prove that they serve the public interest (*Meinnützigkeit*) as a registered society, which includes, at the very least, nonprofit operation and openness to all interested affiliated mem-



bers (i.e., anglers). In addition, before fishing permits are issued, in most states anglers have to pass an examination proving their knowledge in ichthyology, aquatic ecology, legislative matters, and fish handling and killing processes in line with sophisticated fish welfare principles (von Lukowicz 1998). This angler examination is the basis for obtaining a public fishing license and becoming a member of an angling club or association. Consequently, with few exceptions, anglers in Germany need two authorizations to be allowed to go fishing: a public fishing license (issued by the state) and a fishing permit (issued by the fishing-rights holder) (Steffens and Winkel 2002).

An important feature in German recreational fisheries is the distinct governance structure in "East Germany" and "West Germany" (Figure 1). In West Germany, angling clubs on the local level constitute the major leaseholders of fishing rights and are thus users and managers of local fisheries at the same time, assisted by fisheries agencies and occasionally by a fisheries biologist employed by angler associations (Arlinghaus 2006a). In contrast, in present East Germany, the fishing rights are typically, but not always, held by state angler associations at the regional or state level (DAV 2004); angling

clubs in East Germany are organized within those angler associations and usually are not fishing-rights leaseholders or owners of water bodies. Thus, the system of largely centralized fisheries management in East Germany is based on large numbers of water bodies scattered throughout the state, while in West Germany, angling clubs typically manage a small number of fisheries in a decentralized way. The reason for this difference originates from the separated governance structures and legislative environments existing in West and East Germany before the reunification of Germany in 1990 (Herold 1998; Mau and Müller 1998; Grosch et al. 2000). Throughout this paper, we use the term "East Germany" to designate the territory of Germany that constituted the former German Democratic Republic (GDR) before the reunification in 1990 with West Germany (named Federal Republic of Germany [FRG]). Current Germany (also named FRG) is still characterized by a distinct governance structure in recreational fisheries (decentralized in "West Germany" and centralized in "East Germany"), and the two separate territories are pictured in the background of Figure 1.

In most German states, the major objective of the officials in the state fisheries authorities is

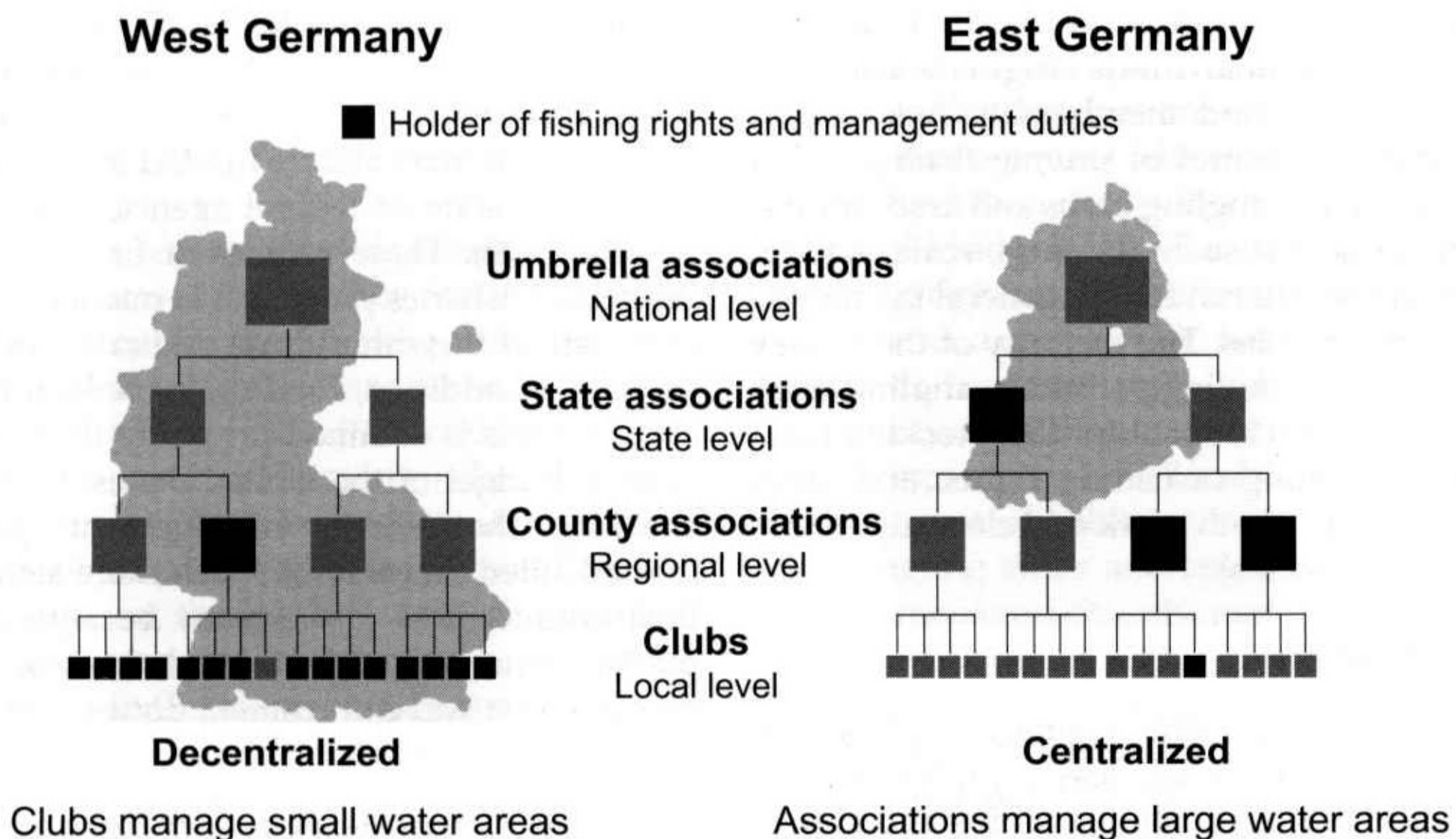


Figure 1.—Common property rights regimes in inland recreational fisheries on different levels in Germany. The prototypical situation is shown. In both West and East Germany one can find regional-level (West) and local-level fisheries governance (East) as exceptions.

to supervise and support recreational and commercial fisheries activities and management in inland waters in agreement with the rules prescribed in fisheries legislation (see below). In doing so, they enforce public interests in this policy field. In different states, public fisheries agencies take a more or less active role in supervising management actions of fishing-rights holders, (e.g., by controlling management plans developed by fishing-rights holders, so-called Hegepläne, Mau 1996; Wetzlar 2000). Fisheries authorities are well staffed in some states, while in other states, only a handful of people are responsible for fisheries issues for an entire state. One reason for this disparity might be that fishing-rights holders, such as angling clubs and associations, are supposed to deal sufficiently with major management issues on the local level, such that state authorities' involvement in fisheries management is not needed. A further reason is that inland fisheries are not considered overly important in current Germany (Rosenthal and Hilge 2000); thus, investments by public agencies into fisheries management are not a top priority.

The funding of the inland water management measures by fisheries authorities in German recreational fisheries is mainly provided by a tax system (based on angling license income, *Fischereiabgabe*, and other tax money) that varies in scope and magnitude from state to state. Additional funds originate from the fishing permits and membership fees, which are under the control of private fishing rights holders, such as angling clubs and associations. Larger projects, such as large-scale habitat management, are funded by general tax money from state agencies. The majority of the money raised through angling permits in angling clubs and associations is spent for fish-stocking measures, the renting of fishing rights, and other activities (e.g., youth work and clean-up operations at watersides).

### *United States*

The U.S. property-rights regimes of inland water resources are much less complex than in Germany because in almost all instances, fisheries resources are considered public property (Table 1). Inland waters of the United States can be defined as all waters wholly within the boundaries of the country, excluding the Great

Lakes. The ownership of fisheries is thus held by the public (i.e., the state has the alienation right and all other four subordinated rights [exclusion, management, withdrawal, and access], although there may be exceptions with certain trust species, etc.). State and sometimes federal fisheries agencies are involved in all issues surrounding management and use of the fisheries resources. In nearly all inland fisheries, anglers get access and withdrawal rights to fisheries resources by purchasing fishing licenses from state agencies (although some are purposely exempted, such as youth and others). Given this property-rights regime, the agents of the recreational fisheries governance structure are mainly state fisheries authorities. In some limited instances (largely as a result of treaty rights retained by Native Americans), there will be co-management relationships between state and tribal governments (Lamb and Coughlan 1993). Anglers in the United States only acquire access and withdrawal rights by obtaining fishing licenses but generally do not have the legal opportunity to acquire management or exclusion rights as do angling clubs and associations in Germany.

The funding of recreational fisheries management in the states is mainly provided through the sales of fishing licenses and other assorted fishing permits, an excise tax on recreational fishing equipment, and tax from gasoline used by recreational boaters (Radonski and Loftus 2008). Larger projects, such as large-scale habitat management, may also be funded by tax money from other state or federal agencies (Ross and Loomis 1999). These sources of funding allow most state fisheries programs to maintain extensive staff to fit within these dedicated funding streams. In addition, funding for federal fisheries programs is obtained primarily through the general budget of the United States. Generally speaking, the fisheries management agencies in the United States have much more staff than their counterparts in Germany because of the public ownership regimes and the associated management and enforcement duties.

### Legal Frameworks and Common Management Actions

A legal framework for fisheries consists of formal institutions governing fisheries. Informal



institutions such as taboos, norms, or codes of conduct (North 1990) also exist, affecting fisheries outside of the legal framework. All institutions can be defined as "rules-in-use" (Ostrom 2005). Their purpose is to regulate the relationship between humans as they utilize the common natural resource base (Vatn 2005). One major objective of formal institutions such as fisheries legislation and regulations is to regulate who is assured the property rights to use the resource and, potentially, which management duties and behavioral rules are connected to this right (Gordon 1954; Hilborn et al. 2005; Huppert 2005; Grafton et al. 2007). Another objective of fisheries regulations is the determination of minimum standards in resource management, such as size-based harvest limits, seasonal and spatial fisheries closures, or daily bag limits. The enforcement of property rights and harvest regulations for inland fisheries is usually guaranteed throughout the industrialized world by the state as the "unit of coercion" (Bromley 1992). However, in some fisheries governance structures, state responsibilities are further supplemented by granting fishing rights and associated management duties to private entities, such as in Germany. This results in differences in legal frameworks as well as operational management actions as a function of the property rights regime in place, as exemplified by the situation in Germany and the United States.

### Germany

Germany is a federal republic currently consisting of 16 states (*Länder*) after the reunification in 1990. Accordingly, 16 unique fishery acts and complementary ordinances exist because the sovereignty for inland fisheries is assigned to the state level in Germany (Mau and Müller 1998; Braun 2000). Regardless of the distinct features of property rights regimes in East and West Germany, the legal framework for inland fisheries management is similarly constructed in all states in Germany at the present time because of their origin in the Prussian fisheries law of 1916, which was the first in modern form in German territory (Herold 1998; Mau and Müller 1998). However, many specific details vary among the 16 fisheries laws (Braun 2000), such as the minimum age to be allowed to go fish-

ing. The minimum age varies between 7 and 12 and either requires assistance by a licensed angler or a special children's license (Steffens and Winkel 2002).

Generally, in Germany, three major types of formal regulations exist in all states; they are organized in three hierarchical levels and are binding for recreational and commercial inland fisheries management and thus for all fishing-rights holders. First, as mentioned earlier, every state has a fisheries act, which defines who is allowed to use (i.e., catch) fish resources and who is responsible for protecting and conserving fish stocks and fish habitats. Note that for wild fish stocks, this does not mean that the fish stocks are owned by the fishing-rights holder (*res nullis*), but they are the only stakeholders to have the right to catch and to manage them. Second, detailed minimum standards of resource management such as minimum-size limits, and protected seasons, permitted and prohibited fishing and angling gear, fisheries monitoring rules, and actions in case of administrative offenses are delineated in complementary fisheries ordinances. Third, bylaws are often established by private fishing rights holders (e.g., angling clubs, associations, or commercial fishing enterprises, see Table 1); they are not official laws, but nevertheless regulate specific conditions of local fisheries and are binding for angling club and association members. Except those water bodies used for aquaculture purposes, all inland waters are subject of the same general management duty (*Hegepflicht*) prescribed by fisheries acts in each German state (Mau and Müller 1998). This duty declares that all fishing rights holders are required to protect and enhance a species-rich, healthy, native, and natural or "near-natural" (*naturnah*) wild fish community, including all other aquatic organisms, in agreement with local ecological conditions in terms of habitat quality and structure. Thus, angling clubs and associations have the duty to manage not only game fish, but also nongame fish for conservation reasons (Salva 2008). Accordingly, fishing rights holders are allowed to strengthen the minimum standards of fisheries regulations in bylaws for waters under their management regime if these regulations are considered necessary to maintain sustainable exploitation levels and restore or protect a native fish community locally (Braun 2000).

Fisheries regulations in acts and ordinances in each of the 16 German states are the result of comprehensive negotiations between public fisheries authorities, representatives of elected parties, various stakeholders, and their interest groups. The policy decision process in most states is organized by the agricultural ministries, in particular by their fisheries officials. In addition, different interest groups with a stake in inland waters, such as recreational fishers, commercial fishers, environmental protection groups, and animal welfare groups, as well as scientists, have a say in this process. The results of this process—the modified fisheries acts and ordinances—have to be followed by private and public owners of waters and the respective fishing-rights holders in consistency with other laws in Germany (e.g., the Federal Animal Protection Act or the Federal Nature Conservation Act).

The above-mentioned framework in Germany can be characterized as a delegated co-management system (see McConney et al. 2007 for other forms of co-management) where many operational management duties are delegated from the state to the fishing-rights holders. In this approach, the government formally organizes the sector, but stakeholders in fisheries make day-to-day decisions with respect to planning and execution of fish stock management and conservation (Arlinghaus et al. 2002; Arlinghaus 2006a). To fulfill the obligation of sustainable use of fish stocks, all typical fisheries management measures (except voluntary catch and release, which is not officially used as a tool, see Arlinghaus 2007) are found in both East and West German inland recreational fisheries management (Table 2).

Despite the generally similar legal framework for recreational fisheries governance across Germany, some differences in the application of selected operational management tools can be identified in the distinct governance structures in East and West Germany (Table 2). In terms of access regulations, small angling clubs in West Germany carefully regulate the number of users to align with the usually restricted availability of fishing area. In addition, some fisheries authorities in West Germany prescribe a fixed number of allowable fishing permits per hectare of water area in fishing rights lease contracts or in management plans (Harsányi 1996; Klupp 2002). By contrast, recreational fisheries

management in East Germany is, by far, more open and less constrained in terms of access. In particular, angler associations in East Germany at state and regional levels deliberately do not restrict the number of permits on their usually abundant waters (DAV 2004). This also may limit the necessity to use closed fishing areas to control anglers' effort on intensively fished water bodies. Besides this difference in access "philosophy" (DAV 2004), all other input control measures (Morison 2004), such as closed fishing seasons, and rod and tackle restrictions (which also may serve an output control rule if the restrictions constrain catches) are similarly applied in East and West Germany. Typical output control measures (Morison 2004), such as bag limits or minimum-size limits, are regularly used throughout Germany (Arlinghaus et al. 2002). In general, there is a limited use of special size-based harvest regulations (e.g., protected or inverse slot-length limits, maximum-size limits, Arlinghaus 2006b; Arlinghaus et al. 2010). Instead, across Germany, harvest regulations are generally confined to protected species and minimum-size limits as prescribed in fisheries legislation and occasionally strengthened in local bylaws developed by angling clubs and associations, thus following a "one-size-fits-all" policy (Carpenter and Brock 2004) across entire states.

In terms of management measures directly targeting fish stocks and habitats, further differences between East and West Germany are apparent (Table 2). In West Germany, fish stocking measures tend to be conducted regularly in most water bodies governed by local angling clubs to maintain and increase fish stocks (Klein 1996). Similarly, in East Germany, fish stocking is regularly conducted by angler associations, but it appears to be conducted somewhat less intensively. In addition, in both East and West Germany, there is management of unwanted species (e.g., removal of zooplanktivorous fish supposed to reproduce uncontrolled and impacting negatively on water clarity; Mehner et al. 2004; Meinelt et al. 2008). Finally, habitat management measures such as enhancing spawning habitat or installation of fish migration facilities (Cowx and Welcomme 1998) and installation and maintenance of fishing sites are regularly conducted in German inland recreational fisheries management (Lauterbach 1998; Bartmann 1998).

Table 2.—Prototypical input and output controls, fish stock management, and habitat management measures in inland recreational fisheries management in East and West Germany and the USA.

	West Germany	East Germany	USA
Dominant governance structure	Angling clubs	Angler associations	State fisheries authorities
Scope of regulation	Small number of local water bodies	Large number of water bodies on regional or state levels	All inland waters, except for tribal waters
Input control			
• Access regulation	Membership and license/permit	Membership and license/permit	State license
• Closed fishing area	Sometimes	Rarely	Rarely
• Closed fishing season	Always	Always	Always
• Rod limits and tackle restrictions	Always	Always	Often
Output control			
• Bag limits	Always	Always	Always
• Minimum-size limits	Always	Always	Always
• Special size limits	Rarely	Rarely	Often
• Protected species	Often	Often	Often
• Voluntary catch & release	Not officially approved	Not officially approved	Sometimes (species-specific)
Fish stock management			
• Fish stocking	Always	Often	Often
• Reduction of unwanted species	Often	Often	Often
Habitat management	Sometimes	Often	Always



### *United States*

Legislation for recreational fisheries management in the United States is dependent on their location and the government jurisdiction under which these fisheries operate. Similar to Germany, the United States is a federal republic consisting of 50 individual states and the District of Columbia. In general, sovereignty for inland fisheries is reserved for the states, and each state has separate rules under which these fisheries operate. In some limited instances, recreational fish species are deemed "trust species" and, as such, fall under federal jurisdiction, regardless of where these species are located (Lamb and Coughlan 1993; Buck 1999). In the United States, fisheries resources are held in trust by either the state or federal government for use by all citizens (Lamb and Coughlan 1993; Buck 1999). Responsibility for management of inland recreational fishing and management generally resides with the state or Native American governments or, in a few limited cases, with the federal government. A common objective of fisheries agencies is to manage the recreational fisheries resources for public use today and for perpetuation of the resource for future generations. Management includes development of regulations, monitoring and assessment programs, public education, habitat and stock enhancement, and regulation of access to recreational fisheries resources. The detailed minimum standards of resource management, such as minimum-size limits and protected seasons, are delineated in state or federal laws or regulations. Federal jurisdiction over direct management of resources is limited to treaty rights and trust species, and recreational users have no direct rights to change fisheries regulations (outside of participating in a public comment process).

Comparable to Germany, many parts of the regulations for fisheries in the 50 states are rather similar in wording, generally to meet the intent of the ruling of U.S. Supreme Court (*Illinois Central Railroad v. State of Illinois*, 146, U.S. 387 [1892]), which has held that states have a duty to exercise protection of wildlife resources within the borders as a trust benefit of the people (Meyers 2003). However, there is considerable variance in specific regulations implemented by each state for each recreational fishery, and in

practice, regulations may differ from one fishery to another (Paukert et al. 2001; Radomski et al. 2001; Carlson and Isermann 2010). In most states, anglers over a minimum age (commonly 16) will need to purchase a fishing license, even though all citizens have the right to fish, regardless of age. There are few requirements to purchase general fishing licenses in a given state, effectively constituting an open-access situation. The cost of a fishing license varies by state and water types, and generally these licenses must be purchased every year.

Fisheries regulations in the United States are developed by the government agency with jurisdiction over the fishery, generally working through extensive public comment and input processes. Groups with an interest in the fishery provide written, oral, or formal input to proposed regulations, and these comments are integrated into the final regulations. In many instances, statutorily mandated commissions, commonly comprised of citizens of the states, have the final rule-making authority for recreational fishing regulations. Angling clubs, associations, and species-specific interest groups can influence regulations in recreational fisheries activities through lobbying and public input, although these voices are often specific to the group and may not be representative of all anglers (Hunt et al. 2010). Their interest might also disagree with the duty of fisheries agencies to weigh game and nongame fish management (Clarkson et al. 2005). However, the resulting regulations must be followed by all individuals participating in recreational fishing. Thus, a consultative co-management system (McConney et al. 2007) exists in the United States in which the government formally interacts with stakeholders in fisheries (e.g., angler groups) but retains the authority to make decisions with respect to day-to-day fish resource management. The management of inland waters in the United States is therefore conducted primarily by state fisheries agencies and by staff trained mainly in fisheries biology and less in the human dimension of management (Fulton and Adelman 2003).

Because recreational fishing property rights are publically held in the United States, management is centralized (i.e., the state agency is responsible for management authority). Direct input and output control measures (Morison 2004)

are generally not fixed in fishery legislation; the managers of inland waters are responsible for the development and implementation of these rules to manage each fishery, and in some states, there are many fishery-specific regulations (Pereira and Hansen 2003). Various forms of output control measures (i.e., harvest regulations, including also voluntary catch-and-release angling practices) are used extensively in the United States (Table 2) and are generally more common to use for management of recreational fish species than input control limiting effort (Cox and Walters 2002). Common harvest regulations as output regulations include protected species, daily bag limits, and various types of size-based harvest limits (Paukert et al. 2001; Radomski et al. 2001). By contrast, input controls such as direct limitations on angling effort (e.g., through closed fishing areas or entry limitations; Pereira and Hansen 2003) are rarely used in inland waters, except for seasonal closures on some species and rod limits and tackle limitations (Table 2). Most recreational fisheries management regimes in the United States do not limit the number of anglers or the amount of time that they can fish, but rely on the concept of "self-regulation" or the idea that angling effort and subsequent harvest declines toward zero as fish population's densities decline (Post et al. 2002). Thus, angling effort regulations are generally not seen as necessary, although there are recent papers calling into question the idea of self-regulation (Cox and Walters 2002; Post et al. 2002). Other management strategies such as fish stocking, removal of unwanted species, or habitat management are also used intensively in the United States (Table 2). They are usually developed by the fisheries agencies as part of an overall management strategy for recreational fisheries (see Epifano 2000; Radomski et al. 2001; Radomski 2003; Sullivan 2003; Clarkson et al. 2005).

### Fit of Common and Public Fishing Rights Regimes with Institutional Design Principles for Robust Common-Pool Resource Management

In the final section, we discuss potential consequences of the various fishing rights regimes described earlier for sustainable resource management by comparing the fit of each of

the property-rights regimes with eight design principles for crafting robust institutions (Table 3) identified by the recent (2009) Nobel Prize Laureate in Economics Elinor Ostrom and her colleagues (Ostrom 1990, 2005). These design principles are thought to facilitate sustainable management and governance of local common-pool resources such as fish stocks.

#### 1. Clearly Defined Boundaries

The focus of the first design principle for institutions capable of managing natural resources sustainably is that boundaries of the resource systems as well as institutional boundaries in terms of individuals or groups with full or restricted property rights (e.g., access and withdrawal rights) are clearly defined. The boundary rules are related to the assumption that if resource users can determine their own membership, including harvest, management, and exclusion rules, they are likely to develop higher levels of trust and cooperation among "insiders" of the group that are entitled to use and possibly manage the resource base (Ostrom 2005).

For inland waters in Germany and the United States, this principle is well addressed by a fully established public license or private permit system that facilitates identification of legitimate users of resources. However, in situations when fishing rights for particular (typically large scale) water bodies are held by multiple fishing rights holders or mobile fish move between river sections or across state borders, the identification of property rights is difficult. This might influence the incentives of managers to invest into the resource facing the situation that stocked fish in a river section of one fishing-right holder might be harvested by another fishing-right holder. Generally, in both the United States and Germany, managers and anglers experience clear and legally fixed boundaries of access, use, and management responsibility on their waters, although each country has numerous interjurisdictional waters. Notwithstanding, the identification of "outsiders" might be easier in small user groups fishing on a small number of water bodies, either because of personal knowledge of peers or local enforcement of rules and licenses by authorized enforcement personnel. Thus, the principle of clearly defined boundaries in terms of the possibility to identify "insiders" and "outsiders" seems to be particularly well addressed in com-

Table 3.—Fit of property rights regimes in West and East Germany and the USA, with eight design principles for crafting sustainable resource management institutions (Ostrom 2005). The description summarizes the prototypical situation, but exceptions exist.

	West Germany (angling clubs)	East Germany (angler associations)	USA (fisheries authorities)
<b>1. Clearly defined boundaries</b>			
License and permit system	Restricted	Clearly defined	Not restricted
Number of permits/licenses		Not restricted	
Water boundaries	High	Clearly defined with few exceptions	Low
Effort limitation on particular waters	High	Medium	Medium
Place attachment		Medium	
<b>2. Equivalence between benefits and costs</b>			
Investments into fish results in exclusive benefits for users	High	Medium	Medium
Free riding and rivalry in consumption	Low	Medium	Medium
<b>3. Collective-choice arrangements</b>			
User involvement in the establishment of local rules	High	Medium	Medium
User commitment to local rules	High	Medium	Medium
Involvement of science-educated staff	Low	Medium	High
<b>4. Monitoring</b>			
Scientific support	Low	Medium	High
Scientific data quality	Low	Medium	High
Local knowledge	High	Medium	Medium
User involvement	High	Medium	Low
<b>5. Graduated sanctions</b>			
Enforcement among users	High	Medium	Medium
Peer pressure for rule compliance	High	Low	Low
Perception of severity levels for offences	Low	Low	Medium
<b>6. Conflict-resolution mechanisms</b>			
Communication intensity	High	Medium	Low
Speed of conflict resolution	High	Medium	Low
External support	High	Medium	Low
<b>7. Recognition of rights to organize</b>			
Local user rights	High	Medium	Low
External recognition	Low	Medium	High
<b>8. Nested enterprises</b>			
Ability to deal with local issues	High	Medium	Low
Networks and political power on regional and states level	Low	Medium	High

mon fishing rights systems at local levels in West Germany, followed by East Germany and then the United States.

The principle of clearly defined boundaries is also related to the number of waters available to anglers. This affects both anglers' access and their emotional relationship to a given local water body (called "place attachment," Kyle et al. 2004; Jorgensen and Stedman 2006). The number of waters under a particular governance regime differs substantially in West Germany and East Germany/United States. Accordingly, effort control measures are more regularly implemented in West Germany (to align number of users with the availability of water) than in East Germany or in the United States, where state or regional level governance of large-scale fisheries with a "quasi-open-access" policy to local fisheries is common. In this situation, the idea of clearly defined boundaries is violated from the perspective of unregulated access of license and permit holders within association or state waters. Facing other anglers harvesting the same fish stock might strongly reduce the willingness of an individual angler to sacrifice personal harvesting because others might free-ride on the personal conservation investment. This quasi-open access may enhance risk of overexploitation for particular water bodies (e.g., those that are close to cities and large aggregations of angling effort, Cox and Walters 2002; Post et al. 2002, 2008). Quasi-open access might also reduce the development of the so-called attachment to place and the associated environment stewardship among anglers towards local fisheries (Epifano 2000; Jorgensen and Stedman 2006; Moore and Sowles 2010). The degree of clearly defined boundaries and the associated benefits for sustainable exploitation and management seems to be expressed strongest in West Germany, intermediate in East Germany, and lowest in the United States.

## *2. Proportional Equivalence between Benefits and Costs*

The second design principle facilitating the development of sustainable natural resource governance relates to the proportional equivalence between benefits and costs. Under this principle, rules specifying the amount of resource products (e.g., fish harvest) that a user or user group is allocated is related to local conditions

(e.g., productivity, scarcity of the resource) and is proportional to the inputs (e.g., labor, materials, money, energy, time, and monitoring costs) needed to produce the benefit. The design principle of proportionality of benefits and costs also relates to the likelihood that users feel the rules they are exposed to be equitable and fair.

Due to the license and permit system in both Germany and United States and the reinvestment of funds into fisheries resource conservation and management, a proportional equivalence between benefits (fish extraction, angling experience) and costs (permits and licenses) exists to some degree within the angling community. Therefore, the principle of equivalence of benefits and costs might be perceived to align particularly well with access-restricted management systems, such as in West Germany. Indeed, the limited number of waters and accordingly restricted number of anglers managed by angling clubs might also be perceived as costly and inequitable by the excluded angler community. However, a generally well-balanced equivalence between angling activities and permit system collapses when external drivers, such as nonfishing-related habitat loss, strongly impact fish stocks, as is often the case (Cowx et al. 2010). In such situations large investments by angling clubs and associations in Germany or the state fisheries agencies in the United States do not result in equivalent benefits for the angler constituency. Irrespective of the fishing-rights regime in place, this may undermine the incentives of fisheries stakeholders to invest into natural resources via fisheries conservation and management measures.

In addition, the principle of proportional equivalence between benefits and costs is violated under certain conditions, in particular if individual angler behavior does not correspond with social interests of the angling club or association community. The argument runs as follows: access to fish is typically common to all fishing license and permit holders in all three governance structures. While each angler receives the immediate benefits of catching the limited resource, the individual angler might not internalize the potential costs of taking the fish, which may result in overfishing (Post et al. 2002), and these overfishing costs are shared among all anglers. This phenomenon is called free-riding. Thus, because the social costs of overfishing are



not necessarily part of the economic thinking of each individual angler, it is economically rational for the individual to take a fish before another resource user harvests it (Hardin 1968). Quasi-open access within defined resource boundaries occurs in both the United States and Germany and may, in turn, create social dilemmas known as the "tragedy of the commons," where selfish behavior impacts on the collective well-being (Hardin 1968, 1998).

The rivalry among license or permit holders to harvest fish resources is supposed to be controlled or reduced by bag limits or other harvest regulations in order to distribute harvests more equally in both the United States and Germany (Radomski et al. 2001). However, harvests in recreational fisheries are nearly always unequally distributed among anglers (Smith 1990; Baccante 1995) because harvest success of the individual is strongly affected by angler skills and an individual angler's investments in fishing in terms of time and financial resources (Arlinghaus and Mehner 2003). The principle of proportional equivalence of benefits and costs, applied to the individual angler perspective, implies that those anglers who invest more time in fishing, and possibly also into maintenance of fisheries, should receive more benefits (e.g., higher annual harvests). This is usually not the case, which might fuel rivalry in consumption and a "race for fish" among the angling community. This situation can be oriented along a gradual continuum of risk among the difference governance approaches for inland fisheries, depending on the intensity to which anglers' harvest activities are monitored. For example, the possibility for intensive regular interaction among individual anglers in small-scale, local angling clubs in West Germany may enhance mutual surveillance and build friendships and trust. This may, in turn, facilitate the formulation of informal rules of commonly agreed conservation behavior, reducing the risk of free-riding (Moore and Sowles 2010). By contrast, in East Germany and the United States, individual anglers are potentially more disconnected from participation in management decision making and planning of conservation actions in specific local water bodies relative to West Germany. Thus, in these systems, anglers may perceive other anglers not as members of a close peer group sharing a common resource pool, but rather as competitors, which might re-

duce cooperative behavior substantially (Kitts et al. 2007). The anticipation of shared costs stemming from overfishing and the consideration of such potential when weighing benefits of take versus potential costs of take might thus be lower for anglers in large-scale property-rights regimes in East Germany and the United States than in small-scale regimes such as those in West Germany.

### 3. Collective Choice Arrangements

The third design principle of importance for sustainable governance of natural resources held in common is the importance that individuals who are affected by harvesting and resource protection rules at the local level are included in the group who is entitled to modify these rules. Property-rights regimes that allow local resource users to devise their own rules should be better able to create, adapt, and enforce rules that fit social and ecological circumstances. Involvement of local resource users in collective choice arrangements capitalizes on the local ecological knowledge and the users' strong incentives to abide by locally tailored rules (Pomeroy and Berkes 1997; Berkes 2003). In addition, user involvement in decision-making processes increases the probability that rules are considered fair by all users, which might further promote cooperation, self-commitment, and rule compliance (Bryan 2004).

In Germany, all fishing-rights holders are largely independent of fisheries agencies or other bodies able to tailor harvest or other management regulations specifically to local ecological conditions. Moreover, such rules are often decided collectively in the angling club where anglers' involvement in decision making is relatively direct, especially in the local governance structure of West Germany. By contrast, in East Germany, the potential of individual anglers to influence fisheries-management decisions is more difficult because anglers need to overcome up to three internal organizational levels to initiate changes in the angler associations' bylaws, usually determined by a limited number of association leaders. Yet, collective choice by recreational anglers is generally possible across most inland fisheries in Germany.

By contrast, in the United States, the possibility for collective choice of management



regulations by local anglers is more constrained, despite the existence of intensive public input processes (Hennessey and Healy 2000; Fayram et al. 2009). This can be either an advantage or a disadvantage, depending on whether anglers' opinions align with broader societal goals. For example, the planning and implementation of fish stocking practices to maintain or enhance stocks of recreationally highly valued species, which might have harmful genetic effects or may contribute to the spread of diseases (Lewin et al. 2008), are under the control of scientifically trained experts in fisheries agencies in the United States and are not left solely to anglers. Similarly, people educated in fish and fisheries biology are routinely employed by angler associations in East Germany to guide fisheries-management decision making. From a conservation perspective, this is an advantageous situation compared to West Germany where voluntary fisheries managers in local angling clubs make decisions about stocking practices largely independently and with little scientifically trained expert assistance and may occasionally do so unsustainably to comply with peer pressure by local anglers (Arlinghaus 2006a).

#### 4. Resource and Resource-User Monitoring

The fourth design principle emphasizes the importance of monitoring both the condition of the resource as well as the resource user. This entails gathering knowledge about fish stocks and harvesting activities, as well as monitoring rule compliance and other dimensions of anglers' behavior (EIFAC 2008). In addition, monitors should be accountable to fishing-rights holders and the resource-user community.

In Germany, depending on the size and importance of the water body, monitoring of fish stocks in angling clubs and associations is conducted with the assistance of authorities and state fisheries research organizations (Klupp 2002; Rümmler 2007). However, in most situations, fish stocks are self-monitored by angling clubs and associations, mainly using catch diaries (total catches at the species level and the water body, Mau 1996), and anglers are monitored by officers. Fishery-independent surveys are rare in smaller water bodies in German angling clubs and associations. Moreover, diaries and fishery-independent surveys are not standardized

across clubs or associations. The return rate of anglers' diaries is often low (Brämick 2008), and diary information is supposedly biased towards more avid anglers (Bray and Schramm 2001). In addition, because diaries usually collect catch information without corresponding data on effort, a reliable assessment of population trends is not possible (Murawski et al. 2005; Brodziak et al. 2008). The situation is particularly relevant in angling clubs in West Germany. They usually do not conduct standardized stock assessments and only occasionally engage professional fisheries biologists. The situation is more professional in angler associations in East Germany (which are typically larger and therefore financially better equipped). These associations usually can afford to hire one or more professional fisheries biologists for coordinating monitoring and assessment activities and advising local angling clubs. This is in stark contrast to the situation in the United States where the monitoring and assessment of fisheries is exclusively conducted by professional fisheries biologists and managers in fisheries authorities. They regularly monitor the status of fish stocks changes and, to a lesser extent, the catch and harvest by, and the human dimensions of, anglers (Fulton and Adelman 2003). In addition, fisheries managers in the United States regularly publish peer-reviewed reports and papers using agency-derived data of high quality, whereas there is no similar professional documentation and publication outlet for recreational fisheries management results in Germany.

These different professional standards in the United States and Germany can be explained by the public versus private monitoring mandate in both systems. In Germany, private fishing rights holders are largely responsible for overseeing their fisheries and are not required by law to collaborate with fisheries biologists outside fisheries agencies. In the United States, monitoring activities are based on scientific principles (e.g., creel surveys, angler surveys, see Pollock et al. 1994, 1997; for standardized fish sampling, see Bonar et al. 2009). Additionally, a condition for accepting a major source of funding for public agencies in the United States (Sport Fish Restoration Program) requires state agencies to maintain professional staff. Therefore, it is safe to assume that the quality of monitoring data is higher in the United States

than in most parts of Germany. Yet, in the face of often hundreds of thousands of freshwater fisheries, there are always trade-offs to be made between regular monitoring efforts and financial investments into other activities (Hayes et al. 2003; Lester et al. 2003; Fayram et al. 2009). Consequently, full and updated knowledge about all freshwater fisheries in a landscape will possibly never exist because of logistic and manpower constraints.

While the quality of monitoring data about freshwater fisheries differs in Germany and the United States, the strength of a local self-organized monitoring system, as implemented in West German angling clubs, is that the management boards and local anglers accumulate a wealth knowledge about local ecology and anglers' behavior and preferences, which in turn feeds back to influence locally tailored management decisions. Peer pressure to monitor each other's practices (compare Hauert et al. 2007; Sigmund 2007), as well as surveillance of unintended effects of nonfishing stakeholders and industries on aquatic ecosystems, is thus normally strong, providing an effective barrier to illegal activities. Such type of local monitoring and management is more difficult for regionally governed East German fisheries systems, particularly in the vast water areas in the northern part in Germany, and management systems in the United States (Fayram et al. 2009).

### 5. Graduated Sanctions

The fifth design principle of importance for sustainable common-pool resource governance stresses that users who violate rules and therefore risk sustainable conservation of the resource receive graduated sanctions that align with the severity of the offense. This, for example, entails that the first violation with minor ecological or social impact (e.g., keeping an undersized fish) may be given a low sanction (e.g., a small monetary fee) while severe or repeated rule breakings may be heavily punished by the user community (e.g., lifetime loss of angling license). Maintaining some level of sanctioning is important for keeping the system functional because rule violations without sanctions can generate a downward cascade of unsustainable resource use among a user community (Ostrom 2005).

Sanctions can be imposed by any person or public officials accountable to users. In the United States, there are detailed regulations as well as graduated sanctions for inland waters, and they are enforced by state (and, in some cases, federal) fisheries authorities. The intensity of law enforcement and the severity of the sanctions for identical offenses (e.g., illegal stocking), however, vary widely among jurisdictions (Johnson et al. 2009). In Germany, graduated sanctions that depend on the frequency and severity of noncompliance with rules are formally detailed in all three types of formal regulations (fisheries acts and ordinances and angling club or association bylaws). Rule infractions are mainly divided into administrative offenses, which include infractions such as using more rods than allowed, keeping an undersized fish, or infringement of stocking regulations such as introduction of nonnative species, and statutory offenses such as larceny or poaching (e.g., harvesting fish without a private angling permit from the fishing-rights holder). In the German state Thuringia, as an example, administrative offenses graduate from on-the-spot fines at very low levels (generally below 50 euros) versus penalty charges at notably higher levels (e.g., in case of recurrence, with a maximum limit of 5,000 euros). Statutory offenses are more strongly punished and are regulated in the German Criminal Code (e.g., §293 for poaching of wild fish). They are sanctioned with prison up to 2 years or monetary penalties up to several hundred or thousand euros.

In Germany, property-rights offenses are regarded much more severely than stocking regulations violations, although the latter can have serious and potentially irreversible ecological consequences (e.g., release of a nonnative fish, Johnson et al. 2009). For example, in Thuringia, stocking regulation offenses are punished with fines of 100–500 euros in the first offense and 200–2,500 euros in case of recurrence. Illegal stocking in the United States is punished with a maximum fine of \$10,000 and a year in jail, but the typical penalty is about \$2,000 (Johnson et al. 2009). The rather small penalty for violating stocking regulations does not convey the seriousness of the crime. This can be considered "not graduated" in both the United States and Germany because the introduction of nonnative species or genotypes not

native to particular habitats can cause severe damages to aquatic biodiversity and may result in large restoration costs that easily exceed the penalty charge by several million U.S. dollars (Johnson et al. 2009). Bylaws of German angling clubs and associations usually do not compensate these and other loopholes in fisheries acts and ordinances. They instead focus on violation of club- or association-specific regulations. Here, the most severe sanction is exclusion from the angling club or association, which regularly happens in case of repeated or severe violation of club rules. Despite the existence of graduated sanctions in Germany and the United States, execution of graduated sanctions is challenging because of difficulties in enforcement. Yet, due to the small scale of many West German angling clubs, enforcement of rules and rapid execution of club-specific sanction are likely to be easier than in East Germany and the United States. Moreover, the small size of the angling clubs probably may result in greater transparency of rules and regulations, greater peer pressure, and less rule-breaking behavior.

#### 6. Conflict-Resolution Mechanisms

The sixth institutional design principle refers to a conflict-resolution mechanism that shall be rapid, low-cost, and locally tailored to ensure that rules are understood by all resource users and officials. Conflicts in recreational fisheries encompass user and management conflicts. User conflicts refer to relationships among anglers or between anglers and other resource users while management conflicts relate to issues of acceptability of fisheries-management issues or impacts on fisheries resources originating from outside the fisheries sector (compare Arlinghaus 2005). Solving conflicts demands good communication of rules and regulations to users and involvement of users in decision-making processes (Krueger and Decker 1999). Many conflicts can be avoided a priori when rules are clear to everybody and agreed upon by all (Osstrom 2005).

Comparing the different property-rights regimes and their ability to deal with user conflicts, the West German decentralized management approach may provide more rapid access to low-cost local processes to conflict resolution because anglers and managers know each other

well and communicate intensively. By contrast, anglers in East Germany and the United States often do not know and never meet the fisheries officials on the regional or state level. Thereby, conflicts or misunderstandings about regulations might accumulate over time and might not be resolved quickly. Similarly, user-conflict resolution among anglers and between anglers and managers are more challenging at the local level in quasi-open-access fisheries in East Germany and United States where anglers are largely disconnected from decision makers in agencies and regularly meet "strangers" (unknown anglers) at their local fisheries. Conflicts in the United States are generally resolved by the fisheries agencies after listening to concerns of the conflicting agents through processes such as formal commission meetings or through other official processes.

As mentioned before, the close and regular contact probably facilitates rapid conflict resolution mechanisms in West Germany. However, this assumption is fraught with uncertainty and depends on the type of conflicts. For example, many interpersonal conflicts might emerge because people regularly interact with each other in small angling clubs (e.g., conflicts between two anglers over an angling site, Arlinghaus 2005). Some additional management conflicts are more difficult to solve and address in small-scale West German angling clubs, relative to East Germany and the United States. For example, due to the usually small number of fisheries and fishing opportunities managed by angling clubs in West Germany, satisfaction of diverse angler types might be more difficult than in East Germany and the United States. Moreover, many threats and challenges exist in inland recreational fisheries that originate from external impacts on freshwater resources (Cowx et al. 2010). These challenges are more difficult to solve in West Germany's local angling clubs because of little financial and political power. Indeed, in contemporary German society, recreational fisheries are often perceived as a minor policy field and thus have been neglected or ignored by policy makers (Arlinghaus 2006a). In turn, hydropower development, flood prevention, or nature protection measures, excluding recreational fisheries, are often given higher priority compared to development of recreational fisheries (Arlinghaus 2006a). In these situa-

tions, larger organizational bodies such as angler associations in East Germany, or fisheries agencies in the United States, may have greater financial and political power to engage in, and potentially resolve, the resulting management conflicts through cooperative partnerships and political lobbying (Arlinghaus 2005). Finally, some specific forms of conflict (e.g., claims by nature conservationists that angling is depleting stocks) demand access to sophisticated knowledge and scientifically solid data. These data are often lacking in small-scale angling clubs in West Germany and are more likely to exist under public governance in the United States or in East Germany. These governance regimes may thus offer better mechanisms to resolve such "science-based" knowledge conflicts.

#### *7. Minimal Recognition of Rights to Organize*

The seventh design principle for robust institutional design refers to the importance of retaining a minimal recognition of rights of users to devise their own institutions in the long term, which involves the precondition that users of resources have long-term tenure rights to the resource.

This principle is well established in Germany's inland fisheries. Here, angling clubs and associations as fishing-rights holders are entitled to devise their own regulations in by-laws to guarantee sustainable use and management of local fisheries. These rules and regulations can be established largely independently of any other body or stakeholder. In addition, 12-year lease contracts for fishing rights secure long-term access and management rights, and these rights are well recognized by governmental authorities (Braun 2000). By contrast, in the United States, while there is a strong societal-level support for recreational fisheries, individual anglers or angling clubs cannot devise fisheries regulations independently of public agencies. However, anglers in the United States retain the right to organize into groups. These groups may then import their interests into fisheries management decisions, although these interests often vary among different anglers' organizations (Churchill et al. 2002). In limited instances, within some U.S. states, umbrella organizations have formed to purportedly represent the interests of all angling groups, similar to the

East German angler associations. This organization level may become politically important when recreational fisheries are threatened by groups who aim at restricting or even banning angling activities (Arlinghaus et al. 2009).

#### *8. Nested Enterprises*

The last design principle of importance for sustainable governance of natural resources held in common refers to situations where common-pool resources transcend large spatial scales, potentially crossing jurisdictional boundaries (e.g., a large river). In these situations, governance activities regarding appropriation, provisioning, monitoring, enforcement, and conflict resolution shall be organized in multiple layers of nested enterprises.

Both governance approaches for fisheries in East and West Germany developed multiple layers of organization (clubs, state associations, national umbrella associations, and state fisheries authorities) to deal with recreational fisheries challenges on all spatial and temporal scales. However, this does not necessarily assure scale matching to deal with pertinent issues impacting fisheries resources. For example, local angling clubs in West Germany have low capacities to influence a water power plant impacting fisheries resources because of the mismatch of institutions and because fisheries and water management issues are dealt with in separate ministries. Even fisheries agencies in Germany have difficulties enforcing fisheries interests because of the generally low priority of fisheries in the context of water and nature conservation management activities (Steffens 2006). Similarly, in many situations, habitat management rather than fish stocking might be the most sustainable management action in the face of large anthropogenic impacts on freshwater fisheries (Arlinghaus et al. 2002). However, large-scale habitat management cannot be conducted and financed by anglers alone, necessitating partnerships with various agencies, landowners, and stakeholders (Arlinghaus 2006a; Cowx et al. 2010). The principle of nested enterprises is better addressed in East Germany than West Germany because dealing with these scale mismatches can be easier for large angler associations with management responsibilities and advanced social and political networks at regional or state levels (Sutinen and Johnston 2003). It is particularly well addressed in the



United States because management responsibility here resides with centralized governmental authorities and therefore there is more financial and political ability to match the scale of the problem for fisheries resources with appropriate management responses (Radomski et al. 2001; Roni et al. 2002; Cooke and Cowx 2006). Despite this positive potential in the United States, there is some agreement that a more regional perspective is needed for sustainable exploitation of inland fisheries in North America (Lester et al. 2003; Fayram et al. 2009). However, issues arising at the local level might be easily overlooked under this "broad-scale management" (Lester et al. 2003) because of less consideration of local anglers and local ecological conditions in the planning and design of regulations. This, however, may only be possible through rigorous nesting of enterprises and organizations from local to state levels. For the future, all existent property-rights regimes should be evaluated in terms of how well organizations for fisheries governance are nested from local to regional and states levels and if they are sufficiently capable of solving both large-scale and small-scale issues.

## Conclusions

We have described one public and two common property rights regimes of inland recreational fisheries management by drawing on the United States and Germany as case studies. These regimes have a unique set of strengths and weaknesses when analyzed against eight design principles for robust institutions in sustainable resource management put forward by Ostrom (1990, 2005). The literature on common-pool resource management stresses the importance of user participation in day-to-day management decision making for sustainable resource management (Ostrom et al. 1999; Dietz et al. 2003). As we have shown in our analysis, the degree of participation and involvement of local anglers in fisheries-management decision making constitutes a major difference between the United States and Germany. The difference is that German anglers' representatives in clubs and associations have a direct ownership stake in the inland fisheries and therefore generally make the actual management decisions (e.g., on fish stocking). In contrast, U.S. anglers have an ownership stake as members of the general public, and their

involvement in fisheries management is generally restricted to the policy level. This difference may affect the functionality of the fisheries governance systems. The strengths of common property rights regimes, particularly if small-scale such as in West Germany, are built on regular communication and trust among local users and include (1) increased acceptability of effort controls to manage local fisheries, (2) fostering and use of traditional ecological knowledge, and (3) strong place attachment by anglers resulting in timely conflict resolution and peer pressure towards rule compliance. Major downsides in Germany's inland fisheries, which are particularly pronounced in West Germany, are the restricted access for anglers to a limited number of fisheries under angling club management, including comparably high angling permit prices, and the lack of scientific monitoring data and science-based expert assistance in fish stock assessment activities and management planning. This induces the risk that potentially unrealistic anglers' expectations and perceptions dominate management activities, resulting in nonsustainable management practices such as intensive stocking. This risk is much less pronounced in the public fishing rights system in the United States, whose strength includes the existence of high-quality fisheries-dependent and fisheries-independent data. These data provide the base for management decisions implemented through comparatively well-staffed fisheries agencies. U.S. managers may therefore better deal with potentially ecologically unrealistic expectations by the local angler constituency and they can develop a landscape perspective for recreational fisheries management. Such perspective facilitates the possibility to manage for diverse fishing opportunities across the landscape avoiding pitfalls of one-size-fits-all policies (Carpenter and Brock 2004). Based on the review presented in this paper, we can conclude that the United States is providing a more structured and science-based system to recreational fisheries management, whereas the German system is based more on user self-organization and, to some degree, trial-and-error management based on anecdotal evidence and experience by local managers (Arlinghaus 2006a). However, the science-based system in the United States comes at the cost of local anglers having comparably little direct involvement in management decisions



compared to their greater involvement in West Germany. In addition, researchers recommend that U.S. fisheries managers incorporate more angler knowledge and information about anglers' behavioral patterns in their management processes (Ditton 1996; Hunt and Ditton 1997). Depending on the quality of communication between U.S. fisheries agencies and the fishing public, this may challenge management credibility (Sutinen and Johnston 2003; Fayram et al. 2009) and affect compliance with regulations (Gigliotti and Taylor 1990; Pierce and Tomcko 1998; Sullivan 2002; Walker et al. 2007). The East German management and governance approach can be located somewhere in between West Germany and the United States, although it is clear that the quality of science-based data is weaker compared to the United States.

One issue that may be a common threat to all fishing rights regimes is the risk of pronounced rivalry among anglers for fisheries resources within defined boundaries of state, angler association, or angling club waters. This calls upon the need for continued enforcement of rules and regulations (Walker et al. 2007) and thorough and continued communication of the rationale of all changes to regulations to the local anglers. This is particularly challenging in large-scale management systems such as in East Germany and the United States where users are dispersed throughout the landscape and not personally known to the managers.

Each of the three distinct governance structures described in the present paper has inherent strengths and weaknesses. Our findings agree with Sikor's (2008) observation of a false dichotomy between private and public property rights regimes for natural resources because both regimes operate functionally on different levels and to different degrees. Similarly, the three fishing-rights regimes examined in this paper are functional and do not necessarily result in more or less sustainable trajectories. To be functional, property rights should be appropriate to both the attributes of the resource and the resource user and are therefore always specific to a particular cultural and ecological setting (Ostrom et al. 1999; Anderies et al. 2004; Paavola and Adger 2005). A functioning management system for natural resources generally depends on well-established and well-defined property-rights rules (Schlager and Ostrom

1992; Radomski et al. 2001; Yandle 2007). This is given in both the United States and Germany, and due to lack of comparative biological and social science data, we cannot conclude which of the governance regimes examined is more or less likely to assure sustainable exploitation. By carefully reflecting on the weaknesses of each system, institutional change can be initiated to improve the future functionality of the recreational fisheries governance and management systems.

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