GLOBAL CHALLENGES IN RECREATIONAL FISHERIES

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Chapter 3

Meaning and relevance of the ecosystem approach to recreational fisheries management

Emphasis on the importance of the human dimension

Robert Arlinghaus and Ian G. Cowx

Abstract

In recreational fishing, high and often selective angling mortality coupled with deleterious management actions such as stocking non-native fish can, under certain situations, impact fish communities and entire ecosystems. To counterbalance these impacts, an ecosystem approach to recreational fisheries may be needed. This chapter reviews the meaning and relevance of the ecosystem approach for recreational fisheries focusing on inland waters. It examines the principles behind the approach and potential constraints on adoption in recreational fisheries management. Most of the principles of the ecosystem approach for recreational fisheries are already enrooted in a properly defined sustainability paradigm. Thus, the concept is not new. For its success, it is important to account for the vital role of the human dimension in at least two areas: setting of management objectives and expecting paradoxical dynamics resulting from the anglers' behaviour. Local capacity-building and self-empowerment of anglers to internalize the importance of an ecosystem approach to recreational fisheries management is crucial if recreational fisheries are to be integrated into the wider framework of aquatic ecosystem management.

Introduction

Recreational fishing is firmly established as the dominant or sole user of many coastal and most inland fish stocks in industrialized societies (Arlinghaus *et al.*

2002), and its importance in less developed countries is increasing rapidly (Cowx 2002b). Fishing activity of any kind, whether commercial or recreational, affects fish communities (e.g. size and age structure, recruitment), food webs (e.g. trophic relationships) and, indirectly, aquatic ecosystems (Pauly *et al.* 2002; Post *et al.* 2002). Given the potential cumulative fishing mortality of millions of recreational anglers, it is possible that recreational angling can deplete exploitable fish stocks in much the same manner as has occurred in commercially exploited marine stocks (Goedde and Coble 1981; Cooke and Cowx 2006; Lewin *et al.* 2006). Indeed, Post *et al.* (2002) discussed several examples of angler-exploited Canadian freshwater fish stocks that showed signs of severe overexploitation, with some stocks of rainbow trout (*Onchorhynchus mykiss*), walleye (*Sander vitreus*), pike (*Esox lucius*) and lake trout (*Salvelinus namycush*) collapsing or declining severely in two to three decades of intensive fishing. Of the 27 walleye fisheries examined by Sullivan (2003), 12 collapsed in response to angling mortality. Also, in the marine environment, there are well-documented examples of recreational fishing contributing to stock declines (Schroeder and Love 2002; Westera *et al.* 2003). The main reason for these patterns is that locally annual exploitation rates can range up to 80% for popular target species (reviewed by Lewin *et al.* 2006). Despite this evidence, the potential role of recreational fishing in global fish reductions seems to be largely ignored by decision makers (Cooke and Cowx 2004, 2006). This is partly because weak monitoring and the diffuse nature of recreational fishing in the landscape leads to invisible stock declines (Post *et al.* 2002). As a consequence, the potential negative biological impact of recreational fishing is less obvious to stakeholders, fisheries managers and politicians (Post *et al.* 2002), which, in reality, can constitute a conservation issue of global relevance, particularly in selected freshwater fisheries (Arlinghaus and Cooke 2005).

Unintended consequences of fishing, including habitat destruction, incidental mortality of non-target species, evolutionary shifts in population demographics and changes in the function and structure of ecosystems are being increasingly recognized in the marine commercial fisheries (Pauly *et al.* 2002; Pikitch *et al.* 2004). Critical in this respect is the need to recognize that recreational fishing can also induce large-scale, sometimes irreversible, changes in fish communities and aquatic ecosystems. This can be related to selective exploitation patterns inducing ecological and evolutionary changes in the fish stocks (see Cooke and Cowx 2006; Lewin *et al.* 2006; Lewin *et al.* this book for extensive reviews) or be a result of detrimental fishing practices or management actions, especially stocking of native, hatchery-reared fish and introduction of exotic species or transfer of fish across catchments (Arlinghaus *et al.* 2002; Cooke and Cowx 2006; Lewin *et al.* this book). Stocking, for example, can be both beneficial or extremely detrimental to the ecosystem and fish community structure and functioning. An example of negative ecological impacts associated with introductions is brown trout (*Salmo trutto*) stocked into New Zealand streams and subsequently displaced

many native fishes in the family Galaxiidae. Historically, galaxiids were common top predators, but are now restricted to trout-free reaches above waterfalls and other barriers to migration (Townsend 2003). Other impacts associated with stocking are genetic contamination and spread of disease, of which many examples exist in the literature (Lewin *et al.* 2006, this volume). Many more examples of impacts of stocking top predatory fish into native communities on the ecosystem level were recently provided by Eby *et al.* (2006). Given the impacts associated with recreational fishing mortality and activity (e.g. disruption of wildlife, groundbaiting, Niesar *et al.* 2004; Arlinghaus and Niesar 2005) and with recreational fisheries management practices such as stocking, accounting for potential ecosystem-level impacts induced by fishing has relevance for some, clearly not all, recreational fisheries. The relevance is evident in recreational fisheries where intensity of fishing is high or stocking is considered a panacea for management and where mismanagement has been identified in the past (e.g. Post *et al.* 2002; Sullivan 2003). The first step would involve increased awareness of the potential ecosystem impacts of recreational fishing, instead of trying to discount them in the public discussion (Nussmann 2005).

However, declines in fish stocks are only partly the result of fishing. Anthropogenic activities, such as agriculture, damming, deforestation, navigation, wetland reclamation, urbanization, water abstraction and transfer and waste disposal have altered freshwater ecosystems profoundly, probably more than terrestrial ecosystems (Cowx 2002a). Consequently, in most areas of the world the principal impacts on freshwater recreational fisheries do not originate from the fishery itself but from outside the fishery (Arlinghaus *et al.* 2002). The need for concerted effort to prevent and reduce modification of fisheries habitats – as well as conservation of fish and fisheries as renewable common pool resources or entities in their own right – are the greatest challenges facing sustainable development of recreational fisheries [Food and Agricultural Organization of the United Nations (FAO) 1999].

An emerging approach to help address the multifaceted problems prevalent in the marine commercial fisheries sector is ecosystem-based fishery management (Pikitch *et al.* 2004). This approach, which potentially has its roots in inland catchment-based management and coastal zone management, may also be applicable to recreational fisheries. The objective of this chapter is to review the concept of ecosystem-based management and assess whether it is appropriate for recreational fisheries in freshwater ecosystems.

Ecosystem approach to fisheries (EAF) management

Meaning of the EAF

In recent years, an increasing number of terms and concepts that have reversed priorities for management from the target species, particularly fish, to the ecosystem

have been proposed (Pikitch *et al.* 2004). These include ecologically sustainable development (ESD, e.g. Scandol *et al.* 2005), ecosystem management (EM, e.g. Larkin 1996; Lackey 1998; Schramm and Hubert, 1999), ecosystem-based management (EBM, e.g. Ward *et al.* 2002), ecosystem-based fishery management (EBFM, e.g. Brodziak and Link 2002; Pikitch *et al.* 2004) and EAF (e.g. Garcia and Cochrane 2005). Although they differ slightly in the scope of the regions and activities covered, and therefore the breath of issues to be managed (Fletcher 2006), all approaches recognize that management must deal with the full suite of ecological and evolutionary consequences of fishing.

In this context, the term EAF is preferred instead of the more common EBFM advocated by Pikitch *et al.* (2004) to avoid misunderstanding among stakeholders that the ecosystem *per se* is the 'foundation' of fisheries management (Garcia *et al.* 2003). This may be misinterpreted as giving environmental considerations pre-eminence over socio-economic and cultural ones, raising concern about equity, political and socio-economic issues (Garcia *et al.* 2003). Also the term 'approach' inherent in EAF delineates a way of taking ecosystem considerations into more conventional fisheries management and a mechanism to account for ecosystem processes in the formulation of management measures (Sissenwine and Murawaski 2004). The EAF hence emphasizes an evolution of fisheries management rather than a revolution (Mace 2004), thereby avoiding that 'revolutionary ideas' might be interpreted by fisheries stakeholders as a threat to continued participation.

According to FAO (2003), the global interest in an EAF has been motivated by

- heightened awareness of the importance of interactions among fishery resources and between fishery resources and the ecosystems within which they exist
- recognition of the wide range of societal objectives for, and values of, fishery resources and ecosystems within the context of sustainable development
- poor performance of current management approaches as witnessed by the poor state of many of the world's fisheries
- recent advances in science, which highlight knowledge and uncertainties about the functional value of ecosystems to humans (i.e. the goods and services they are capable of providing).

In both large- and small-scale commercial and recreational fisheries, fishing activities usually affect other components of the ecosystem in which the harvesting is occurring. For example, there are sometimes issues such as by-catch of non-targeted species, physical damage to habitats, food-chain effects or changes to biodiversity (FAO 2003; Cooke and Cowx 2006; Lewin *et al.* 2006). Responsible fisheries management must therefore consider the broader impact of fisheries on the ecosystem as a whole, taking biodiversity across genetic, species and population levels into account. This is the basic premise of the EAF, that is, the sustainable use of the whole system, including their functions, services

and fish stocks, to persist in the long term (Costanza and Patten 1995), not just a targeted species.

In this context, the ecosystem approach to sustainable fisheries was defined by FAO (2003) as 'to plan, develop and manage fisheries in a manner that addresses the multiple needs and desires of societies, without jeopardizing the options for future generations to benefit from the full range of goods and services provided by marine ecosystems'. Therefore, the EAF strives to balance diverse societal objectives, by taking account of the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries (FAO 2003). The ecosystem approach recognizes that humans are an integral component of ecosystems, not a non-natural disturbance to be avoided. It can be considered a general framework for analysis and implementation of the objectives of the Convention on Biological Diversity (www.biodiv.org, UNEP 1998).

These broad objectives correspond to the concepts of maintaining ecosystem health, ecosystem integrity, social–ecological resilience and ecosystem productivity and utilizing the productivity of fish stocks in an equitable manner. However, these objectives can only be achieved by transforming these difficult-to-define concepts into socially acceptable and more tangible issues such as conserving biodiversity, maintaining fishery habitats, protecting important components of the ecosystem and translating these issues into activities that can be related to operational objectives.

The definition of an EAF provided above by the FAO (2003) has a striking similarity to the one of sustainable development popularized on a global scale by the Bundtland report [World Commission on Enviroment and Development (WCED) 1987], and subsequently adopted by the United Nations Conference on Environment and Development ('Earth Summit' Agenda 21 in Rio de Janeiro 1992), viz 'meeting the needs of the present generation without compromising the ability of future generations to meet their own needs'. Thus, the EAF is not a separate concept from the overarching sustainability paradigm, but is enrooted in sustainable management and can be considered a means to approach sustainability in situations where one activity, here recreational fishing, comprises the socially accepted or the socially demanded state of an exploited ecosystem (Arlinghaus *et al.* 2002). The roots of the EAF are deep in early days of inland water fisheries, wildlife and forest management. So, traditional fishery management, as practiced by small-scale fishing communities, was possibly more ecosystem-conscious than the modern, conventional management of large-scale marine fisheries (Garcia and Cochrane 2005). However, despite the emphasis on the social and economic dimensions of fisheries and in contrast to a properly defined sustainability concept, the EAF concept typically focuses on ecologically sustainable development (Scandol *et al.* 2005) or ecological sustainability (Charles 1994). It essentially means 'fisheries management in an ecosystem context,

not ecosystem management in a fisheries context' (Link 2002) or 'using what is known about the ecosystem to manage fisheries' (Fluharty 2005).

Principles of the EAF

According to FAO (2003) and Pikitch *et al.* (2004), the EAF should

- limit fishing impacts on the ecosystems, as measured by indicators of environmental quality and system status
- minimize the risk of irreversible change to natural assemblages of species and ecosystem processes as a result of fisheries
- through good governance, obtain and maintain long-term socio-economic benefits without compromising the ecosystem
- generate knowledge of ecosystem processes sufficient to understand the likely consequences of human actions.

Others, more general principles of the ecosystem approach to conserve and sustainably manage biological diversity, including fish, were developed in a workshop on the ecosystem approach as guiding for the implementation of the convention on biological diversity. These principles are today known as the Malawi principles, reflecting the location where the workshop took place in 1998 (UNEP 1998); they have great relevance within the ecosystem approach to recreational fisheries management. Their main feature is that social aspects and issues are explicitly dealt with, that is, a single focus on the ecosystems and biology is avoided. It is also noteworthy that societal choice dictates management objectives, that is, those are subjected to change and interpretation of different stakeholders. Also, the ecosystem approach explicitly acknowledges that some impact of humans on ecosystems is inevitable, which should be guiding for recreational fishing as well. The 12 principles are

(1) Management objectives are a matter of societal choice.
(2) Objectives for ecosystem management should be set for the long term.
(3) Management must realize that change is inevitable.
(4) Management should be decentralized to the lowest appropriate level.
(5) The ecosystem approach should be undertaken at the appropriate scale.
(6) A key feature of the approach includes conservation of ecosystem structure and functioning.
(7) Ecosystems must be managed within the limits of their functioning.
(8) Ecosystem managers should consider the effects of their activities on adjacent and other ecosystems.
(9) There is a need to understand the ecosystem in an economic context.

(10) There must be a balance between conservation and use.
(11) All forms of relevant information should be considered, including scientific and indigenous and local knowledge, innovations and practices.
(12) All relevant sectors of society and scientific disciplines should be involved.

Where knowledge is insufficient, that is, where the local situation is poorly understood due to lack of data and lack of efficient monitoring (Post *et al.* 2002; Arlinghaus 2006), robust and precautionary recreational fisheries' management measures that favour the ecosystem should be adopted. Critical in this respect is awareness of potential ecosystem impacts and right incentives among resource users, including those of recreational fisheries, to strive for an improved ecosystem state or avoiding ecosystem-level impacts. In simple terms, good governance must motivate anglers to ensure that, through their fishing activities, no undesirable impacts on the ecosystem and the fish stocks are induced.

EAF challenges of managing ecological services generated by fish

The National Research Council (NRC 1999) described the EAF as 'an approach that seriously takes all major ecosystem components and services – both structural and functional – into account in managing fisheries'. It is therefore a fundamental distinction between ecosystem components (e.g. fish, habitat and people) and services. Ecosystem services are the benefits people obtain from ecosystems (summarized for fish in Table 3.1). Fisheries management deals explicitly with cultural services (yield, income, recreational experience, aesthetic values), but other ecological services provided by fish, particularly supporting ones, are usually not considered (Garcia and Cochrane 2005). Fisheries may have an impact on such other services that in turn may impact on the productivity or resilience of the entire social–ecological system of recreational fisheries (Carpenter and Folke 2006). The EAF can help to raise awareness of the total environment in which fisheries and its management takes place, which contrasts with the traditional, narrow, fisheries focus or single species orientation of many fisheries stakeholders and managers (Schramm and Hubert 1999; Cowx 2003). In recreational fisheries, this problem is sometimes less prevalent; fisheries stakeholders have successfully contributed to effective aquatic ecosystem conservation by, for example, replacing stocking by a more sustainable set of harvest regulations, striving for improved water quality or rehabilitation of water bodies to promote natural regeneration (Bate 2001; Arlinghaus *et al.* 2002).

The EAF to recreational fisheries necessitates three key changes in management philosophy to move beyond the current sectoral approach to fisheries management (Figure 3.1). First, management goals must be framed with respect to the conservation or improvement of all ecosystem services of fish as long as

Table 3.1 Major fundamental and demand-derived ecosystem services generated by fish.

Fundamental ecosystem services	
Regulating services	*Linking services*
Regulation of food web dynamics	Linkage within aquatic ecosystems
Recycling of nutrients	Linkage between aquatic and terrestrial ecosystems
Regulation of ecosystem resilience	Transport of nutrients, carbon and minerals
Redistribution of bottom substrates	Transport of energy
Regulation of carbon fluxes from water to atmosphere	Acting as ecological memory
Maintenance of sediment processes	
Maintenance of genetic, species, ecosystem biodiversity	
Demand-derived ecosystem services	
Cultural services	*Information services*
Production of food	Assessment of ecosystem stress
Aquaculture production	Assessment of ecosystem resilience
Production of medicine	Revealing evolutionary tracks
Control of hazardous diseases	Provision of historical information
Control of algae and macrophytes	Provision of scientific and educational information
Reduction of waste	Keeping people in close contact to nature
Supply of aesthetic values	Promotion of respect for wildlife
Supply of recreational activities including recreational fishing	Learning and environmental education
Supply of social benefits and quality of life including cultural, social (e.g. friendships), psychological (e.g. satisfying various needs through fishing) and physiological (e.g. human health) dimensions	
Supply of economic benefits such as jobs	
Supply of ecological benefits such as the impetus for fishers to engage in fish population management/rehabilitation	

Source: Modified from Holmlund and Hammer 1999.

achieving this is possible for fisheries managers (which is not always the case; e.g. large-scale habitat improvement schemes can rarely be implemented by fisheries stakeholders alone – see below). With respect to recreational fisheries, the primary goods and services referred to in the EAF include security of satisfactory recreational experiences, provision of healthy fish for domestic consumption, preservation of the myriad of socio-economic and ecological benefits recreational fishing provides to society (Arlinghaus *et al.* 2002), but also conserving

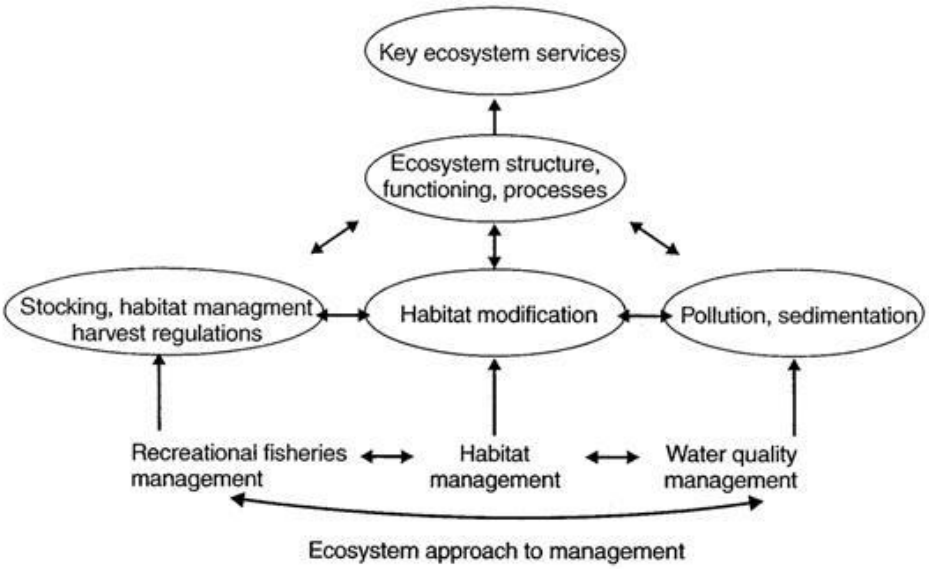

Figure 3.1 Key aspects of an ecosystem approach to managing the ecological services generated by fish. This approach considers the cumulative and interactive impacts of multiple sectors on the stocks and flow of key ecosystem services. Fisheries stakeholders are often not able to modify impacts acting on a particular fishery outside their traditional domain (*Source*: Modified from Rosenberg and McLeod 2005).

biodiversity and maintaining habitats. In much of the industrialized world, rebuilding ecosystems can be viewed as the overarching goal of modern sustainable fisheries management and not sustainable fisheries *per se*, because public support is more likely to occur for sustainable ecosystems than for sustainable fisheries (Pitcher 2001).

Second, an ecosystem approach to recreational fisheries must account for interactions betweens sectors by integrating management goals across multiple sectors (Figure 3.1). Current approaches in fisheries management, both marine and freshwater, ignore these interactions at the cost of decreasing the overall ability of systems to provide the full range of services, as well as compromising the ability of any given policy to meet individual sector goals (Rosenberg and McLeod 2005). There is a need to manage recreational fisheries, with wider cross-sectoral implications in mind. For example, opening up access for fishing should not impinge on wildlife or groundbaiting should not contribute to nutrient loading (Niesar *et al.* 2004; Arlinghaus and Niesar 2005). On the other hand, non-fishery impacts due to, for example, agricultural practices affect habitat and water quality through nutrient input into surface waters, which in turn alter the productivity of freshwaters and the fish community structure and abundance. The EAF must recognize all these activities in concert.

Third, cumulative impacts across sectors, such as non-fishery-induced habitat impacts noted earlier, may significantly undermine ecosystem services. Unfortunately, fisheries stakeholders are often politically and financially compromised

and so are unable to take effective actions, and they are required to consult with a multitude of stakeholders, such as water management authorities, landowners or owners of hydropower plants, to exert a response. The EAF can only be successful if all stakeholders work together for a common goal.

Threats to the implementation of the EAF in recreational fisheries, with emphasis on the human dimension

The ecosystem approach as a potential new management philosophy in recreational fisheries has evolved because

- Recreational fisheries, owing to human population growth and intense anthropogenic alteration of freshwater ecosystems, tend to be intrinsically linked to heavily managed water bodies (rivers, lakes and coastal waters) where multiple user conflicts are well described and acknowledged (Cowx 1998; Arlinghaus 2005).
- Recreational fishers, owing to increased mobility, high communication speed and technological progress (e.g. echo sounders), can effectively exploit fish also in remote, previously inaccessible areas (Cox and Walters 2002).
- Of the consideration of multiple human values by various stakeholders in the process of natural resource management – values that are necessary for setting policy, establishing laws and ultimately making management decisions and actions (Cambray and Pister 2002).
- Of the freshwater biodiversity crisis, which can only be halted or reversed by rehabilitation or conservation of crucial aquatic habitats (Cowx and Collares-Pereira 2002).

Existing frameworks for implementing the EAF in the marine environment (e.g. FAO 2003; Garcia *et al.* 2003) do not appear to account fully for the interaction between, and impact of, other stakeholders on fisheries but concentrate on the impact of fisheries on ecosystem functioning (Figure 3.1). This is an important issue because degradation of habitat through non-fishery impacts is equally, if not more, important for the maintenance of natural fisheries resources in inland waters.

In inland waters, where the principal drivers are environment related, the concept of EAF is appropriate, although the concept may be premature because, as repeatedly mentioned, many ecosystems have been heavily impacted, and defining a healthy ecosystem is based on highly diverse value systems of different stakeholders (Arlinghaus 2005). Nevertheless, this issue has to be resolved because various legislation worldwide such as the European Water Framework Directive are now encouraging 'good' environmental governance (whatever that means is dependent on the values of different stakeholders facilitating intensive conflicts between, say, nature conservationists and fisheries stakeholders; Arlinghaus 2005).

However, before it can be fully accepted as a management approach for recreational fisheries, EAF needs to be more advanced in terms of evaluating alternative ecosystem states, defining operational ecosystems objectives and specifying ecosystem management standards and performance measures analogous to those that currently exist for single-species management of fisheries (e.g. Larkin 1996; Mace 2001). This process includes segregating the difference between anthropomorphic expectations and end states derived by natural recovery processes; what is deemed acceptable to society may not necessarily be appropriate to optimal ecosystem functioning. This setting of ecosystem objectives or standards is considered by scientists (e.g. Scandol *et al.* 2005) to be a major constraint on the adoption of EAF because of the unacceptably high research costs in gaining the information to support the decision making for most small-scale fisheries, a characteristic of most recreational fisheries. This is particularly true in freshwater recreational fisheries, where millions of anglers exploit thousands of different fish stocks. It would be prohibitively expensive and impractical to monitor them all (Cox and Walters 2002). Consequently, it should be recognized that alternative feedback mechanisms between exploiters and the exploited system on the status of recreational fisheries, such as angler creel surveys, are necessary, which cannot be replaced by fishery-independent fish population surveys.

A number of other factors are also likely to threaten the implementation of EAF. These include

- difficulty of reconciling competing objectives of the multiple stakeholders
- insufficient or ineffective participation of stakeholders in the development and implementation of the approach
- insufficient knowledge, as well as biological uncertainties combined with ecological uncertainties
- inadequate solutions to equity issues and in defining roles and responsibilities among stakeholders
- sometimes unrealistic expectations on what management can realistically achieve and how pristine, unexploited fish stocks look like together with lack of ecosystem thinking and environmental concern and behaviour among various stakeholder groups.

Perhaps more important than the lack of appropriate environmental behaviour as a constraint to the future implementation of the EAF concept, is the lack of what socio-psychologists call inappropriate indirect pro-environmental behaviour. Such behaviour is the lack of support for the EAF concept or for measures that target the ecosystem rather than single species or that are more likely to benefit entire communities instead of single species.

This is, for example, critical in central Europe, where recreational fisheries stakeholders are not only users of fisheries resources, but are also private managers of a large set of water bodies (Arlinghaus 2005, 2006). Thus, the beliefs,

attitudes and incentives of the local angler community often determine what type of management action is taken in a particular water body, irrespective of whether this is agreement with the principles of the EAF. In practice, there is sometimes little appreciation of ecosystem considerations as evidenced by, for example, the dichotomy of management preferences of some angler populations that tend to focus on stocking of single species (Arlinghaus and Mehner 2003, 2005) instead of approaches such as habitat management that could potentially benefit entire fish community and ecosystem functioning (Cowx 1999, 2002a). Anglers residing in Berlin (Germany), for example, support stocking and tend to avoid habitat management (Arlinghaus and Mehner 2003), even if these anglers fish outside the city borders in less disturbed, more rural areas (Arlinghaus and Mehner 2004). Highly modified water bodies or even artificial systems such as ponds or canals can over time become the 'natural' reference state as perceived by anglers, which reduces their perceived need for habitat enhancement as a necessary tool to enhance fish populations and angling quality. As suggested by Arlinghaus and Mehner (2003), some anglers, particularly those living in highly urbanized environments, may perceive long-term degraded water bodies (and the impoverished fish stocks therein) as a fixed baseline or a fixed reference point against which management measures are judged (Figure 3.2). This may arise because few anglers experienced a severe decline in fishing quality over their lifetime because of the slow response of fisheries to non-fishery impacts on aquatic ecosystems and because most anthropogenic alterations such as artificial river embankments occurred previous to birth of the contemporary angler generations in Berlin. As a result, anglers may no longer perceive habitat degradation to be the primary threat to sustainability of recreational fisheries, thus dissipating support for EAF (Figure 3.2). The shifting angler–nature relationship is also evident in the growing trend towards artificial, highly stocked fisheries in Central Europe including the United Kingdom (North 2002; Arlinghaus *et al.* 2002) and the observation that many anglers have adapted or grown accustomed to a deterioration in habitat and water quality (Lappalainen and Pönni 2000). However, there is a trend towards 'exotic' fishing tourism worldwide that exposes some angler segments socialized in highly urbanized environment to more pristine areas. It remains to be seen whether this changes the perspectives described above for Central Europe in the future.

Another dichotomy between strong support for traditional management versus less support for management that is more in line with the EAF occurs under public fishing rights regimes and open-access characteristic of large parts of North America. Here, there is an intensive scientific debate towards more active management of angling effort to more effectively control domino-like overfishing tendencies occurring across a landscape of spatially structured open-access fisheries, where traditional management aiming at indirectly controlling effort/mortality through bag limits and size limits has been found to be ineffective at high angling effort levels (Cox and Walters 2002). Cox *et al.* (2002) showed that

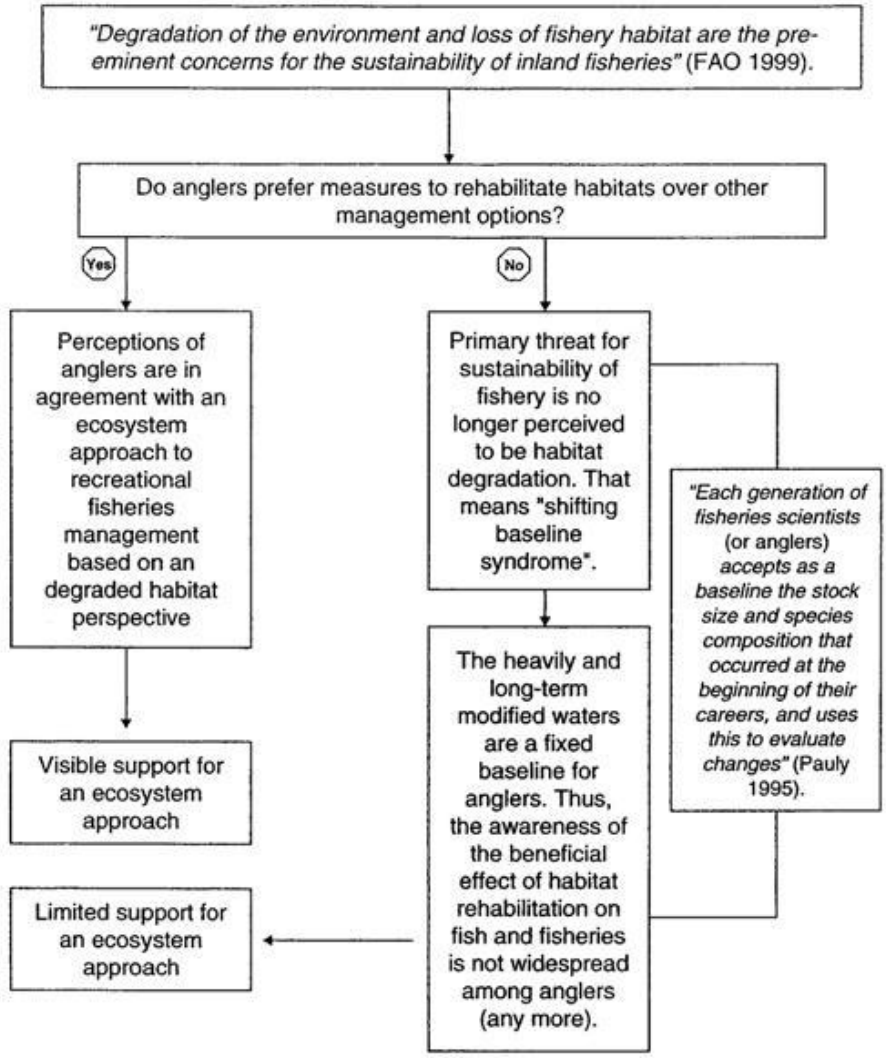

Figure 3.2 Schematic presentation of the likely impact of the shifting baseline syndrome for the anglers' support for strategies in agreement with the ecosystem approach to recreational fisheries management (*Source*: modified from Arlinghaus and Mehner 2003).

under open-access and unlimited effort, traditional harvest regulations such as bag limits and seasonal closures are not drastic enough to affect total exploitation. Despite clear signs of local overfishing particularly among the most productive stocks attracting higher angling effort levels (Parkinson *et al.* 2004), some North American angler populations show little support for partially limiting angling effort as a means to more effectively controlling overexploitation (Cox and Walters 2002). This lack of support can be counterproductive to the implementation of the EAF to recreational fisheries management (Post *et al.* 2002).

In both Central Europe under restricted-access as well as in North America under open-access, the intrinsic incentives and personal reward systems of anglers seem to be sometimes counterproductive to the implementation of EAF

and may create perverse dynamics that counter any potential for implementation of EAF measures such as habitat management instead of stocking or effort limitation instead of output controls such as minimum size limits or bag limits. For many anglers, an important driver for support of management measures is catch-dependent angler satisfaction. For example, in Germany, satisfied anglers are more likely to support ecosystem-based habitat management, whereas less satisfied anglers are more likely to focus on stocking of single fish species or a new species to increase fish abundance and angling quality (Arlinghaus and Mehner 2005). Consequently, efforts should be made to closely pay attention to the determinants of catch-dependent angler satisfaction because support for the EAF to recreational fisheries is very likely dependent on high satisfaction levels among the angler population. Alternatively, opposition can be strong whenever stricter regulations or intervention is needed or planned to be implemented (Cox and Walters 2002). Hence, it can be concluded that appropriate incentives, beliefs and attitudes within the angler community is essential if the EAF is to be successfully implemented locally and regionally. It is safe to assume that support for the EAF will very likely only develop if anglers experience personally the rewards of increasing fish abundance by limiting angling mortality through effective effort controls or by changing traditional management approaches such as stocking in favour of alternative actions that increase natural recruitment. We like to call this 'a second-chance approach to education and information of anglers' based on personal experiences rather than information campaigns via brochures or leaflets. Nevertheless, managers have to be prepared for unforeseen dilemmas in almost all situations depending on the values of the local angler constituency. For example, Sullivan (2003) provided a compelling case study about active management of angler effort in Alberta, Canada, and the resulting increase in walleye stocks that in turn created discomfort among anglers *despite* high catch rates. The reason was that, in that case, catch rates were high, but regulations very stringent in terms of the fraction of the catch that was allowed to be removed. The local angler constituency, however, was mainly harvest-oriented. Hence, dissatisfaction was first high when stocks were growth-overfished (i.e. fish were harvested at small sizes before reaching their maximum productivity), but also remained high when stocks and the associated and catch rates recovered over time due to low harvest rates. Such social dynamics have to be accounted for if the EAF is to be a success in recreational fisheries management.

Conclusions and outlook

Although the EAF is being considered a novel strategy (Pikitch *et al.* 1994), in the freshwater and coastal environment it has its foundations in catchment management planning and coastal zone management. The concept is hence

everything but new and is in fact enrooted in the (properly defined) sustainability paradigm. It is nevertheless important to increasingly consider potential ecosystem impacts associated with recreational fishing and its management. Recreational fisheries would benefit from the EAF because it may lead to more sustainable exploitation of fisheries resources and it is much more inclusive in terms of the diversity of stakeholder involvement and human values to be considered than a sectoral, single-species management approach to recreational fisheries management. The prerequisites for its implementation are well developed in most recreational fisheries. For example, Hilborn, Orensanz and Parma (2005) identified three primary influences on fisheries management success: (1) the way in which individuals are allowed access to fish resources (access), (2) the decision making structure of the institutions (decision making) and (3) the spatial scale of management (scale). Review of several case studies indicates that there is no single prescription for successful fisheries management; however, a better outcome is more likely with more restrictive access, more appropriate incentives, and increasingly simpler institutions and appropriate management scales (Hilborn *et al.* 2005), all of which is given in many privately governed recreational fisheries systems (Arlinghaus 2006).

To move forward, the greatest challenge for recreational fisheries is to accept that ecosystem-level impacts are possible through their activity (see Cooke and Cowx 2006; Lewin *et al.* 2006). If this becomes accepted among all those involved in the management of recreational fisheries, progress towards addressing these impacts can be expected, particularly if stakeholders build strong alliances with non-fishery stakeholders. This is relevant in Europe and other regions where non-fishery activities, rather than fishing itself, most strongly impacts on fish communities. Unfortunately, the EAF tends to stress the ecological 'well-being' of the sustainability equation as a means to counterbalance the narrow and human-centred vision of conventional fisheries management (Garcia 2005). Without acknowledging the human dimensions of anglers and the need to providing incentives and governance structures that make the interest of the anglers consistent with the interest of society as a whole, progress towards successful implementation of the EAF will be slow. It will also be slow because, with the exception of stocking (Cowx 1994) and possibly intensive fishing pressure (Post *et al.* 2002), the impact of recreational fishing will be largely dependent on local conditions (e.g. state of the ecological system, number of anglers, collaboration between stakeholders regionally). Consequently, adoption of the concept rests on the spread of the idea from one local angler community to the next, particularly in central Europe, where small-scale governance structures exist (e.g. local angling clubs). This slow internalization of the concept may work against recreational fisheries because they will be marginalized by the more powerful players in the target ecosystem.

For the immediate future, it is necessary to translate the broad policy statement about conservation of ecosystems into practical ways of setting and measuring

progress towards ecosystem-level goals and specifying ecosystem-level indicators and trigger points for performance monitoring as they currently exist for single-species fisheries management (Gangl and Pereira 2003). The paucity of knowledge about how recreational fisheries behave in the wider ecosystem context of improvements in environmental quality is perhaps the major constraint that must be addressed (Scandol *et al.* 2005). There is too little research into the responses, and hence indicators of fishing success, and of the ecosystem consequences of recreational fisheries. To address this, and other issues in the EAF, it is suggested that scientists and environmental managers engage with anglers and other stakeholders to provide appropriately targeted advice and information. Such public outreach must become mandatory for technically competent persons to inform about potential ecosystem impacts of seemingly benign activities of great social and economic value such as recreational fishing. What might be needed to stimulate changes in management approaches and understanding is the promotion of local expertise to ensure that the concepts and philosophies are taken up by the local end-users. Particularly in Europe, this local capacity-building and self-empowerment of anglers is crucial if recreational fisheries are to be integrated into the wider environmental framework of aquatic ecosystem management.

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