

# Reviving the unique potential of recreational fishers as environmental stewards of aquatic ecosystems

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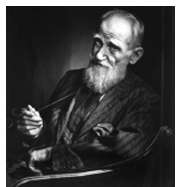
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## Abstract

Recreational anglers have been key players in aquatic conservation, but this role is increasingly obscured. Other environmental sectors are now more visible stakeholders engaged with biodiversity. Recreational fishing has relevant environmental and moral implications, but these can be resolved via improved governance and management. More difficult is replacing the stewardship capacity provided by anglers. When analysed against a novel environmental stewardship framework based on place and identity, care, knowledge and agency, we find that marginalizing anglers could diminish aquatic biodiversity conservation. This outcome is likely because excellence in recreational fishing involves habituation of skills and ethical imperatives associated with sustainable and responsible use of fish populations. These dimensions are probably not so pertinent and correspondingly less developed in other nature stakeholders. Importantly, catching and killing wild animals catapults anglers into a food web and associated ecological conscience that most other outdoor activities cannot generate. As a result, recreational fishing often engenders feelings of care and responsibility for aquatic systems that support personal well-being, bridging the stewardship value-action gap through development of local assessment, management and evaluative competencies and associated agency. Transdisciplinary cooperation with scientists, managers and policymakers can unleash the stewardship potential of recreational anglers and engage their capacity for the common good.

## KEYWORDS

biodiversity conservation, care, inland fisheries, norms, pro-environmental values, social-ecological systems, virtue ethics



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## Etymology of Ghoti

George Bernard Shaw (1856–1950), polymath, playwright, Nobel prize winner, and the most prolific letter writer in history, was an advocate of English spelling reform. He was reportedly fond of pointing out its absurdities by proving that 'fish' could be spelt 'ghoti'. That is: 'gh' as in 'rough', 'o' as in 'women' and 'ti' as in palatial.

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## 1 | INTRODUCTION

Environmental stewardship has emerged as a boundary concept describing concern for biodiversity and active support for conservation and ecosystem rehabilitation (Bieling et al., 2020; Chapin III et al., 2010). The concept emphasises care and responsibility (Enqvist et al., 2018; Tengö et al., 2022), with a focus on human behaviour. It places the components of individual pro-environmental behaviour (Klößner, 2013) in a broad social arena (Steg & Vlek, 2009), sharing important elements with education for sustainable development and multi-loop social learning in conservation (Armitage et al., 2008; Pahl-Wostl, 2009). In this context, education for sustainability emphasizes how actors move from feelings of care and connection to nature and wildlife to relevant knowledge and ultimately develop capacities that support sustainable behaviour (Bögeholz, 2006). In multi-loop environmental learning, change is conceptualized as a stepwise social learning process, with informal networks playing a crucial role (Pahl-Wostl, 2009).

We combine these ideas to propose a novel environmental stewardship model that outlines the personal elements and developments inherent in engagement with biodiversity conservation (Figure 1). Our model can be related to various humans-in-nature domains, but it is examined here against recreational fishing as a foundation for stewardship of local and regional aquatic systems. Communities with a strong stewardship ethic often achieve wise use of biodiversity through relevant people-in-nature norms related to wildlife harvest (Blasiak et al., 2021), while those without this ethic may still develop concern for sustainability (Raymond, 2007) but are more likely to impose irreversible changes to natural systems (Ellis et al., 2021). Communal environmental stewardship with a focus on individual care and action is particularly evident in many indigenous (Waller & Reo, 2018) and traditional fishing (Fujitani et al., 2017) communities. It is also visible in grass roots conservation collectives (Harrison et al., 2018) that yield hopeful 'seeds for a good Anthropocene' (Bennett et al., 2016).

Unification of use, care and stewardship has helped make recreational fishing (Bate, 2002; Kirchofer, 2002) a historical foundation for fish conservation that is often sustainable when external factors that impose negative impacts (e.g. hydropower, agriculture) are well integrated in a resource management system (Arlinghaus et al., 2002). Conservation initiatives by recreational fishers ('anglers') may be perceived as selfish because they help protect target populations, but self-interested conservation is consistent with wide benefits that accrue when a community owns and identifies with a use-of-nature system, imparting sustainability incentives (Ahmed et al., 2008). Groups with explicit conservation norms and related 'ownership' of natural resources typically assume responsibility for their local system when they have the necessary knowledge, agency, conflict resolution and sanctioning mechanisms (Ostrom, 2005).

Widespread stewardship by extractive user groups contrasts with frequent negative ecological impacts of fishing (Lewin et al., 2006), which may reflect failure to care (Von Essen & Allen, 2021) but can also result from individually rational but collectively disruptive

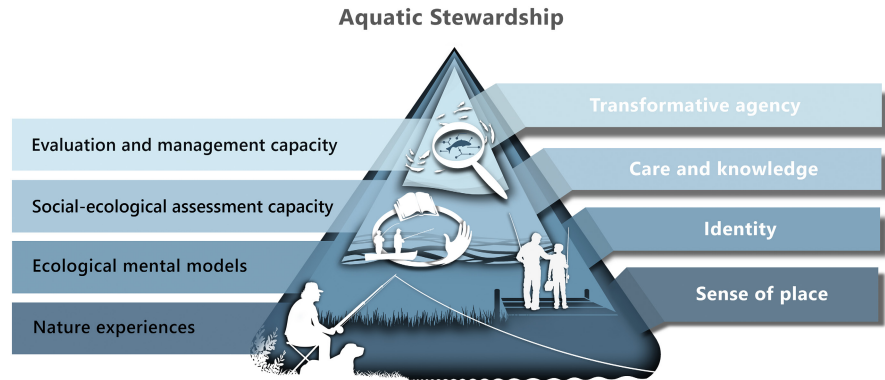
outcomes (Hardin, 1968). There are many examples of overharvest in recreational fisheries (Coleman et al., 2004; Embke et al., 2019; Post et al., 2002) as well as the disturbance of habitat and wildlife (Schafft et al., 2021). Selective targeting and removal of top predators can destabilize aquatic ecosystems through trophic cascades (Daskalov et al., 2007), reduce biomass and truncate size structure (Post et al., 2002) and contribute to tipping points (Möllmann et al., 2021). Frequent and often irreversible ecological impacts have followed the release of non-native organisms used by anglers as bait or target species (Cambray, 2003; Laikre et al., 2010).

Environmental harm has led to criticism of extractive users of fish and wildlife (Hart, 2021), and portrayal as key contributors to aquatic biodiversity crises (Arlinghaus et al., 2012; de Leeuw, 2012). As a result, fishing organisations have lost their status and social license as leading environmental actors to environmental non-governmental organizations who have assumed powerful roles in biodiversity policy (Cahoone, 2009). In some western countries, anglers find themselves in mostly defensive positions in public discourse about biodiversity conservation (Arlinghaus et al., 2021; Hampton & Teh-White, 2019; Hart, 2021).

The eroding social status of recreational fishing in some countries is often correlated with declining nature experience among large parts of society due to urbanisation, characterized by loss of personal connections to fishing and diminished social reward in being an angler (Heberlein & Ericsson, 2005; Manfredo, Teel, et al., 2020; Soga & Gaston, 2016). It is further related to the anthropomorphization of animals that follows economic development and education in western societies (Manfredo, 2008; Manfredo, Urquiza-Haas, et al., 2020) and to a growing emphasis on mutualist values which may grant wildlife or habitats a 'personhood' that is assumed to be disrupted by humans (Wallach et al., 2020). Shifts in public perception and judgement highlight the role of moral arguments in fishing discourse (Arlinghaus et al., 2021; Fischer et al., 2013) and demonstrate the different ways in which humans can care for biodiversity, for example in the spectrum from 'non-interference' to 'sustainable use' (Pascual et al., 2021). There is increasing focus on leveraging diversity in the ways that people care for nature (Leventon et al., 2021). Therefore, it becomes important to explore whether some modes of care are more likely than others to achieve biodiversity conservation within ethically plural nature's contributions to people perspectives (Hill et al., 2021).

A practical expression of current social values favouring preservation over sustainable use of wildlife is protected area movements. Current policy proposals related to the Convention on Biological Diversity, for example the EU Biodiversity Strategy (European Green Deal), aim at excluding extractive use in 10% of land and sea. Leonard et al. (2021) argued for non-use rights to nature, supporting acquisition of public resource rights for the purpose of preventing extraction. In this social and policy context, we test recreational fishing against a novel stewardship model (Figure 1) and conclude that grassroots conservation in aquatic systems might lose out by marginalizing or excluding anglers from widespread locales. Support for this conclusion emerges through evaluating the characteristics

**FIGURE 1** Stewardship that extends from care to action involves four core experience-based components that are fostered by extractive people-in-nature systems (left). These components can create four psychological outcomes (right). The entire process from bottom to top can be expressed as development of environmental virtue.



and psychological outcomes of recreational fishing against a norms-based view of environmental stewardship that is centred on sustainable catching and (sometimes) killing and eating wild animals. We propose that the diverse processes involved in the chase for fish can foster unique potential for anglers to develop as stewards of aquatic ecosystems. Our proposal does not disregard the negative pathways by which anglers affect ecosystems but instead calls for better governance to address these issues while supporting angler stewardship.

## 2 | A NOVEL FRAMEWORK FOR ENVIRONMENTAL STEWARDSHIP

Our model follows the definition from Chapin III et al. (2010) that stewardship is the 'proactive shaping of physical, biological, and social conditions to sustain, rather than disrupt, critical earth-system processes in support of nature and human wellbeing at local-to-planetary scales'. Our model also builds on education for sustainable development, emphasizing that care must be activated through direct experience of management processes and outcomes (Fujitani et al., 2017). We integrate environmental social norms (Chapin et al., 2022; Nyborg, 2018), and propose that establishing an ethical foundation for stewardship involves four core experience-related components (left in Figure 1). The first two components are direct nature experiences and the development of environmental values and mental models of ecosystem functioning. The subsequent two components are practical stewardship capacities (habituated skills) related to assessing, evaluating and managing natural systems (Figure 1). These four components create four psycho-social outcomes at the level of angler communities (right in Figure 1): sense of place and connection, identity, care and knowledge of the environment and transformative agency. The most developed ('excellent') stewards experience all four components and show all four outcomes. We posit that anglers are particularly likely to achieve all eight.

### 2.1 | Four core experience components of stewardship

Environmental psychology (Rosa & Collado, 2019) and education (Hoover, 2021; Schwass et al., 2021) suggest that action-oriented

environmental values are predicted by outdoor experience, which can shape accurate mental models of ecosystem functioning (Jones et al., 2011). These models are personal representations of reality used to interact with the environment; they structure understanding of a complex natural resource system (Jones et al., 2011). Mental models interact with values, defined as enduring beliefs about proper conduct, which are formed early in life through social interactions with important others and through experiences with nature and other domains (Manfredo et al., 2017). Environmental values concern how we *should* interact with or within nature; they are frequently place-based and expressed as local social-ecological relationships and responsibilities (Chapin et al., 2022; Tadaki et al., 2017). Aldo Leopold called this dimension an 'ecological conscience', emphasising the ethical dimension of stewardship (Kentish & Robotom, 2008), and the connection to environmental and civic virtues, in the sense of virtue ethics (List, 2013).

The two primary experience-based components of our stewardship model—'exceptional nature-bonding and human experiences' (Swan, 2010) and subsequent environmental value developments—are seeds of practical and moral reasoning on which two action-oriented stewardship competencies can unfold (left in Figure 1). Our model follows research in experiential learning to phrase this development as a process of habituation through prolonged hands-on experience within the domain of interest (here aquatic ecosystems) that cannot be replaced by theoretical knowledge alone (Fujitani et al., 2017). Mentors contribute here as teachers, judges and observers, supporting and guiding new entrants, especially young people.

Important applied competencies comprise the ability to assess states of nature (e.g. ecosystem health), to evaluate the possible outcomes of certain actions (e.g. overharvesting fish stocks), and to implement transformative actions in management or in individual behaviour, which includes political support for pro-environmental actions. For example, experienced anglers can understand that habitat restoration improves fish populations more than stocking (Bryan, 1977). Active participants in extractive resource use systems may thus have greater inherent potential than less connected 'observers' to develop the cognitive competency to suggest tractable sustainable use pathways.

Aristotle explains that virtue is a disposition to the good that follows habituated right behaviour (*The Nicomachean Ethics*). Our stewardship model assumes that the most virtuous actors, that is

highly skilled and ethically motivated, are most successful and influential in their peer group. In recreational fishing, these are typically the more avid and psychologically committed anglers (Hahn, 1991), who might develop leadership roles (Gray et al., 2015). Embedded resource use communities that demonstrate practical excellence (environmental virtue) can have assessment and management competencies relevant to ecological impacts or the scope for management intervention to create solutions that mirror the best scientific knowledge (Aminpour et al., 2020). This capacity can motivate long-term stewardship engagement, especially where there is sufficient resource ownership (Lachapelle & McCool, 2005) and related incentives in local communities of resource users to act (Ostrom, 2005). Environmental virtue extends to civic virtue when users develop multi-sectoral collaborations to achieve biodiversity conservation that incorporates diverse stakeholders and their objectives beyond the core fishing sector.

## 2.2 | Four higher order psychological outcomes leading to stewardship behaviour

Environmentally engaged people who experience and develop all four components of our model will ultimately generate four broader psychological and social outcomes (right in Figure 1). These outcomes are sense of place and identity, feelings of care, knowledge and transformative agency (Brown et al., 2019; Plieninger et al., 2013). Prolonged experience within a particular natural environment establishes values and sense of place that embed a person as an integral part of their social-ecological system (Siemer & Brown, 1998). The embodied relational and nature connections (Guiney & Oberhauser, 2009) can become profoundly tied to personal and social identity, and elicit a desire to look after a natural place (Bramston et al., 2011) that supports personal well-being (Gatersleben et al., 2014; Harrison et al., 2019). The resulting feelings of attachment and responsibility express the relational value of care (West et al., 2018), which is core to stewardship (Enqvist et al., 2018). As Aldo Leopold proposed, 'we can only be ethical in relation to something we can see, understand, feel, love...'

Despite the significance of care, psychological theory reveals that this feeling is not sufficient to bring about remedial action (Clayton, 2012). Environmental stewardship is expressed when an individual or group proactively shapes trajectories of change (Cooke et al., 2019). Our conceptualization follows the system, objective and transformation knowledge domains of transdisciplinarity in sustainability science (Hadorn et al., 2008). It also relates to multi-loop learning in resource governance, in which a local 'community of practice' develops an identity, history and body of shared knowledge which are used to address sustainability problems through feedback processes (Pahl-Wostl, 2009). When place-based education is continually pursued through experiential knowledge gain (Gallay et al., 2016; Kudryavtsev et al., 2012), as observed in angler communities that self-govern fisheries (Fujitani et al., 2017), an individual and the collective of individuals with a shared history can

ultimately develop transformative agency. This step bridges care and action, empowering individuals and collectives to use their gifts for the common good (Kevany, 2007). Agency can operate as individual and community assets, supported or impaired by institutional governance (Bennett et al., 2018). We propose that sustainable development rests on collaborations of people expressing all four higher order stewardship outcomes (Norström et al., 2020).

Pro-environmental values and behaviours often arise from identification with specialized communities and places (Landon et al., 2018; Stets & Biga, 2003), where corresponding social norms are probably most effective (Perry et al., 2021). Our rationale suggests that the 'appropriate' values, attitudes and skills for environmental stewardship are mentored and reinforced in outdoor communities of practice. We now use this model (Figure 1) to explore whether recreational fishing has substantial inherent potential to develop stewards of aquatic ecosystems unfolding all eight components.

## 3 | IS RECREATIONAL FISHING PARTICULARLY CONDUCTIVE TO CREATING ENVIRONMENTAL STEWARDS?

Recreational fisheries are coupled social-ecological systems (Arlinghaus et al., 2017), which engage around 10% of the population across industrialized nations (Arlinghaus et al., 2021). Many countries experience a 'life cycle' of inland fisheries (Cowx et al., 2010), in which subsistence and commercial fisheries are superseded by recreational activity with economic development, and subsequently by a 'post-materialistic' stage associated with increasing support for biodiversity preservation as an alternative to extractive use (Arlinghaus et al., 2021). In addition to ecological concerns, there is debate about the capacity of fish to experience pain or consciousness (Browman et al., 2019; Sneddon et al., 2018). Recreational angling, due to its generally non-essential nature for the individual participant, may be perceived as large-scale animal suffering (De Leeuw, 1996). For both reasons, that is ecological impacts and animal suffering, it has been suggested by some that society should 'sacrifice the interests of anglers for the interests of nature' (De Leeuw, 2012). Conversely, others think that recreational fishing might be justified if it instils environmental values (Landon et al., 2018; Lovering, 2006) concordant with the land ethic of Aldo Leopold (or 'freshwater ethic', Cooke et al., 2021). Many angling groups claim that they organize and implement participatory conservation through an inherent stewardship (Tufts et al., 2015) that combines (self-interested) environmental and civic virtue (Arlinghaus et al., 2012; Granek et al., 2008; List, 2013).

These vivid contrasts in perception highlight two key challenges to the notion of recreational fishing as a path to environmental stewardship. First, there is the question of whether anglers and their organizations embrace stewardship in practice. We will not rehearse here detailed reports on the negative impacts of recreational fishing (reviewed in Post et al., 2002; Lewin et al., 2006, 2019) or list the numerous examples of environmental

conservation shown by angling groups (e.g. Granek et al., 2008). Instead, we explore the psycho-social conditions that might make recreational fishing conducive to the development of aquatic environmental stewards, while acknowledging unequivocally that this outcome is not always achieved and that the objectives of individual anglers may counter biodiversity conservation. We contend, however, that well-documented positive and negative outcomes do not violate the premise that the stewardship *potential* of anglers is substantial relative to other outdoor stakeholders. To make this case, we consider a second question. Might other nature activities, for example wildlife photography (Lovering, 2006), have the same capacity as recreational fishing to build stewards of fish and aquatic ecosystems? If so, we can have stewardship without anglers! We will conclude that the care, knowledge and capacity accessible to anglers, enhanced by the moral immediacy associated with catching and sometimes killing animals (Cahoone, 2009; Jensen, 2001), make an important difference.

### 3.1 | Nature experience in angling develops nature connection and sense of place

Experiential learning through angling creates strong nature connections (Cooke & Lane, 2015; Soga & Gaston, 2016). It offers prolonged engagement with nature in meaningful locations (Gottwald & Stedman, 2020; Larson et al., 2018), including catching and handling wild animal species that are seldom observed and poorly understood by large segments of mostly urban societies (Kochalski et al., 2019). There are also abundant incidents of vanishing species and environments in aquatic systems, and loss of associated human–nature relationships (Jax et al., 2018), which long-term resource users experience directly (Eden & Bear, 2011; Harrison et al., 2019). Anglers' fidelity to favourite venues often creates a sense of place, empathy and responsibility, especially when fish abundance is perceived to decline (Daedlow et al., 2011; Raynal et al., 2020). This link between nature experience and place-based stewardship can be interpreted through relational models (West et al., 2020) that foreground the role of empathy in conservation. It invokes the idea that sustainability needs to be 'felt' (Carolan, 2014), expressing the immersion of a person in their environment (Cooke, West, & Boonstra, 2016).

Feelings of locale and connection can be intensified in fishing because of the place-based learning required to be a successful angler (Eden & Bear, 2012). Diagnosing and solving the 'problem', that is, how to catch fish given incomplete knowledge and uncertain conditions, is a trial-and-error process where success is never guaranteed (Seekell, 2011). Anglers must be guided to develop practical reasoning, that is a 'feeling' for how environmental variability shapes fish behaviour in a particular location (Monk & Arlinghaus, 2017). This is exactly the 'knowledge acquisition and development of an aesthetic competence under the guidance of wise mentors' (List, 2013) that is key to developing ecological conscience in our stewardship model.

Some of these dimensions may also apply to nature photography (for example) when mentored outdoor experiences and skills allow participants to develop communal nature connections (Richardson et al., 2022). However, anglers require complex additional ecological knowledge to catch and perhaps kill a wild animal, with potential to choose virtuous actions that maintain a sustainable and ethical harvest or allow fish to be released unharmed (Arlinghaus et al., 2012). Many opponents remain 'unconvinced by the necessity of death' (Swanson, 2013), and so we must ask how the actual process of (ethically) killing an animal might help to elicit stewardship in a way that cannot be attained through other outdoor activities. We return below to the significance of killing and eating fish, while noting here that the catch and kill elements are out-with the realm of photography but constitute much of the canon of angling culture. Further separated are transient and observational water activities, for example boating, that require less developed and more observational human–nature relationships (Morales-Nin et al., 2021) and may lack community stewardship norms related to wild animals (Verbrugge et al., 2013), especially if recreational sites are easily substitutable.

### 3.2 | Angling develops environmental values and mental models that shape identity

Committed anglers typically exist in groups that are moderated by deeply held ethical norms and embedded social–ecological wisdom (Bryan, 1977; Hahn, 1991). Many participants are introduced to the system by relatives and friends (Sofranko & Nolan, 1972), imparting multi-generational knowledge, memory and belonging (Figure 2). This process of induction and membership, in a system where success and seniority are closely tied to place-based ecological knowledge, may reinforce environmental identity and virtuous civic engagement (Harrison & Schratwieser, 2008; List, 2018). Angler identity invokes collective moral norms that are upheld by social consequences (Bennett et al., 2018) and can be leveraged (Bova et al., 2017) or nudged (Mackay et al., 2018) to improve management participation. Of course, realized environmental behaviour depends partly on underlying personal propensities. Many anglers will never become excellent stewards and may remain casually involved, but recreational fishing will lead other participants further along the path towards deep ecological engagement (Bryan, 1977).

The social dimension in many recreational fisheries means that anglers must balance harvest against the good of both biotic and civic communities (Van Riper et al., 2021). This trade-off integrates ecological and social forcing on future fishing opportunity and can contribute to acquiring environmental and civic virtues, for example moderation (List, 2013). Social pressure for sensitive use also exists among non-extractive nature use groups, for example the 'do no harm' ethic in wildlife photography (Fennell, 2020) or 'responsible' animal ecotourism (Burns, 2015). However, in addition to sustainable use, fishing is set apart by the ethically laden catching and killing of wild animals. How might this 'hunting' dynamic link anglers to environmental stewardship?





**FIGURE 2** Prolonged and multi-generational nature experience in angling yields sense of place, nature connection and identity as one moves across time. Participants witness changes in local ecosystems directly and through knowledge transfer.

Part of our answer concerns the emotional intensity of killing a wild creature, which propels extractive anglers into a food web ('animal interdependence', Cahoone, 2009). When someone hunts, kills, cleans and processes an animal, the connections are deep and meaningful (Jensen, 2001). Leopold highlights how participants can remember intimate details of wild places in which they caught a fish, including the individual animal, the contents of its intestine and an awareness of blood. Although the initial aversion to killing and blood diminishes over time, the kill remains a stark and emotional aspect throughout the lifetime of an angler. It contributes to the realization that life is fundamentally connected to death—hunting has thus been called a 'cultural trophic practice consistent with ecological ethics' (Cahoone, 2009). Emotions and values are closely linked to personal meaning in environment and sustainability education (Manni et al., 2017). We suggest that the potential for developing environmental virtue is enhanced by the 'specific tension' in catching and possibly killing a wild animal (List, 2013) as well as the 'realistic awareness of death' (Tantillo, 2001) expressed as 'humility, gratitude and respect' (Evans, 2005; Jensen, 2001) or 'excitement and remorse' (Luke, 1997). This emotional depth offered by extractive angling, and its potential influence on value development, emerge precisely because of the ultimate and lethal intervention that is rejected by other modes of care. Where the photographer leaves off, the angler can continue to a people-in-nature role, catapulted into a web of life that teaches respect for the life of animals through the kill (Evans, 2005), which fulfils key elements of our stewardship model.

### 3.3 | Angling teaches environmental assessment capacity that elicits knowledge and care

Successful angling requires practical reasoning, mentoring, skill acquisition, contextual application of knowledge and responsiveness to changing conditions (List, 2013). Leopold believed that angling invites and rewards 'personal amateur scholarship' in natural history (Figure 3), and Eden and Bear (2011) highlighted the 'lay ecologies'



**FIGURE 3** Angling provides inherent stewardship education and capacity. The process runs from becoming a better angler towards how to sustain exploited stocks and ecosystems. Participants can develop intuitive knowledge of ecology and system change, which may motivate sustainability action.

inherent in anglers whose collective wisdom can approximate the best scientific understanding (Aminpour et al., 2020). Local ecological knowledge acquired in recreational fishing benefits environmental assessment (Cooke et al., 2019; Shephard et al., 2021), and anglers frequently act as citizen scientists (Shephard et al., 2019), with voluntary catch recording systems that track environmental change (Jansen et al., 2013). Many angler communities also directly witness in their target populations the consequences of (intrinsic and extrinsic) environmental destruction and/or restoration through management intervention (Fujitani et al., 2017).

Authors back to the 15th century consistently reveal how the engrained experiences, knowledge and values of anglers are

realized in relational care for aquatic ecosystems (Berners, 2019). This enduring stewardship dynamic is expressed in both the German *Waidgerechtigkeit* or 'fair chase', and the English 'good sportsmanship' (Walton, 1653), which relate (frequently romanticised) nature participation to self-imposed normative constraints on the effectiveness of fishing, for example which gear is used and when. Connecting care to catch demonstrates pluralistic wildlife values (Bruskotter & Fulton, 2008), for example both utilitarian and mutualistic (Riepe & Arlinghaus, 2014). Anglers are often willing to trade off extractive use against conservation (Bronnmann et al., 2022; Camp et al., 2017; Dorow et al., 2009), especially when the perceived consequences of inaction are significant (Oh & Ditton, 2008).

Nature participation and fair chase seem to be most important in the activity and identity of highly specialized anglers (Bryan, 1977). Such heavily invested individuals can develop leadership roles in angling communities of practice. They act to enhance others pro-environmental behaviour because it is in their best interest (Hahn, 1991; Raynal et al., 2020), that is it limits impacts on the natural systems that they care for (Dietz et al., 2005). Even if self-interest means a focus on conserving beloved 'game' fish, actions such as small-scale protected areas established in self-governed lakes, will have conservation effects on other non-target taxa and habitats (Nikolaus et al., 2022).

### 3.4 | Angling moves inherently from care and knowledge to transformative agency and stewardship action

It can be difficult to foresee which management tools will affect positive change in complex social-ecological systems, but anglers have 'learned to manage' (Cooke et al., 2019; Hansen et al., 2015).

This adaptive trial-and-error learning is particularly effective if assisted by scientists and educators in adaptive management (FAO, 2012; Fujitani et al., 2017). Anglers are 'unusual experts', who make a unique contribution to aquatic environments in partnership with state agencies (Eden & Bear, 2011) and can impart resilience (Camp et al., 2020) through their role in ecosystem-based management, advocacy and ethical practices (Arlinghaus et al., 2016). Bright spots in recreational fishing increasingly show successful management, restoration and conservation (Jeanson et al., 2021).

Angler expertise can be enhanced and leveraged by environmental education programmes and cross-disciplinary collaborations (Monroe et al., 2013), especially built around community-based monitoring (Aceves-Bueno et al., 2015) and knowledge co-production (Norström et al., 2020). Angling groups frequently pay for conservation learning (Schmetterling & Bernd-Cohen, 2002) and organize local management activities, for example habitat restoration (Acuña et al., 2013) and restocking of depleted (Harrison et al., 2018) or extirpated fishes (Lorenzen et al., 2012). Anglers can thus develop naturally the components of action-oriented stewardship (Andrews, 2007; Siemer & Knuth, 2007) as a prototype of education for sustainable development (Schmetterling & Bernd-Cohen, 2002).

Angler commitment to sustainable management is embedded in self-interested ownership and may be difficult to reproduce in outdoor pursuits where success is not linked directly to target animal populations. However, it is best to establish transdisciplinary frameworks that invoke conservation partnerships with other outdoor groups (Figure 4), scientists and policymakers to achieve the ecological objectives of diverse interests and stakeholders (Elmer et al., 2017). Buy-in by anglers is probable if awareness is high and threats to the fishery system are external (Cowx et al., 2010; Granek et al., 2008). Policy activities for aquatic ecosystems can benefit from the unique knowledge of wild fish held by recreational fishery stakeholders.



FIGURE 4 Angler stewardship works best as part of cross-sectoral collaborations in biodiversity conservation.

## 4 | CONCLUSIONS

We suggest that outdoor experience in a skilled community of practice can develop environmental stewardship based on place and identity, care, knowledge and agency (Figure 1). Embedded recreational fisheries seem to have unique potential to create ecological awareness of aquatic systems and to fulfil our model, especially when nature experience is combined with relevant mentoring. For other outdoor activities, for example nature photography, we conclude that nature experience and stewardship realization may be less profound in relation to aquatic ecosystems and especially fish. The stewardship initiatives of recreational anglers may focus on selected fish species, but many activities supported by angler communities, for example habitat enhancement or reduced fishing pressure, also benefit non-target taxa and habitats (Nikolaus et al., 2022).

Sustainability norms in fishing are intensified through the catch, kill and eat aspects, which embody anglers as part of the food web and teach them the principles and limits of living systems to a degree that other activities will rarely achieve. There are many cases where anglers cause environmental harm and there will always be those who simply do not care at all, but we posit that recreational fisheries and conservation objectives for aquatic biodiversity can be reconciled (Cowx et al., 2010) through improved management and governance (Arlinghaus et al., 2019). This integration will allow anglers to play a central role in future conservation activities rather than the marginalized position that has become common in some countries. Transdisciplinary cooperation among multiple sectors and players will help fully realize the stewardship potential of anglers.

If many anglers and other nature users express the values and behaviours shown in our stewardship model, communities will respect 'ecological constraints and the intrinsic value of biodiversity' (Cooke et al., 2019). We recommend revived support for collaborative networks of recreational fishing groups, scientists, managers and policymakers in transdisciplinary settings (Fujitani et al., 2017) to build on the extraordinary stewardship potential of anglers and thereby work for the common good.

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### DATA AVAILABILITY STATEMENT

There are no data available from this essay.

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