

## Review Paper

# Habitat-dependent outdoor recreation and conservation organizations can enable recreational fishers to contribute to conservation of coastal marine ecosystems

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## ABSTRACT

Stakeholder engagement is essential to conserve ecosystems and associated biodiversity. Outdoor recreation specialists represent stakeholder groups that often rely on specific healthy ecosystems and have unique incentives to contribute to conservation and stewardship. We introduce the concept of habitat-dependent outdoor recreation conservation organizations (HDORCOs) and their potential to harness outdoor recreation enthusiasm to achieve ecosystem-scale conservation objectives. We identify potential roles for HDORCOs in nurturing pro-environmental attitudes and facilitating stewardship behavior among recreationists, focusing on examples from recreational fishing specialists and coastal marine ecosystems. While HDORCOs have achieved conservation outcomes in a range of settings, transferability across recreational specializations and ecological, cultural, socio-economic, and governance contexts could remain challenging and potentially requires further development of the HDORCO concept. Communication with HDORCOs is one strategy to enhance engagement of recreationists, stakeholder groups not traditionally associated with pro-environmental behavior, in ecosystem-scale conservation efforts.

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## 1. Introduction

Biodiversity and associated ecosystem services continue to decline despite our efforts to apply the most promising conservation tools available (Watson et al., 2016). For example, while protected areas (PAs) are an essential tool to achieve ecosystem-scale conservation, they often fail to accomplish their goals because their placement tends to be biased toward locations that hold little promise for extractive uses, rather than areas of highest conservation value and need (Joppa and Pfaff 2009; Venter et al., 2018). Though it is politically, economically, and pragmatically convenient to focus restrictions on such

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“residual” areas in the short term, this ultimately limits the efficacy of PAs as a conservation tool (Devillers et al., 2015; Margules and Pressey 2000; Pressey 2013).

Residual PAs arise for many of the same reasons that other conservation measures can also be unsuccessful, at least in part because governments must appease diverse stakeholders. Management agencies rely on decision-making processes that require public support, and in the long term, stakeholder cooperation is essential to achieve compliance with regulations that effectively sustain natural resources. Conservation efforts are complicated by diverse and sometimes competing stakeholder goals and increasing demands for resources. Stakeholders who rely on natural resource extraction for livelihoods, culture, or lifestyle often oppose management that restricts their access to those resources (Crist et al., 2017; Reed et al., 2009). As a result, extensive strategic stakeholder engagement is essential for meeting conservation objectives (Paloniemi et al., 2018). Creative alternatives need to be explored to involve the public (e.g. land owners, special interest groups, rights holders, and recreationists) in conservation through sustainable resource use and nurturing a culture that values intact and productive ecosystems, or what is often referred to as “stewardship” (Berry 2006).

Habitat-dependent outdoor recreationists are one example of natural resource users who often place high value on natural ecosystems. Potential for strategically engaging outdoor recreationists to enhance conservation outcomes via stewardship warrants further exploration (Kearney 1995). While, in many cases, recreation enthusiasts oppose management measures that would restrict their activities (Holsman 2000), we posit that habitat-dependent outdoor recreation conservation organizations (hereafter referred to as HDORCOs) can help to achieve conservation by harnessing recreation enthusiasm to support ecosystem-scale conservation outcomes, focusing on win-win opportunities between resource use and conservation. We further suggest that individuals who are most intensively involved, or aim to intensify their involvement, in habitat-dependent recreation are likely to benefit most from HDORCO services and might join HDORCOs if they are already motivated to engage in conservation, or for other material membership benefits (e.g. recreational education and community). These recreationists can play vital roles in instigating and/or contributing to HDORCOs, linking conservation and outdoor recreation ideologies, and reinforcing environmental stewardship in outdoor recreation culture, thereby strengthening engagement among recreationists more generally so that HDORCOs’ goals, including conservation, can better be realized.

We define habitat-dependent outdoor recreation as recreation that depends upon relatively intact and functional natural ecosystems to support the core aims of the activity (as opposed to many outdoor team sports, motorsports, etc.) and, therefore, potentially provides incentives for participants to engage in conservation (Dunlap and Hefferman 1975; Jackson 1986). We define HDORCOs as organizations that engage habitat-dependent outdoor recreationists in ecosystem-scale conservation and help to set and/or achieve conservation goals. Conservation in this sense should not only aim to preserve populations of species directly impacted by the recreation activity, but also the habitats that support those species, and additional biodiversity that relies on those habitats. The conservation mechanisms involved can be very diverse, ranging from formal protected areas and regulation for altered use of land and water to financial, social, and political incentives, as well as education and support for conservation ideals.

There are some promising developments in this area. Ducks Unlimited is an HDORCO that was started in 1937 by a group of North American hunters concerned about reductions in duck habitat. According to their 2019 annual report, Ducks Unlimited is responsible for rehabilitation and conservation of more than 14.5 million acres (5,867,900 ha) of wetlands and grasslands that support over 900 species, including waterfowl (Anderson and Padding 2015; Ducks Unlimited, 2019; Tori et al., 2002). Though it is unclear if some of this area might be “residual” with respect to other potential uses (e.g. agricultural development), it is remarkable that recreational hunters have formally partnered with government and non-government organizations to protect habitats for almost a century.

HDORCOs have also engaged recreational fishers of freshwater and marine systems (e.g. Trout Unlimited, The Coastal Conservation Association, The Billfish Foundation, Bonefish and Tarpon Trust). In addition to protection of habitat for conservation and recreation purposes, conservation strategies of HDORCOs include marketing advocacy among recreationists, land owners, and the general public, facilitating and interpreting research, and lobbying for political and legal support. HDORCOs also represent a platform for stakeholders to acquire scientific, social, and political support for meeting conservation goals.

Here, we explore the potential for HDORCOs to contribute to conservation of coastal marine ecosystems. Conservation of coastal ecosystems is urgent because of their compounding global and local threats and high human dependence (Hassan et al., 2005). While the roles of recreational fishing in management of target species are discussed in the literature (e.g. Adams and Cooke 2015; Cooke and Schramm 2007; Elmer et al., 2017), the potential for sportfishing to contribute to ecosystem-scale conservation has been largely overlooked (but see Everard and Kataria 2011 on freshwater habitat), particularly for coastal marine systems (but see Adams and Murchie 2015; Copeland et al., 2017). In the following sections we review the roles of recreational hunting and fishing in habitat and species conservation to identify how recreational fishing can potentially foster similar, if not even stronger, pro-environmental outcomes than hunting (section 2), examine the relationship between outdoor recreation and pro-environmental behavior (section 3), describe potential roles of HDORCOs in promoting conservation action by recreationists (section 4), and finally consider the potential efficacy of the HDORCO model in different governance, socioeconomic, and cultural contexts (section 5). We primarily provide examples of HDORCOs that are focused on recreational fishing and coastal marine habitats, but also point out that HDORCOs can be based on a wide variety of recreational activities and ecosystems, and describe a range of potential environmental benefits. We focus on examples where environmental benefits of HDORCOs have been claimed or observed, in order to better understand contexts required for HDORCOs to contribute to conservation.

## 2. Roles of recreational hunting and fishing in conservation

Hunting and fishing represent common activities that directly and indirectly impact ecosystems. They are most often consumptive habitat-dependent activities, frequently recreational, and their potential positive and negative influences on conservation efforts are varied and debated. Both hunting and fishing have inspired numerous HDORCOs. Fishing-based HDORCOs have generally been modeled after hunting-based HDORCOs that began to be established many decades prior (e.g. Ducks Unlimited). Exploring similarities and differences between recreational hunting and fishing can further our understanding of how habitat-dependent outdoor recreation might influence engagement in conservation.

Recreational hunting has both contributed to conservation and led to negative impacts on ecosystems. While recreational hunting may seem to be an unlikely driver of conservation, advocates often argue that hunters have an innate understanding that maintaining healthy populations of game species requires conservation of habitats, predators, and prey (Mahoney 1995). Hunting has been deeply intertwined with concepts of wildlife conservation and environmental stewardship (Geist et al., 2001; Heffelfinger et al., 2013) and embedded within the North American model of wildlife management (Prukop and Regan 2005). Trophy hunting in sub-Saharan Africa has been considered essential for providing incentives to maintain natural habitat and to fund parks and conservation organizations ('t Sas-Rolfes 2017; Fox and Du Plessis 2000; Lindsey et al., 2007). On the other hand, hunting can cause environmental problems in the same places that it provides potential solutions. For example, supporting population growth of whitetail deer, a popular North American game species, might be well intended, but overpopulation of this species has led to habitat degradation and limited native biodiversity in some locations (Horsley et al., 2003). Advocating for increased populations of game species does not qualify as conservation or stewardship (Holsman 2000) and, despite potential for the hunting industry to support conservation, costs and benefits of hunting are difficult to untangle from unknown effects of selectively removing animals from populations (Loveridge et al., 2016; McComb et al., 2001). Additionally, present levels of hunting big game and rare species could be unsustainable in some cases (Creel et al., 2016) and, with or without hunting, funding can be insufficient for achieving desired conservation outcomes (Lindsey et al., 2017).

While hunting has frequently been associated with ecosystem-scale natural resource management, recreational fishing is rarely viewed in scientific literature as a potential asset to habitat or biodiversity conservation (though see Adams and Murchie 2015; Copeland et al., 2017; Tufts et al., 2015). In some cases, recreational fishing harvest contributes to over-exploitation of fish stocks where management strategies do little to reduce fishing-induced mortality because the number of recreational fishers is not properly regulated, harvest is inadequately quantified, and/or size and bag limits increase regulatory discards and therefore fishing mortality (Coleman et al., 2004; Cooke and Cowx 2004; Post et al., 2002). Recreational fishing also leads to direct and indirect changes to habitats and community structure via pollution and disturbance associated with boat traffic (Sargent et al., 1995; Willby and Eaton 1996), lost or discarded tackle (Asoh et al., 2004), bait collection (McPhee and Skilleter 2002), stocking and introductions (Einum and Fleming 2001), and nonlethal interactions with fishes (Cooke et al., 2002). Damage can also extend beyond fished areas (Dundas et al., 2018). For these and other reasons (see Cooke and Cowx 2006; Lewin et al., 2006), it has been argued that recreational fishing may be largely incompatible with some conservation goals (McPhee et al., 2002).

Yet, managers might too often overlook opportunities for collaboration with recreational fishers on stakeholder-driven conservation. Kearney (1995) suggested that conservation-minded recreational fishing communities represent one of the greatest potential powers to promote aquatic biodiversity conservation. In Australia, for example, recreational fishers have requested increased harvest restriction on inshore game fishes (ECIFFC 2008), representing a request for collaboration with management agencies for non-residual protection of fisheries. While recreational fishers' responses to proposed rezoning of the Great Barrier Reef Marine Park in 2003 were largely summarized as requests to maintain access for recreational fishing, they also included concerns for biodiversity, protected species and habitats, nursery areas, and land-derived pollution (GBRMPA 2003). Intensive involvement of recreational fishers in the GBR rezoning process led to extensive changes to draft zoning plans, and the engagement process likely reduced public objections to increases in no-fishing zones that now protect one third of the park. Navarro et al. (2018) found that most recreationists who fish in Australian marine parks support no-take marine reserves, and that support increases with age of the reserve once established. Granek et al. (2008) and Cooke et al. (2016) discussed twelve cases across diverse socio-economic settings where recreational angling has potentially benefited conservation. In developing nations, sportfishing tourism can also finance alternative livelihoods that reduce extractive activities and provide incentives to protect the environment (Barnett et al., 2016; Cooke et al., 2016).

One aspect distinguishing fishing from hunting is that fishers do not necessarily remove the targeted animal from the ecosystem. Catch-and-release fishing provides fishers with a range of opportunities not available to most hunters: to meet their recreational goals while minimizing impacts on targeted populations, ecosystems, and associated biodiversity (Lowerre-Barbieri et al., 2003; Pauly et al., 2002). In fact, Nord et al. (1998) found that fishing more closely resembled non-consumptive activities, like hiking and birdwatching, rather than consumptive activities, such as hunting, in terms of association with pro-environmental behavior. Cooke et al. (2006) suggested that carefully monitored recreational fishing within MPAs can be compatible with conservation goals in some cases. Though non-consumptive recreation within PAs can still have negative impacts on habitats that should be minimized (Buckley 1990; Cooke et al., 2006; McCool 2009), catch-and-release fishing within MPAs can potentially gain support for MPAs that are not residual to fishing and can mitigate other threats to species and habitats. This is one example of how catch-and-release fishing enthusiasm can lead to ecosystem-scale conservation outcomes. Catch-and-release fishing still includes risk of barotrauma, deep hooking, decreased survival or fitness due to

exhaustion after prolonged fighting, bycatch of protected species, or lost gear that presents potential hazards. However, educated fishers can minimize these risks by using established best practices including appropriate handling, gear, and targeted environments and species (Brownscombe et al., 2017; Pelletier et al., 2007).

### 3. Outdoor recreation and pro-environmental behavior

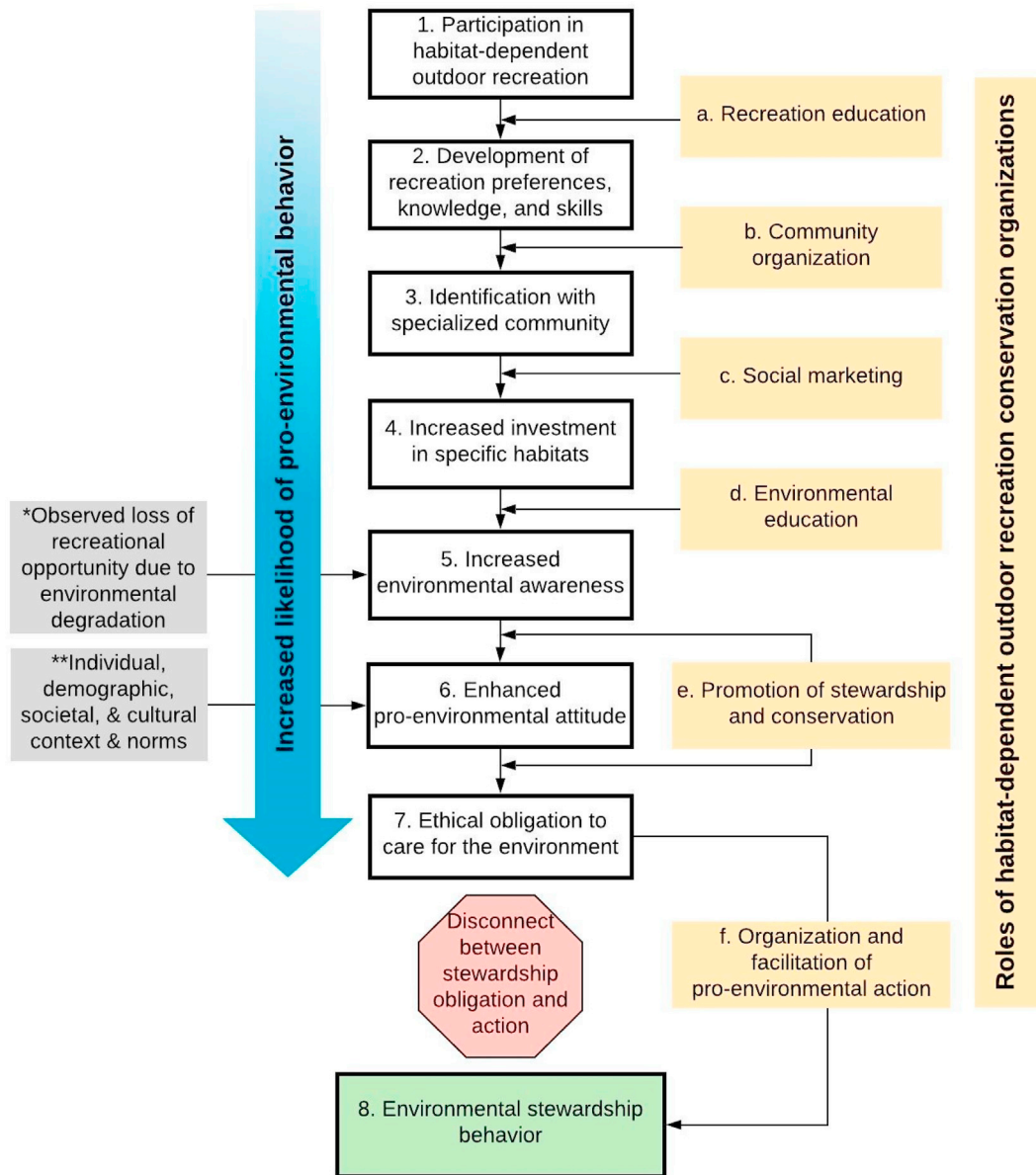
Various types of habitat-dependent outdoor recreation have different associations with environmental attitudes (Bjerke et al., 2006). To understand why some recreationists become strong advocates for conservation while others oppose restrictions required to achieve conservation, we must understand how outdoor recreation enthusiasm relates to pro-environmental behavior (Hutt and Bettoli 2007). Pro-environmental attitudes often arise from multiple aspects of recreation specialization including identification with specialized communities, financial and personal investments in habitat-dependent resources, and environmental awareness. Together, these factors can reinforce one another and potentially inspire environmental stewardship behavior (Fig. 1). Many other factors also interplay to determine human behavior, and numerous theories have been designed and adapted to explain influences on pro-environmental behaviors specifically. For example, aspects of the Theory of Planned Behavior (Ajzen 1985), the Value-Belief-Norm Theory (Stern et al., 1999), and Leisure Value Systems (Bryan 1977) have contributed significantly to ideas expressed in Fig. 1. Here, we build on prior work to highlight specific potential influences of habitat-dependent recreation on pro-environmental behavior, and how HDORCOs can potentially provide direction in this process.

#### 3.1. Recreation specialization and specialized communities

Outdoor recreation specialization (Fig. 1, box 2) has been conceived and applied in various ways in the literature. At a broad scale, Dunlap and Hefferman (1975) described recreation specialization in terms of appreciative (e.g. hiking, camping, birdwatching) versus consumptive (e.g. hunting, fishing) activities. They deduced that environmental concern is generally associated with outdoor recreation, and is most highly associated with appreciative activities. However, consumptive versus appreciative activities are not necessarily homogenous categories, and different types of both hunting and fishing can be associated with environmental attitudes in diverse ways (Bjerke et al., 2006). More recent work has defined recreational specialization as an intensity of involvement in a particular activity (Scott and Shafer 2001) and/or applied the concept to distinguish between subgroups of activity participants in order to understand drivers of pro-environmental attitudes and behavior (Cheung et al., 2017; Han and Oh 2018), and focus management strategies for fisheries (Hyman and McMullin 2018), endangered species (Lessard et al., 2018), and essential habitats (Roberts et al., 2017), and for numerous other purposes. Though some studies have found little evidence for a connection between recreation specialization and pro-environmental attitudes or behaviors (e.g. Pinhey and Grimes 1979), the potential relationships can be difficult to quantify because individual and social values and personal experiences and perspectives influence environmentalism in complex ways, and these factors can be convergent or divergent among recreationists (Bjerke et al., 2006; Schuett and Ostergren 2003; Thapa 2010).

The term “recreational specialization” was originally introduced to describe a continuum among trout fishermen ranging from participants with “minimal interest and skill” to “highly committed and specialized” individuals, reflected by factors including equipment, experience, skills, and values (Bryan 1977). Bryan (1977) suggested that recreationists tend to progress through a developmental process yielding not only intensity of involvement for individuals, but also specialized communities (Fig. 1, box 3) of individuals who share preferences in environmental setting as well as other values (Bryan 1977; Ditton et al., 1992). Indeed, some specialized recreation communities are more associated with the setting than with the activity itself (Arlinghaus and Mehner 2004) and are more likely to think and act in environmentally conscious ways when a specific environmental setting is required for their recreation (Nord et al., 1998; Teisl and O'Brien 2003). For example, “ecological quality” is important to some fishers (Arlinghaus 2006), and highly specialized fishers tend to be more dependent on natural resources and more motivated by experiencing a natural setting than less specialized fishers (Fedler and Ditton 1994). Furthermore, experienced recreationists tend to prefer settings with less human influence (Virden and Schreyer 1988) and have greater awareness of depreciative recreational behaviors and environmental impacts (White et al., 2008). Finally, recreation specialization implies first-hand, context-specific ecological and species behavioral knowledge. For example, scientists rely widely upon local ecological knowledge of stakeholders, including recreational fishers and other specialized recreation communities, to inform ecological studies and natural resource management strategies (Kamikawa et al., 2015). All the points above suggest that recreation specialists who are dependent on specific environmental settings (i.e. habitats) can be more likely to make financial and personal investments in pursuing their recreation (Fig. 1, box 4), become aware of environmental impacts on those habitats (Fig. 1, box 5), develop concern about conservation (Fig. 1, boxes 6,7), and exhibit pro-environmental behavior, including but not limited to, identifying ecosystem threats, conservation priorities and strategies, and iconic species and habitats (see Noble et al., 2020).

On this basis, sight fishing on tidal flats is an example of a recreational fishing specialization that has potential to contribute to coastal marine habitat conservation. Comparable to highly specialized fly fishing in mountain streams for trout – the activity originally cited by Bryan (1977) in the development of the recreational specialization concept – sight fishing requires specialized knowledge, skills, and techniques. Sight fishing is highly selective, with individual fish identified prior to angler pursuit, limiting possibility of bycatch. It is generally motivated by sporting goals rather than consumption, and most sight fishers practice catch-and-release. Sight fishing often relies on specific habitats, including seagrasses, mangroves, and



**Fig. 1.** A conceptual framework for how outdoor recreation can lead to environmental conservation. While this process is not necessarily linear and some individuals might skip steps (e.g. individuals at any recreation specialization level can think and act in pro-environmental ways for a variety of reasons) or fail to progress in some cases, HDORCOs can help to nurture characteristics that potentially engage recreationists in a pathway towards conservation and stewardship. HDORCOs can provide opportunities for recreationists to identify connections between their recreation pursuits and enhanced ecosystems and to act on those connections, either progressively or directly, at any time that HDORCOs and recreationists are able to engage with one another. Numbered white rectangles (1–7) represent the steps that cumulatively increase the likelihood of pro-environmental behavior. White rectangles 2–5 are developmental aspects associated with the process of recreational specialization (Bryan 1977). Yellow rectangles (a–f) represent opportunities for HDORCOs to nurture progression towards an ethical obligation to care for the environment and bridge the potential disconnect (red octagon) between ethical obligation and stewardship behavior (8) (see Ajzen 1985 on the Theory of Planned Behavior). More generally, the long yellow rectangle on the far right represents the roles of HDORCOs in promoting pro-environmental behaviors among recreationists at any stage of the represented progression. Some key additional influences on steps are identified in grey rectangles on the left (\*, \*\*). All arrows represent potential direct linkages between factors. Additional aspects of this schematic are derived from concepts addressed in extensive literature on values and norms and their impacts on human behavior (e.g. Stern et al., 1999). (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

tidal flats, that favor the visual experience of the activity, making it common for fishers to associate habitat quality with success. These habitats are also vulnerable to anthropogenic degradation (Polidoro et al., 2010; Short et al., 2011). In Everglades National Park, USA, sight fishers depend on overall habitat health for productivity and satisfaction (Brown et al., 2018), and sight fisheries for bonefish (*Albula vulpes*) have declined in recent years, likely as a result of poor water management

leading to seagrass die-offs in the region (Larkin 2011; Santos et al., 2017). Impacts of poor water quality on flats fisheries has motivated specialist sight fishing communities to lead conservation initiatives in south Florida in recent years, giving rise to several HDORCOs (e.g. Captains for Clean Water; [bullsugar.org](https://bullsugar.org)).

### 3.2. Habitat-dependent recreation investments

Financial and personal investments in specialized, habitat-dependent recreational fishing activities represent investments in specific habitats (Fig. 1, box 4). These investments can be considered a component of recreational specialization (see Buchanan 1985 on “commitment”) and can be substantial, both on the part of individuals, as well as cumulatively across recreation specialization communities. Financial investments associated with habitat-dependent recreation are important to livelihoods and economies in both developed and developing nations. In Everglades National Park, Brown et al. (2018) linked habitat health to fishers’ willingness to pay for fishing trips and related costs; these fisher investments are important to the Florida economy. In the Western Atlantic, sight fishing on saltwater flats is focused on three main species: bonefish, tarpon (*Megalops atlanticus*), and permit (*Trachinotus falcatus*), and contributes a total estimated annual economic impact of approximately 56 million USD in Belize (Fedler 2013a), 169 million in the Bahamas (Fedler 2010), and 466 million in the Florida Keys (Fedler 2013b). While personal investments needed to acquire experience, knowledge, and skills required for success in highly specialized outdoor recreation are difficult to quantify, time and effort spent on personal investments is considerable, in addition to financial investments.

Where healthy habitats are required for a return on recreation investments, specialists may be motivated to engage in habitat conservation. Jackson (1986) found stronger associations between recreationists’ pro-environmental attitudes towards aspects of the environment that were essential parts of their preferred recreation than environmental aspects that were not essential to their recreation. He went on to indicate that “... only when participants in a recreational activity deviate strongly from the rest of the public are the differences large enough to be statistically significant”. Recreationists whose attitudes and behaviors deviate strongly from the general public in association with their recreation, by definition, are specialists. Communities of highly invested sight fishers around Florida who have organized to conserve habitats that are required to support their valuable fisheries provides one example of specialists’ motivation to engage in habitat conservation. Resulting conservation organizations include Lower Keys Guides Association (<https://lkga.org>), Bonefish and Tarpon Trust (<https://www.bonefishtarpontrust.org>), and Captains for Clean Water (<https://captainsforcleanwater.org>).

Individuals who are heavily invested in habitat-dependent recreation are also likely to act to enhance others’ pro-environmental behavior because it is in their best interest (Ostrom 1990, 2000). Specialized fishers often aim to sanction others who do not fish according to best conservation practices (Guckian et al., 2018), and the most highly invested fishers are more likely to do so (Chapman et al., 2018). Social sanctioning is just one of many ways that highly invested fishers influence others to achieve conservation goals (Granek et al., 2008). For example, few people are more personally invested in recreational fisheries and the habitats that support them than charter guides. In 2013, tarpon fishing guides in Key West, Florida, led social marketing and lobbying campaigns that influenced a local government decision to reject a proposal to widen shipping channels to accommodate “mega cruise ships” in Key West Harbor (Accioly 2015; Benson 2013; LKGA 2017). Fishermen cited concerns about siltation and loss of benthic habitats and biodiversity resulting from passage of deep draft vessels and associated dredging projects, in addition to negative impacts of altered coastal ecosystems on recreational fisheries (Murray 2005). *Saltwater Sportsman* magazine published an article leading up to the decision, warning fishermen of potential damage to ecosystems that could affect tarpon fishing if dredging were to occur (McMurray 2013). This represented a commitment to conservation of ecosystems on the part of the sportfishing community. Even if the ultimate goal of fishermen was to conserve a specific fishery, incidental protection was provided to habitats and a broader range of species.

### 3.3. Environmental awareness

Environmental awareness (Fig. 1, box 5) is a factor of recreational specialization that is essential if recreational enthusiasm is to drive pro-environmental behavior. Connections between environmental awareness and pro-environmental behavior are complex (Kollmuss and Agyeman 2002), sometimes indirect (Yuriev et al., 2020), and depend on various scales of culture, setting, psychology, and demographics (Li et al., 2019; Sarvilinna et al., 2018; Tam and Chan 2017). Despite complexity of associations between environmental awareness and pro-environmental behavior, the more recreational specialization yields ecological awareness and knowledge, the more it can inform conservation and enhance stewardship (Danylchuk and Cooke 2011; Thornton and Scheer 2012). Few studies have investigated environmental awareness of recreational fishers as a step toward coastal habitat conservation. In one example, Copeland et al. (2017) identified that fishers largely perceived connections between habitats and the quality of fisheries associated with those habitats, and that the most effective way to improve catches was to improve habitats. They also found that those who were most invested in recreational fishing, and those who perceived changes in fish availability over time, were more likely to participate in habitat conservation. Importantly, recreational fishers who rated themselves as highly knowledgeable about habitat issues were five times more likely to participate in habitat management activities (Copeland et al., 2017). This study provides strong evidence linking specialized experience and personal investment in recreational fishing with participation in habitat conservation, and highlights the importance of awareness of habitat-related issues in driving pro-environmental behavior. This connection further suggests that less knowledgeable or less conservation-minded recreationists could contribute further to conservation efforts if

strategically educated and engaged. Although observed loss of recreational opportunity might primarily lead to selfish motivation to engage in science and conservation for some specialists (De Dominicis et al., 2017), it can also influence pro-environmental attitudes (Fig. 1, box \*).

### 3.4. Stewardship

Stewardship is a term often used to bind outdoor recreation with pro-environmental attitudes and behaviors (Fig. 1, boxes 6–8). Though the term can be used to describe general management of an area or paid restraint on extractive activities, we interpret environmental stewardship as ‘an ethical obligation to care for the environment and exhibit behavior required to provide that care’, following Dixon et al. (1995).

Stewardship calls for a range of behaviors. These behaviors often include sacrifice on the part of individuals to benefit ecosystems that communities depend on, as well as influencing the behaviors of others within the community. Appropriate stewardship behavior is context-dependent and can include driving less, consuming less, or using renewable energy sources. For recreation specialists, stewardship behavior can include optimizing rather than maximizing production of game species, diversifying recreational opportunities, or contributing to ecosystem protection (Holsman 2000).

Cultural, socioeconomic, lifestyle, and governance contexts also influence pro-environmental attitudes and stewardship behavior (Fig. 1, box\*\*). Given a virtual continuum of potential self-sacrifice and intrusive action on others in order to achieve conservation, stewardship requires interpretation and communication of good judgement on human roles in specific physical and societal settings. This can be philosophically complex, and can result in social and political contention, which can delay or prevent effective governance. Where legislation falls short of achieving conservation outcomes, a system including social accountability and social sanctioning can help to establish societal norms of acceptable behavior, potentially resulting in self-management of natural resources within communities (Ostrom et al., 1992). Effective communication of accurate information is key to achieving conservation outcomes in such a system. Environmental stewards, whether individuals, organizations, or government agencies, should strategically educate themselves and members of their communities, to achieve pro-environmental behavioral norms.

## 4. Roles of HDORCOs in promoting conservation by recreationists

We have outlined how recreation specialization, habitat-dependent investments, and environmental awareness can influence pro-environmental attitudes and behaviors among recreationists (Fig. 1, boxes 1–8). In doing so we identify six opportunities for strategic interventions by which HDORCOs can nurture progression from participation in habitat-dependent outdoor recreation to pro-environmental attitudes and stewardship behavior among recreationists: providing recreational education, community organization, social marketing, and environmental education, promoting stewardship and conservation, and organizing and facilitating pro-environmental action (Fig. 1, boxes a–f).

We have identified that the process of recreation specialization requires development of preferences, knowledge and skills (Fig. 1, box 1). HDORCOs are key providers of recreational education (i.e. development of recreation knowledge and skills), which can encourage recreation generalists to become more specialized, and thus embark on a pathway towards stewardship (Fig. 1, box a), as described in Section 3. This education can start when interest in outdoor recreation begins and can include specialists sharing their expertise with those who are less specialized (Gray and Jordan 2010). HDORCOs can strategically continue recreation education for expert recreationists in this way, and in other ways such as involving them in citizen science that can enhance their expertise. Bonefish and Tarpon Trust includes fishing guides and recreational fishers in tagging programs and catch-and-release studies, for example, and distributes information that combines fishing tips with environmental messages such as best handling practices, catch-and-release techniques, and estimating weight of catches without removing them from the water (<https://www.bonefishtarpontrust.org/education-outreach>). These messages capture the interest of fishers and potentially improve the skills of even highly specialized fishers, while improving recreationists' awareness of their potential contributions to conservation.

Bonefish and Tarpon Trust also works with professional fishing guides and specialized recreationists to build communities that can carry a social voice that represents recreational fishers' interests, concerns, and needs (Fig. 1, box b). As a result of these efforts, Bonefish and Tarpon Trust has built a network of fishing guides in south Florida who earn their livelihoods by teaching their clients to fish in pro-environmental ways and to appreciate the value of environmental stewardship (<https://www.bonefishtarpontrust.org/conservation-captain-program>). Additionally, many HDORCOs provide a range of sponsored and member events. For example, the Herman Lucerne Memorial Foundation hosts the annual Backcountry Fishing Championship in one effort to “build communities to amplify [their] voice” (HLMF 2017).

Social marketing strategies have encouraged recreational fishers to engage in pro-environmental behavior for many years (Fig. 1, box c). For example, catch-and-release fishing has been marketed on fishing television programs for several decades, and the majority of currently televised fishing programs portray a value for catch-and-release and otherwise conserving productive fisheries for future generations. Catch-and-release initiatives persist with enhanced pro-environmental messages that reference scientifically supported catch-and-release techniques and best handling practices, and such initiatives are strategically branded in some cases (Danylchuk et al., 2018). A nationwide Australian campaign encouraging best practices for catch-and-release recreational fishing, including six television advertisements, a pamphlet, and a website, was initiated in 2003 under the logo “Released Fish Survival”. This initiative resulted from a partnership of government agencies, private

organizations, and approximately eight recreational fishing-based HDORCOs, and reached an estimated audience of approximately 20 million individuals (Sawynok and Pepperell 2004). HDORCOs are frequently supported by celebrity fishers who now promote ecosystem-scale conservation (e.g. CCW 2016). A fishing program specifically focused on conservation of coastal marine habitats in Florida premiered throughout the United States in spring of 2019 (see Weakley 2018). These examples of social marketing of recreational fishing-inspired stewardship represent efforts, on the part of specialized fishing communities and HDORCOs, to influence perceived normal and acceptable behavior (Cialdini et al., 1991) among skilled specialists.

In addition to recreational education, HDORCOs can also play roles in providing environmental education (Fig. 1, box d). Successful environmental education of stakeholders should establish: an awareness of, and sensitivity to, the environment and its associated problems; an attitude of concern for the state of the environment; and sufficient motivation for actively applying skills to identifying and solving environmental problems (UNESCO 1978). It is important not to assume that awareness leads to concern, or that an attitude of concern leads to active participation in solving problems, but all three are required to develop voluntary environmental conservation action (Hungerford and Volk 1990). Awareness-focused environmental education alone is often unsuccessful at motivating pro-environmental behavior, but experiential learning, as occurs in the recreation specialization process, can better motivate pro-environmental behavior (Cachelin et al., 2009; Otto and Pensini 2017). Recreation specialists likely form an emotional connection to nature, a prerequisite for people to develop pro-environmental behaviors (Hinds and Sparks 2008; Rands et al., 2010). HDORCOs can play an important role in developing emotional connections in the process of providing environmental education to narrow the gap between passion for recreation and motivation for conservation of habitats that support that passion.

HDORCOs can increase stakeholder awareness of their reliance on healthy habitats, of environmental concerns regarding those habitats, and how they can act to protect their interests through ecosystem-scale conservation. Captains for Clean Water is primarily focused on gaining public support for mitigating water quality problems in south Florida. The organization calls on support from recreational fishers, the general public, managing agencies, and policy makers by providing education on the degraded state of Florida waters, the historical baseline of water conditions and hydrology, causes of pollution and habitat decline, specific solutions, and the relevance of these topics to recreation, property values, public health, and local economies. This represents a strategic approach to progressing stakeholders who are invested in coastal systems towards increased understanding of their reliance on specific ecosystems, as well as their dependence on healthy ecosystems to experience returns on their personal and financial investments associated with recreational fishing.

Promotion of stewardship and conservation (Fig. 1, box e) is another primary role of HDORCOs. HDORCOs can encourage engagement in conservation holistically through the processes outlined previously in this section. HDORCOs promote stewardship and conservation through an ongoing nurturing process, including education, organization, and social marketing throughout the development of recreation specialization. As a result, pro-environmental attitudes and ethical obligation to care for the environment can potentially become a characteristic of habitat-dependent outdoor recreation specialization.

Perhaps the most important role for HDORCOs is in organizing and facilitating pro-environmental action (Fig. 1, box f). Recreational fishers who have not engaged in habitat conservation but expressed interest in conservation have cited reasons for their lack of involvement that include organizational limitations such as lack of contacts, funding, and ideas (Copeland et al., 2017). HDORCOs can provide solutions to these organizational limitations, helping to overcome the disconnect between stewardship obligation and action. Disconnect between pro-environmental attitudes and behaviors is not limited to recreationists, but tends to be common among many stakeholder groups (Kollmuss and Agyeman 2002). Therefore, HDORCOs can also play a critical role in bringing environmental managers and recreationists together and facilitating collaborative conservation by providing opportunities and support for stakeholders to act on their pro-environmental attitudes and obligations. For example, Bonefish and Tarpon Trust has harnessed flats fishing enthusiasm to work with Bahamian stakeholders to expand one and establish five new national protected areas in Bahamas coastal habitats (Adams et al., 2019; Boucek et al., 2019). The organization also works with Cuban collaborators to support MPAs for conservation of gamefishes and essential habitats (<https://www.bonefishtarpontrust.org/projects>).

Notably, HDORCOs are able to facilitate or organize pro-environmental action at scales far greater than possible by individual recreationists. For example, The Coastal Conservation Association started as a group of 14 recreational fishers concerned about commercial overfishing on the Texas coast, who recognized that improving recreational fishing depends upon conservation efforts that span state and regional boundaries. In response, they have scaled up their goals and partnered with other organizations to maximize public and political attention. The Coastal Conservation Association currently includes 17 coastal state chapters operating at local, state, and national government levels. Their potential conservation achievements include rehabilitation of a wide range of terrestrial, freshwater, and marine ecosystems across the Gulf of Mexico, Atlantic, and Pacific coasts of the United States (<https://ccatexas.org/who-we-are/>). It is feasible for some HDORCOs to influence state, national, and even global practices and policies. However, organizational goals must be appropriate to ecological, socio-economic, cultural, and governance contexts.

Finally, HDORCOs can best carry out their multifaceted roles by incorporating sound science throughout their programs. For example, Ducks Unlimited and Bonefish and Tarpon Trust engage diverse stakeholders in developing and communicating scientific knowledge to align understanding among researchers, resource users, managers, and the general public. Where scientific knowledge is insufficient to effectively manage resources, these organizations aim to identify and fill knowledge gaps and fund or create partnerships to carry out research that can benefit conservation priorities (Adams et al., 2019; Kemink et al., 2019). By engaging key stakeholders in this process, they can inform and motivate recreationists, legitimize

recreationists' voices among scientists and managers, and reduce potential conflicts and misinterpretation among stakeholders that can otherwise deter conservation achievement (Marshall et al., 2007).

## 5. Efficacy of HDORCOs

In Fig. 1 we identify six potential roles for HDORCOs in promoting the progression of recreationists towards stewardship. However, the extent to which these roles are effectively performed can vary depending on specific characteristics of HDORCOs (e.g. scale, intensions, means, nature of focal recreation). While some HDORCOs (e.g. Ducks Unlimited) have demonstrated positive conservation impacts, organizations focused on harnessing recreational enthusiasm are not always stewards themselves. Outdoor recreation often negatively affects the environment (Altieri et al., 2012; Cole 2004), and recreationists' access to resources should not be supported unconditionally (Arlinghaus et al., 2019). Some recreation organizations primarily represent stakeholder rights, and others ambiguously blend goals of conservation and other special interests that can be counterproductive to conservation achievement. For example, a great deal of research suggests that no-fishing zones are essential for achieving coastal habitat protection and to support biodiversity as well as fisheries (e.g. Lester and Halpern 2008), so angling organizations that fail to support MPAs to maximize support from fishing enthusiasts and maintain stakeholder rights might not be supporting net conservation outcomes even if they do act pro-environmentally in other ways.

If HDORCOs are to make meaningful contributions to conservation of marine and coastal habitats globally, this general approach must also be transferable to other contexts, with varying governance, socioeconomic, and cultural characteristics. It might be particularly important to explore potential for HDORCOs to expand to developing countries where conservation needs are typically heightened by widespread reliance on natural resources to support livelihoods.

Environmental needs and incentives to contribute to conservation differ greatly depending on location. In Florida, bonefish are managed by catch-and-release only policy, and the high value of bonefish fisheries provides incentive to protect the species and the habitats that support it. An individual bonefish has been calculated to be worth up to USD 75,000 to the Florida recreational fishing industry over its lifetime (Ault 2008), although more recent studies indicate that this could be an overestimate (Fedler 2009, 2013b). The high value of recreational fisheries is also realized in Belize where it is illegal to harvest bonefish, tarpon, or permit, and in the Bahamas where commercial sale of and use of nets to harvest bonefish is prohibited. In contrast, bonefish are important sources of protein in many Pacific Islands (Friedlander et al., 2008), where they sell for as little as USD 1 per pound (Fig. 2; Kiribati, B. Campbell, pers comm.). Differences in value of bonefish represent a potential disconnect in transferability of conservation strategies. There could still be financial incentives for developing habitat conservation programs alongside recreational fishing tourism in the Pacific, and other developing countries around the world, although likely at a smaller scale than in Florida (for examples, see <https://www.indifly.org/locations/>).

World renowned recreational flats fisheries for multiple species are established in Kiribati and Hawaii, and recreational fisheries are in early stages of establishment in parts of French Polynesia and elsewhere around the globe. Increased local to international-scale attention on habitat-dependent recreational fisheries could enable enhanced conservation in developing countries if fisheries are developed properly. Guidelines have been designed to ensure that sportfishing ecotourism operations develop in ways that benefit local communities (Barnett et al., 2016; Sheaves et al., 2016). HDORCOs can potentially help to ensure that investments made by traveling recreationists benefit local stakeholders according to these or other appropriate guidelines. Achieving habitat conservation should also be a priority of sportfishing development (Wood et al., 2013). Another important role of HDORCOs in developing countries might be to study and report on actual and potential economic gains related to sport fishing, to gain support for conservation from stakeholders who depend on natural resources for livelihoods, and to counter potential negative perceptions of HDORCOs (e.g. as privileged organizations).

Some conflict is to be expected where recreational fishers compete for fisheries resources with other stakeholders. Financial incentives associated with development of a recreational fishing industry, and cultural links between recreational



**Fig. 2.** Variation in value of Polynesian bonefish. (a) A bonefish caught and released by a guided recreational angler (photo by Christopher Wright), and (b) large adult bonefish for sale in South Tarawa, Republic of Kiribati (photo by Quentin Hanich). Variation in value of bonefish, between the catch-and-release recreational fishing industry and market value in areas absent of recreational fisheries represents a disconnect in transferability of incentives to conserve species and habitats. Local communities can potentially attract greater income while supporting ecosystem-scale conservation by developing recreational fisheries where feasible.

fishing communities, are relevant only in some situations. HDORCOs might be challenged in places where daily catch provides essential nutrition, diverse sectors compete for natural resources without regulations or enforcement, wilderness areas are perceived more as threat than commodity, environmental legislation is lacking, or social norms do not emphasize environmental concern or compliance with rules. Conservation organizations often face these challenges in developing countries, making it difficult to maintain good reputations among stakeholders. Stakeholder perceptions of HDORCOs might have dire consequences for achieving conservation goals, particularly where habitat-dependent recreation is not common. To overcome these challenges, while providing unique contributions to conservation efforts, HDORCOs could focus on relevance of recreational fisheries to supplement nutrition and income, and provide education about and awareness of the importance of ecosystem-scale conservation, compliance with management policies, options for self-imposed regulations, and potential benefits of releasing some catch. These strategies can potentially be carried out in culturally appropriate ways to bridge gaps between political views, financial priorities, social norms, and conservation. Where common ground is found between HDORCOs and stakeholders, partnerships might provide additional support for conservation in ways that other organizations do not provide.

Transferability of a specific organization's actions and goals might be required to enhance international conservation achievements. Bonefish and Tarpon Trust has found relevant ways to work across cultural barriers, with fisheries not only in Florida but also throughout Central America and across the Caribbean. A cultural link in their work is based in flats fishing. In other situations, it could be beneficial to develop or expand HDORCOs over regional and international scales with location-specific projects in areas like Pacific and Indian Ocean islands where fishing tourism is or can be established. Project goals could include promoting recreational fishing to increase international clientele for local operators while developing community outreach and education programs to ensure sustainable development and practices. Working with government agencies and the tourism industry to ensure appropriate management of commercial fisheries, agriculture, and other factors that affect recreational fisheries might also be important. Benefits to a variety of stakeholders could include enhanced international recreational fishing opportunities, economic contributions, and incentives to improve conservation outcomes.

Conservation almost always requires engagement with a diversity of stakeholder groups, many of whom often have divergent interests and perspectives. Enhanced stakeholder engagement strategies are needed to overcome such complexities (Adams et al., 2019). HDORCOs could play a pivotal role in such situations because they occupy a “middle ground” between extractive and conservationist interests.

## 6. Discussion

Identifying and developing opportunities to engage resource users in conservation action can mark a starting point for conservation achievements. In some cases, outdoor recreation inspires strong emotional responses in people, leading to advocacy for ecosystem-scale conservation. Ducks Unlimited is an HDORCO founded on the concept of outdoor recreation enthusiasm driving advocacy for ecosystem-scale conservation in communities not typically associated with pro-environmental attitudes. This enthusiasm and advocacy has spread from hunters to other sectors of North American society. Adams and Murchie (2015) suggested that recreational fishing can similarly lead to conservation of coastal marine ecosystems, and a number of recreational fishing-based HDORCOs appear to be leading such initiatives. Potential for recreational fishing to contribute to conservation action should be further explored and strategically applied, particularly considering widespread degradation of coastal habitats and high human reliance on them.

Conservation organizations that are not characteristically linked to outdoor recreation have recognized the value of working with recreational fishers, even including angling for threatened species and in marine protected areas (Cooke et al., 2006, 2016). For example, the World Wildlife Fund supported the “Fish for Life” project in South Africa which aims to improve the knowledge base and stewardship of its coastal fishery resources (see [www.fishforlife.co.za](http://www.fishforlife.co.za)). The World Wildlife Fund has also partnered with fishing clubs on the Onon River, Mongolia to establish sanctuaries to protect threatened Siberian taimen (*Hucho taimen*) (Hogan and Jensen 2013) and habitat required by the species (Cooke et al., 2016). Palmyra Atoll is a U.S. National Wildlife Refuge jointly managed by The Nature Conservancy and the United States Fish and Wildlife Service; these organizations have allowed recreational flats fishing at Palmyra, presumably recognizing its potential compatibility with, and financial contributions to, conservation goals for the refuge (Friedlander et al., 2008).

Involving recreationists in conservation can help to overcome potential weaknesses of PAs, including poor stakeholder buy-in and residual placement. Although recreational fishers often directly extract resources, can indirectly damage the environment, and sometimes oppose conservation measures, recreational fishers are not a homogeneous stakeholder group. Conservation planners should aim to strategically engage recreational fishers as potential conservationists. For example, harvest-oriented and catch-and-release-oriented recreational fishers might represent distinct groups at opposite ends of a spectrum with different attitudes toward conservation. Other fishers practice both activities and harvest selectively based on potentially complex ethical and practical reasoning. Appropriate multifaceted and strategic engagement of these three subgroups of fishers by HDORCOs might ultimately enhance conservation achievement over time. A failure to recognize heterogeneity among recreational fishers can lead to ‘fishing versus conservation’ partisanship and missed opportunities to ally with recreational fishers in enhanced conservation achievement (Pascoe et al., 2009).

We have identified multiple roles that HDORCOs can play in contributing to conservation. While we have focused on examples from recreational fishing organizations and coastal marine ecosystems in this paper, HDORCOs represent a conservation strategy that has been broadly applied across habitat-dependent recreation groups. Their key roles range from increasing the

likelihood that individual recreationists will develop pro-environmental attitudes, facilitating stewardship actions by conservation-minded recreationists, and lobbying for large-scale conservation action and policy, to carrying out and communicating science and playing a bridging or brokering role in multi-stakeholder conservation negotiations. While there are examples of HDORCOs playing each of these roles, there is scope for these roles to be expanded, and for further research to improve strategies used by HDORCOs, potentially enhancing engagement of recreationists in conservation advocacy.

Each of the roles of HDORCOs outlined in Fig. 1 (yellow boxes) can benefit from targeted research to maximize efficacy. Extensive research continues on social and psychological factors that drive human behavior. This research will be essential to furthering our understanding of factors that lead to pro-environmental behavior among outdoor recreationists, and in general so that better engagement strategies can be achieved. There is also likely to be relevant research from other disciplines (e.g. social marketing) that can be focused on improving roles of HDORCOs and recreational fishers in achieving conservation of coastal marine ecosystems. For example, it might be important to better understand roles of recreation specialization or other factors that can determine fishers' pro-environmental attitudes and behaviors, or to identify cases where conservation has been successful and how and why it has succeeded with or without the support of recreationists.

From an ecological and physiological standpoint, stress and mortality associated with catch-and-release have been fairly widely studied. However, while some factors that determine catch-and-release success apply broadly (e.g. reducing air exposure), more investigation is needed of species and habitat-specific resilience to fishing (Brownscombe et al., 2017). Best handling practices should be developed for more recreationally targeted fishes, particularly to inform management approaches that require catch-and-release (i.e. size and bag limits and seasonal and species restrictions), and identify if management that includes catch and release is not appropriate in some cases. Research aimed at improved PA design might be an important step in conservation planning. Such studies can also provide useful information to conservation-minded fishers who intend to minimize their ecological impacts. Finally, given the wide spectrum of goals related to conservation and stakeholder rights among recreation-based organizations, it is important to identify what characteristics are required for HDORCOs to effectively contribute to ecosystem-scale conservation, because this aim is essential to the HDORCO definition.

HDORCOs have not been the subject of systematic or independent research. Therefore, parts of the conceptual framework we have identified as important for HDORCOs to guide recreationists to pro-environmental behavior are more speculative than we would like, or are based on non-peer reviewed claims made by the organizations themselves. We are also unaware of any peer-reviewed literature on influencing recreational specialization to achieve natural resource conservation, though processes for outdoor recreation clubs and program organizers to promote increased recreation specialization have been outlined (e.g. Kim et al., 2019). Our finding that HDORCOs can play critical roles in enhanced stakeholder engagement in conservation indicates a need for such targeted research. This work should continue within the context of the extensive research on social and psychological influences on pro-environmental behavior. We do not claim that any one factor directly connects recreation specialists to conservation action, and we have not been able to thoroughly review these subjects within the scope of this work. Nonetheless, the cumulative social and psychological influences driving the process of recreation specialization can instill a foundation of characteristics in habitat-dependent recreation specialists that can be nurtured by HDORCOs as a conservation strategy.

Outdoor recreationists are numerous, have taken pride in stewardship agendas, and face loss of lifestyle, culture, and livelihood with declining habitat quantity and quality. Recent environmental advocacy by recreational fishers and fishing guides indicates potential for these groups to contribute to conservation achievements. HDORCOs started by recreational fishers have achieved habitat conservation and have successfully marketed conservation advocacy in a variety of contexts. These organizations can play further roles in shifting social norms by influencing the (perhaps) unlikely conservationist, the outdoor recreationist.

In the modern world, it is important to question what influences people more strongly: increased awareness of the need for conservation, or the tendency to neglect conservation due to trends toward the human-environment disconnect. We suggest that outdoor recreationists will likely play increasingly important roles in conservation efforts, in response to continued loss of recreational opportunities. It is important for them to be organized and well informed to have positive impacts. Jackson (1986) predicted that a societal shift from consumer to conserver should result in recreation specialization shifts from consumptive to appreciative. We see these shifts in sections of society as a whole and in recreationists. Focus on recreation as an influence on society represents another angle to provide leverage to enhance conservation more widely. It is our hope that this work helps to identify avenues for boosting this trend through strategic engagement of recreationists in habitat and species conservation.

### Statement of data archive and ethical approval

This work did not include data collection or any specific human subjects and did not require archiving of data or ethics committee approval.

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## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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