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Is catch-and-release recreational angling compatible with no-take marine protected areas?

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Abstract

Marine protected areas (MPAs) have become a common conservation and management tool for reducing exploitation from the commercial and recreational fisheries sectors. However, the recreational fisheries sector has the potential to be compatible with no-take MPAs when catch-and-release angling is practiced because, in theory, no fish are actually harvested. This presumes that the effects of catch-and-release angling and related activities do not cause appreciable declines in fish populations as a result of direct mortality, sub-lethal effects, or indirect effects on fish habitats, or other problems contrary to the goal of a given MPA. Here, we explore the idea that recreational catch-and-release angling may be compatible with some no-take MPAs provided there are no substantive negative ecological consequences. We argue that it is not currently possible to answer definitively the question of whether recreational catch-and-release fisheries can be compatible with no-take MPAs. Mortality rates of released fish vary extensively (between zero and near 100%) and are influenced by a number of factors including environmental conditions, fishing gear, angler behavior, and species-specific characteristics. Nevertheless, research in the field of catch-and-release is beginning to show that certain handling techniques can significantly reduce post-release mortality in fish. With appropriate regulation and angler education, catch-and-release could help enhance conservation and management goals associated with MPAs while maintaining public support and providing alternative tourism-based revenues for displaced fishers. Until sufficient data are available, research should focus on contrasting the fish community characteristics in regions with no fishing and

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those that permit catch-and-release fishing (i.e., opportunistic observations and controlled manipulations) as well as population-level mathematical modeling to assess the effects of angling on long-term population viability and ecosystem dynamics. Additional efforts should focus on education and outreach that provide anglers and fishing guides with the best available information to reduce catch-and-release mortality, sublethal angling-induced impairments, and broader effects on aquatic environments.

1. Recreational angling and MPAs

Practitioners of conservation science are increasingly utilizing marine protected areas (MPAs) to prevent the degradation of marine ecosystems and to control exploitation rates associated with recreational and commercial fisheries [1,2]. In a recent synthesis of over 100 MPAs, Halpern [3] concluded that, relative to unprotected areas, MPAs were associated with increases in species diversity, biomass, organism size and organism density. These findings are consistent with those of earlier syntheses [4,5]. MPAs serve to protect vulnerable species and habitats, and can also export biomass to surrounding waters [6,7]. As a result, Hixon et al. [1] suggested that MPAs might be the most immediate and effective conservation action available for threatened marine ecosystems. MPAs are now found throughout the world with some researchers advocating that between 10% and >50% (mode of approx. 30%) of the world's oceans should be afforded protection from fishing through imposition of no-take MPAs [e.g., 8]. Most of the existing and proposed MPAs are located in highly productive coastal environments (e.g., estuaries, reefs, sea grass beds), the same habitats frequented by recreational anglers [9,10].

The most common approach for MPAs is to prohibit all extractive or consumptive activities, such as commercial and recreational fishing, that result in the harvest of organisms, while non-exploitative activities such as SCUBA diving and snorkeling are permitted [11]. These types of MPAs are generally referred to as "no-take" (also known as no-take fishery reserves). MPAs also provide an opportunity to directly contrast the effects of different fishing sectors on fisheries and marine ecosystems [10]. Results from such studies have been disparate, but there is some evidence that recreational fisheries that permit harvest can be as or more deleterious than commercial fisheries. For example, in Australia, recreational fishing outside an MPA resulted in reduced biomass and community composition relative to protected areas within the MPA [12]. In California, protected areas had the highest density and best size structure of rockfish (*Sebastes* spp.) whereas in recreational fishing areas outside of the MPA, fish densities were lowest and size structure was poor [13]. Recent research from New Zealand revealed that partial closures that still permitted recreational fishing harvest were ineffective as a conservation tool and that these partially closed regions had angling effort equal to control sites [14]. These examples illustrate why in some cases recreational fishing harvest must clearly be curbed if an MPA is to be effective. However, many recreational fisheries are based upon catch-and-release (either voluntary or mandatory) and fish are released after capture rather than harvested [10], thus potentially reducing the negative impacts of angling on fish populations.

Currently, debate exists as to the compatibility of catch-and-release angling within no-take marine reserves. Superficially, catch-and-release recreational angling would appear to

be compatible with the concept of "no-take" MPAs, as fish released following an angling event may survive to be caught again [15]. Although many fish do survive following release, this is not always the case [e.g., 16,17]. As a result, the population-level impacts resulting from catch-and-release depends upon the success of the species-specific, catch-and-release strategies employed [18]. In essence, the mortality associated with catch-and-release angling could be viewed as "take" and thus incompatible with no-take MPAs. Furthermore, if catch-and-release angling results in impairments in growth or fitness, this would also contradict the objectives of a no-take MPA even though it does not directly result in the mortality of the angled fish.

There has been tremendous controversy associated with the outright prohibition of recreational fishing in MPAs [19]. Results from human dimension surveys of saltwater anglers reveal that support for MPAs may decrease with increasing levels of restrictiveness [20]. The attitudes of anglers towards the establishment of catch-and-release only MPAs was mixed, but more favorable than to outright exclusion [20]. Angler groups and the sportfishing industry in the USA in particular have lobbied extensively to not include recreational fishing in the same discussions as those intended to prohibit commercial fishing [19; see arguments summarized in 21]. Although conservationists have advocated that extensive MPA networks that are "off limits to fishing" are necessary to achieve sustainable marine fisheries [e.g., 22], there has been little discussion of the recreational angling sector, and in particular, catch-and-release. In fact, there have been few scientific studies and little debate in the primary literature over the potential compatibility of catch-and-release recreational fishing with MPAs. This is surprising considering that recreational fishing is a global phenomenon, with crude estimates suggesting that billions of fish may be released annually [9]. To understand better whether catch-and-release angling could be compatible with MPAs, we present a brief case study on bonefish (*Albula* spp.) and assess recent research on catch-and-release angling in a broader group of species. We premise our discussion by stating that fishing of any kind, including recreational fishing, has the potential to affect fish, fisheries, and aquatic environments negatively [10]. Consequently anglers, guides, fisheries managers, conservationists, and researchers must accept the possibility of negative biological consequences prior to considering whether recreational catch-and-release fishing could be compatible with no-take MPAs. We emphasize as well, however, that the positive consequences of catch-and-release angling should also be considered, especially as they pertain to the economic viability and public acceptance of the MPA.

2. Recreational fishing impacts and a case study on bonefish

Bonefish (*Albula* spp.) reside in shallow, near-shore environments throughout the Caribbean and other similar circum-tropical environments [23,24], where no-take MPAs have become popular conservation strategies [11]. Bonefish are the target of specialized and lucrative recreational fisheries, such that the presence of a healthy bonefish fishery can generate large amounts of tourism-based income for local and national economies [24]. Bonefishing lodges and guide service industries have been developed in remote regions of the South Pacific (e.g., Christmas Island), the Indo-Pacific (e.g., the Seychelles), the Caribbean (e.g., Mexico, Venezuela, The Bahamas), and the United States (e.g., Florida Keys, Hawaii). In addition to direct inputs into local economies (e.g., lodging, local transportation, guide fees), funds that anglers pay to reach these destinations, funds spent

on specialized angling equipment, and other related costs can result in substantial economic inputs even to locales distant from where bonefish reside. In Florida alone it is estimated that recreational bonefishing contributes upwards of two billion dollars annually to the economy [25]. In less developed economies, bonefish lodges and outfitting services can support entire communities.

Conflict between proposed MPAs and recreational fisheries, including those targeting bonefish, are already evident in several locales [26]. A study by the University of Miami concluded that chronic overfishing was occurring in Florida's Biscayne Bay [27]. Suggestions of establishing strict no-fishing areas resulted in significant opposition from guides who depend upon bonefishing for their livelihood [28]. An alternative option might be to restrict recreational fishing to particular zones and/or to mandate catch-and-release. At present, however, little data exist to determine whether such recreational angling activity, even if catch-and-release, would be compatible with the function of MPAs. Similar problems have been reported in other jurisdictions, including Hawaii, the Seychelles, Mexico, and The Bahamas [29]. The imposition of no-take MPAs has displaced many subsistence and commercial fisheries [30]. If done in a sustainable manner, the development of catch-and-release fisheries in these areas for bonefish (or other species) could yield better compliance with MPA regulations and provide local communities with alternative sources of income somewhat related to their prior occupation in a different sector. Capacity building in this way could help to ameliorate the initial economic hardships associated with imposition of MPAs.

Globally, bonefish represent one of the best-known examples of a fishery that is almost exclusively catch-and-release due to a strong conservation ethic among anglers and questionable food value of the fish [31]. The ultimate fate of released bonefish, however, is poorly understood [18]. When a fish is hooked by an angler, many factors affect the outcome of the event for the fish [32]. At best, the fish will survive the event, recover quickly, and experience no long-term sub-lethal impairments. At worst, the fish will not survive. Although anglers strive for the former outcome, it is likely that the outcome will be somewhat intermediate of these two extremes. Some of the factors that may affect the outcome are intrinsic, such as fish sex, age, previous exposure to stressors, maturity, condition, size, and degree of satiation, or environment. These factors are largely out of the realm of angler control and have been poorly studied [18]. Anglers generally control the other factors that can influence the outcome of an angling event. This includes choice of fishing equipment (terminal tackle and gear, e.g., bait/lure/fly type, hook type, rod, reel, and line test), behavior of the angler during the fight, when the fish is landed, if it is exposed to air, and how it is handled and released [16,17]. All the factors identified here most likely manifest themselves as a series of additive stressors, rarely acting independently [18,32]. Collectively, it is clear that catch-and-release angling may result in a negative outcome for a fish due to many factors.

At present, there are only three studies that explicitly examine issues associated with catch-and-release in bonefish [33–35]. The first study focused on mortality arising from physiological disturbances and injury associated with the repeated angling of fish in a holding pond that excluded predators; mortality from that study was low (4.1%; [22]). Cooke and Philipp [34] assessed the hooking mortality of bonefish in several field sites in The Bahamas. The first site had a low predator burden, and despite long angling durations, extended air exposure, and frequent loss of equilibrium, no fish died during the post-release monitoring period (24 h). Conversely, in a region with a higher predator burden,

mortality rates were ~40%, in spite of the fact that fish were landed rapidly and exposed to air for shorter durations than at the low predator site [34]. More recently, Danylchuk et al. [35] performed an examination of the short (less than 1 h) and long-term (up to 3 weeks) mortality of bonefish in The Bahamas and found that mortality due to predators appeared to be relegated to the first minutes to maybe hours after a bonefish was released [35]. No long-term mortality was documented in this study.

Interestingly, in 2000, the Government of The Bahamas proposed five marine reserves, one of which is in the area where Danylchuk et al. [35] conducted studies on catch-and-release angling with bonefish (i.e. Eleuthera). In this region, which is often referred to as one of the more economically depressed areas of The Bahamas, a controversial issue surrounding the implementation of the MPA is the ability to provide alternative activities for displaced fishers to garnish an income. Many fishing activities occur at a subsistence level and community members are worried that the presence of a MPA will take away a much-needed food and revenue source for local residents. It thus seems likely that allowing catch-and-release bonefishing inside the MPA, if catch-and-release has little to no effect on local bonefish stocks, would help mitigate some local economic concerns by providing an opportunity for displaced commercial harvesters to begin earning income by participating in tourism endeavors targeting non-resident recreational anglers seeking bonefish. Given that tourism is beginning to redevelop on Eleuthera, allowing catch-and-release inside the proposed MPA would capitalize on the fact that the number of recreational anglers in the area will likely increase, generating more income for local communities while still protecting the resources on which they depend. Consideration of economic factors has been identified as critical to obtaining support from a variety of stakeholders, particularly displaced commercial fishers [36,37].

These three studies provide information on hooking mortality, and two studies provide some information on post-release behavior [34,35], but none provide an assessment of the sub-lethal physiological, energetic or fitness effects of catch-and-release angling on individual bonefish and bonefish populations. In other species, physiological studies that focus on identifying the mechanisms underlying mortality have provided detailed information on specific strategies for reducing stress and mortality in both marine and freshwater systems [32,38,39]. For example, there has been a substantial reduction in initial mortality rates at black bass (*Micropterus* spp.) angling tournaments since 1970, likely due to both to a greater understanding of the factors that contribute to mortality and to the development of strategies to minimize disturbance and stress [40]. Studies at the interface between physiology and conservation, i.e., [41] should yield critical information needed to reveal whether appropriate catch-and-release strategies can be developed for all fisheries. Through regulation of gear types such as hook type (e.g., circle hooks over J hooks; [42]) and angler practices (e.g., prohibiting air exposure [43,44]), it may be possible to lower mortality.

A recent synthesis by Bartholomew and Bohnsack [17] revealed eight factors that influenced mortality in recreationally caught fish (See Table 1). As a result of these factors, Bartholomew and Bohnsack [17] concluded that catch-and-release angling was not compatible with the conservation purpose of no-take protected areas. We have annotated those factors with an assessment of whether they could be minimized/controlled to reduce mortality and increase the likelihood of integrating catch-and-release angling with no-take reserves. In our opinion, all of the factors identified by Bartholomew and Bohnsack [17] as having a significant influence on mortality of fish after catch-and-release angling have the

Table 1
Assessment of the factors associated with catch-and-release mortality and the potential to reduce their impact through education and/or regulation

Factor	Possible to reduce mortality?	Mechanism for reducing mortality	Rationale
Hooking in vital organs	Yes	Regulations and education	Restricting or require specific gear to reduce deep hooking. Advocating gear choices that lead to infrequent deep hooking can be effective. For example, circle hooks have been identified as an effective strategy for reducing incidences of deep hooking and thus chance of hooking vital organs [42]. Use of lures rather than organic baits can also reduce chances of deep hooking [18]
Use of natural/ organic bait	Yes	Regulations and education	Many jurisdictions restrict use of organic baits, a proven method of reducing morality [18]. Angler education and outreach materials can also address gear choice. Related to hooking of vital organs as noted above
Removing hooks from deeply hooked fish	Yes	Education	Many studies have identified that removal of deep hooks causes devastating injury that often leads to mortality [17]. Educating anglers/guides about cutting line for deep hooked fish is essential
Depth of capture	Yes	Education	Increasing body of literature that angling fish from deep water leads to mortality and sublethal disturbance and injury [e.g., 60]. Opportunity to use venting [or fizzing; 61] or other strategies to allow fish to return to depth. Outreach materials can be disseminated to anglers illustrating various techniques. Anglers can also fish in shallower depths
Warm water temperatures	Yes	Education and regulations	Water temperature has a profound effect on fish responses to stress. High water temperatures lead to high mortality in marine and freshwater species [62,63]. Although anglers cannot change water temperature, they can choose to restrict their fishing to periods when water temperature are moderate or make additional efforts to minimize stress during those periods. In some jurisdictions, fishing is restricted when water temperatures exceed thresholds identified as being detrimental to the fish (e.g., Atlantic salmon, *Salmo salar*; [64])
Circle hooks vs. J hooks	Yes	Regulation and education	Circle hooks reduce deep hooking and can result in a 50% reduction in mortality [18]. Circle hooks can be mandated when properly defined to enable enforcement [18]. Education is also possible, particularly regarding the proper method for setting a circle hook
Angling duration and handling	Yes	Education	There is compelling evidence that angling duration [65], handling, and air exposure

Table 1 (*continued*)

Factor	Possible to reduce mortality?	Mechanism for reducing mortality	Rationale
			[43,44] in particular, can influence stress and mortality. There is a need for educational materials outlining species-specific thresholds for angling duration and air exposure, providing anglers with guidelines [66]. Encouraging anglers to use species-appropriate tackle would also prevent angling fish to exhaustion [18]
Barbed hooks vs. barbless hooks	Yes	Regulation and education	Barbless hooks have always been contentious with respect to their ability to reduce mortality [67–69]. However, barbless hooks enable easier hook removal and reduce tissue damage [44], which could indirectly enhance survival. Barbless hook regulations are common in freshwater systems. Education programs could be effective in further advocating their use

When both education and regulation are possible, the most practical one is listed first. The factors used in this table are derived from a meta-analysis conducted by Bartholomew and Bohnsack [17] and represent those that were statistically significant at $P<0.10$. Rationale is based on the best available science, usually providing information from other syntheses [e.g., 18,42] or key primary articles. Note that many of the factors were inter-related. For example, hooking in vital organs is influenced by other factors also identified as contributing to mortality (as in [17]).

potential to be mitigated through either regulation, education, or a combination of the two, resulting in a reduction in the probability of mortality. All of these factors relate to angler gear or angler behavior.

There were several factors that can influence mortality in caught-and-release fish identified by Bartholomiew and Bohnsack [17] for which there were insufficient data to assess statistically, but that also may be important. For example, post-release predation has been recently identified as a factor with major potential to influence mortality [34]. Angler education regarding the need to relocate to areas with lower predator burdens and/or to release fish in better condition may be effective in this regard, although this has yet to be assessed experimentally. It is plausible that an MPA may actually result in increased densities of predators (as has been observed in studies of juvenile European spiny lobster *Palinurus elephas* inside an MPA [45] and postulated in earlier modeling exercises [46]) such that this may lead to even higher rates of post-release mortality. Recreational fishing may also be incompatible with MPAs if angling activities have negative impacts on the surrounding environment and non-target species. A recent review by Cooke and Cowx [10] identified that although commercial and recreational fishing sectors were fundamentally and philosophically different, they both had similar negative effects, including the potential to lead to stress and mortality in fish that are discarded, alter trophic ecology, and degrade aquatic environments. For instance, in the case of bonefish, anglers often walk or 'wade' on the flats rather than fish from a boat. Wading in flats habitats such as seagrass could impact plant and invertebrate communities [47]. Such impacts on flats habitats could have

cascading affects throughout the coastal ecosystems, and work against conservation and management strategies that often include the use of MPAs.

3. Perspectives on integrating recreational fisheries with MPAs

Although knowledge of the number of fish that die as a result of catch-and-release angling is essential for basic fisheries management activities [15], many other sub-lethal effects can render an individual less fit than if it had not been angled [32]. For example, angling increases circulating concentrations of the stress hormone cortisol, and elevated cortisol levels have been linked to reductions in gamete quality in fish [48,49]. Because angling pressure is increasing for many species, and because more remote fisheries are becoming accessible to anglers, there is clearly a need to understand how different species respond to catch-and-release angling [17,18] and if/how catch-and-release recreational fisheries may contribute to global fish declines [9]. Conservation-minded anglers are looking to managers and scientists for better catch-and-release guidelines [18]. A recent study has identified that many of the catch-and-release guidelines that are distributed on websites by state and provincial fish and wildlife agencies in North America are not consistent with the best available science and, in some cases, could actually increase mortality [50]. In many cases, these same agencies are also prohibiting recreational catch-and-release fisheries in MPAs.

The immense variation in species responses to catch-and-release angling necessitates systematic development of a series of guidelines that begin to address mortality rates and sublethal stressors. Until then, some generalized guidelines have been developed by Cooke and Suski [18] that do take a precautionary approach as suggested by Bartholomew and Bohnsack [17]. We also suggest that bonefish (*Albula* spp.), tarpon (*Megalops atlanticus*), permit (*Trachinotus falcatus*), billfish, and several other highly valued recreational fish could serve as models not only for determining if catch-and-release angling is sustainable, but also for determining if it is an activity that could potentially be compatible with the goal of ecosystem protection of no-take MPAs.

Perhaps the best approach may be to only permit fishing for certain species in MPAs; species that can be clearly targeted and do not involve substantial bycatch. Although this type of targeted species-specific regulation/exception is not consistent with the concept of ecosystem management, it may be needed. Roberts et al. [22] argue that MPAs are most effective when considered as just a part of a larger fisheries management and conservation strategy. We would agree and believe that the first steps may involve combining regulations. For example, within an MPA, perhaps recreational catch-and-release fishing would only be permitted in certain zones and in certain seasons, thus protecting key sites during critical stages in a specie's life-history (or an ecosystem or community level type of protection).

Although strong advocates for conservation, we have seen first hand the conflict and distress caused by even a proposal to introduce an MPA. Considering the human dimension is particularly important—otherwise widespread poaching may ensue. Another strategy may involve providing local communities and other stakeholders (including anglers and guides) with a stronger role in determining the goals for MPAs that would affect their community [51]. In practice, such engagement, although important, may require a top-down approach to deal with impasses [52]. Unfortunately, it is actions such as that which have further inflamed recreational angler interest groups [51].

Our discussion thus far has focused almost exclusively on marine systems. Aquatic protected areas can also be placed in freshwater systems and have been done so for many years [53]. There may be opportunity to learn from these examples where in many cases only the recreational fishing sector is involved. One approach is a voluntary "sanctuary" where community stakeholders promote sustainable recreational fisheries through education [54]. Another approach is to have zones that mandate or prohibit use of specific gears such as barbless hooks, live bait, circle hooks, etc. If clearly defined and also combined with an education program, such regulations can be clearly enforced and are worthy of testing in larger marine systems. Mandatory education programs associated with licensing to fish in MPAs may also be an effective strategy for ensuring that anglers understand the purpose of the MPA, how to minimize catch-and-release mortality, and how to minimize their footprint on the environment. So-called "codes of conduct" have been widely promulgated in other parts of the world, but are still uncommon in North America or the Caribbean. Other ways of limiting angling effort (e.g., limited entry models) may also be necessary, since partial fishery closures that exclude commercial fishing but allow recreational angling may have angling pressure that exceeds that of areas outside of the MPA [e.g., 55].

If catch-and-release fisheries could be sustained within no-take MPAs, then these reserves could provide greater economic benefits to local communities, while continuing to provide protection to other organisms. Local acceptance of no-take MPAs could be enhanced by allowing a sustainable and economically beneficial recreational catch-and-release fishery to coexist within its boundaries. All evidence to date suggests that for MPAs to be successful, they require community support [56]. Indeed, successful alternative income projects are one of the primary factors generating such community support [52,57]. As more efforts focus on the human dimensions of MPAs [56], information on the potential sustainability of recreational catch-and-release fishing activities will be required for incorporation into decision-making, policy and management. We hope that this contribution will encourage such research and thinking on the coexistence of catch-and-release recreational fisheries within no-take MPAs.

4. Conclusion

There are currently a number of critical gaps in knowledge that impede the effective use of no take MPAs [58]. At present, lack of sufficient data makes it difficult to answer definitively the question of whether recreational catch-and-release fisheries can be compatible with no-take MPAs. Bartholomew and Bohnsack [17] argued that the precautionary approach would be to exclude recreational angling from MPAs. Conversely, our opinion is that the answer is likely "*sometimes*"; however, this conclusion implies that it will take time and effort before we can make informed and scientifically defensible decisions. How will we know if recreational catch-and-release angling IS compatible with no-take MPAs? Based on the reasoning outlined above, we offer a conceptual framework for addressing this question more effectively (Table 2). Future research should focus not only on comparisons of communities in high- and low-intensity angling areas, but also on large-scale experimental approaches whereby some types of catch-and-release angling are permitted in some MPAs and fishing of all types is prohibited in others (reference sites). Ultimately, careful experimentation will make it possible to determine if catch-and-release recreational fishing can be compatible with no-take MPAs. If conditions are identified that

Table 2
Factors to be considered for determining compatibility between catch-and-release angling and MPAs

Factor	Mechanism
Fish species	Fish species vary in their inherent vulnerability to angling and related lethal and sublethal stress and mortality [18]
Life history characteristics	Certain life-history characteristics can influence the vulnerability fish populations to angling-induced declines. For example, long-lived species are particularly vulnerable [70]
Season	Environmental conditions (e.g., water temperature, hypoxia/anoxia, salinity, etc.) vary among seasons, thus potentially influencing the magnitude of the stress response and potentially the extent of mortality
Reproductive status	Although poorly studied, fishing during the reproductive period has the potential to influence a number of factors including gamete quantity and quality, reproductive behavior, parental care, etc. [32]. Reproductive seasonality varies among species and locations, adding complexity. If the goal of the MPA is to export biomass, angling may conflict if there are impacts on reproductive output
Fish community	Most MPAs are enacted to protect an ecosystem, thus it is difficult to reconcile single or multi-species fisheries with the goal of ecosystem management. Incidental bycatch of non-target species may be unavoidable and detrimental
Location of MPA	MPAs located close to population centers may experience exceptionally high fishing pressure. If catch-and-release were permitted, this may increase effort (and associated disturbance) and incidental mortality, potentially offsetting benefits of implementing the MPA
Size of MPA	Small MPAs may concentrate angling effort in defined areas by attracting those with specialized expertise or interest in that locale. Small MPAs may also lead to multiple recaptures of the same individuals. In larger MPAs, it may be difficult to enforce specific catch-and-release regulations. However, larger MPAs protect against catastrophic events as well as smaller cumulative damage (e.g., propeller scarring of sea grass beds)
Goal of MPA	Some MPA goals may be inherently compatible with recreational catch-and-release fisheries. For example, an MPA implemented primarily to protect adult lobsters and early life-stages of finfish, may not be in conflict with catch-and-release for adult fin fish
Local economics	Locations where MPAs have displaced subsistence and commercial fishers may be especially appropriate for introducing economic opportunities (such as those offered by recreational fisheries) that can help offset the losses incurred by the establishment of the MPA

can enhance the compatibility of recreational catch-and-release angling with the goals of no-take MPAs, the final challenge will be to implement regulations that remain true to the available science. Educating anglers on proper fish handling and fostering an understanding of the importance of MPAs to fisheries conservation may be the first step in reducing the negative impacts of recreational fisheries. Such education should extend beyond those fishing in or near protected areas because MPAs on their own are not sufficient for marine conservation [59].

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