



Sportfisheries, conservation and sustainable livelihoods: a multidisciplinary guide to developing best practice

Adam Barnett^{1,2}, Kátya G Abrantes^{1,2}, Ronald Baker^{1,2,3}, Amy S Diedrich^{1,2}, Marina Farr^{2,4,5}, Alf Kuilboer⁴, Tracey Mahony⁴, Ian McLeod^{1,2}, Gianna Moscardo⁴, Murray Prideaux^{1,2,4}, Natalie Stoeckl^{2,4,5}, Ariella van Luyn⁶ & Marcus Sheaves^{1,2}

¹College of Marine and Environmental Sciences, James Cook University, Townsville, Qld, 4811, Australia; ²TropWATER (Centre for Tropical Water and Aquatic Ecosystem Research), James Cook University, Townsville, Qld, 4811, Australia; ³CSIRO Land and Water, Building 14, James Cook University, Townsville, Qld, 4811, Australia; ⁴College of Business, Law and Governance, James Cook University, Townsville, Qld, 4811, Australia; ⁵The Cairns Institute, James Cook University, Cairns, Qld, 4878, Australia; ⁶College of Arts, Society and Education, James Cook University, Qld, 4811, Australia

Abstract

Ecotourism ventures in developing countries are often among the few alternatives for enhancing sustainable livelihoods without altering traditional ways of life. The best way forward is to continually develop and implement best practice guidelines and, in particular, to flexibly develop them to suit individual cases. We conduct a multidisciplinary assessment of best practice guidelines required to develop and sustain sportfishing tourism in developing countries, while enhancing local livelihoods and promoting environmental stewardship. In general, best practice guidelines should be developed around a sustainable livelihood framework that includes short-term coping mechanisms and longer-term capacity building. Sportfishing development that conforms to ecological and socially orientated criteria, founded on site-specific research that captures local environmental and social complexities, has the potential to provide mutual benefits to tourists and local people, fuelling community development and enhancing the cultural experience of tourists. Best practice guidelines for sportfishing that do not address these dimensions are unlikely to result in a viable industry. Given the current interest and growth of sportfishing in developing countries, the proposed guidelines can help a range of end users manage, conserve and maximize livelihood benefits from their fishery.

Correspondence:

Adam Barnett
College of Marine and Environmental Sciences, James Cook University, Townsville, Qld 4811, Australia
Tel.: 0499097590
Fax: +61 07 4725 1570
E-mail: adam.barnett@jcu.edu.au

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Introduction

At its most valuable, ecotourism involves engagement with the natural areas that promote conservation of wildlife and the environment while improving the well-being of local people (Blangy *et al.* 1993). Although ecotourism is usually thought of in the context of ventures aimed at participants experiencing the natural world while causing a minimum of disruption (Buckley 1994), the range of activities that can fulfil the joint goals of environmental conservation and enhancement of the well-being of local people is quite diverse. For instance, sportfishing (recreational fishing that targets species of fish renowned for being difficult to capture) has the potential to provide the benefits of characteristic of ecotourism, as long as it is managed appropriately. Although its validity as ecotourism has been debated (Holland *et al.* 1998; Fennell 2013; Wood *et al.* 2013), if conducted in an enlightened manner sportfishing has the potential to provide real gains in addressing social and environmental goals in disadvantaged and undeveloped areas. It can (i) provide alternative options for stable livelihoods for some of the world's most disadvantaged people; (ii) support the conservation of species by converting unmanaged extractive fisheries into no- or low-take fisheries; (iii) support the conservation of threatened ecosystems by providing a focus for conservation thinking and environmental stewardship; and (iv) produce a revenue stream for national economies that provide an alternative to extractive industries (such as logging or mining) or activities that transform

natural landscapes (such as large-scale agriculture or aquaculture) (e.g. Sheaves *et al.* in press). In fact, sportfishing contrasts with extractive or landscape-transforming industries because its success relies on conserving resources in as a natural state as possible. Consequently, by the nature of the business, the benefits sportfishing provides are ongoing.

Conservation is increasingly moving towards the recognition that the natural environment cannot be managed effectively in isolation from the human dimension. Where human dimensions and the concept of socio-ecological systems (Young *et al.* 2006) have infiltrated the sportfishing literature (Arlinghaus 2004; Hunt *et al.* 2013; Bower *et al.* 2014), the focus has been primarily on minimizing conflict (e.g. with other users of the resources or with stakeholders who may be ethically opposed to the practice of sportfishing) and maximizing the well-being and compliance of the anglers (European Inland Fisheries Advisory Commission 2008; Bower *et al.* 2014). While these aspects are undoubtedly critical for ensuring the long-term viability of the industry, there has been less consideration of the broader socio-ecological system within which sportfishing is nested (Ostrom 2009). However, with the rapid worldwide growth of sportfishing tourism (Shrestha *et al.* 2002; Bower *et al.* 2014), and the appeal of travel to remote 'untouched' wilderness locations for 'fishing adventures' (e.g. Table 1; Cooke *et al.* in press), ensuring that sportfishing operations take due regard for socio-ecological considerations has become of paramount importance. This is

Table 1 Showing the percentage (%) of episodes filmed in developing countries (DC) for two of the most popular current fishing shows on TV. Potentially interesting is the increase in episodes travelling to developing countries. This could be an artefact of the filming schedule, or an indication that the more people fish, the greater desire to explore remote areas. Regardless, these types of shows promote remote destinations.

| | Season | Episodes | DC | % |
|----------------------|--------|----------|----|------|
| River Monsters | 1 | 7 | 4 | 57.1 |
| | 2 | 7 | 5 | 71.4 |
| | 3 | 7 | 4 | 57.1 |
| | 4 | 9 | 5 | 55.6 |
| | 5 | 6 | 4 | 66.7 |
| | 6 | 6 | 6 | 100 |
| Total episodes in DC | | | | 67% |
| Robson Green | 1 | 4 | 2 | 50 |
| | 2 | 8 | 2 | 25 |
| | 3 | 4 | 4 | 100 |
| | 4 | 8 | 5 | 62.5 |
| | 5 | 6 | 6 | 100 |
| Total episodes in DC | | | | 63% |

particularly important as many of the attractive wilderness locations are located in developing countries (Wood *et al.* 2013), often bringing tourists into contact with societies that have had little exposure to the developed world. For this review, developing countries/economies are those listed as such by the World Bank and the International Monetary Fund, with a particular focus on countries that still have largely traditional village societies. The World Bank states the term country can be used interchangeably with economy.

Most studies on sportfishing best practice have been in the context of developed countries and focused on fish handling, physiology, ethics and management (e.g. Cooke and Suski 2005; Arlinghaus *et al.* 2007a,b, 2010; Donaldson *et al.* 2008; Cooke *et al.* 2013). However, in developing countries where indigenous people maintain customary tenure of natural resources and where people directly rely on these resources to meet basic needs, the context is very different to that in developed countries. A truly sustainable sportfishery in the developing world must produce benefits for, and be supported by, local people. Consequently, if sportfishing is to be developed as a means of supporting livelihoods for disadvantaged communities, it is crucial to consider 'best practice' in a holistic context. Best practice should be incorporated into

all facets of tourism development, encompassing the species and the ecosystems they are embedded in as well as the sociocultural, economic and governance context, rather than simply applying the concept of 'best practice' to the operation of the fishery.

We assembled a multidisciplinary consortium comprised of professionals from diverse fields including fisheries science, ecosystem ecology, natural resource management, governance, tourism, economics, business management, and social science to review and evaluate key issues and constraints that need to be considered when developing best practice for sportfishing in developing countries (see Table 2). The consortium is currently working on the sportfisheries for livelihoods project in Papua New Guinea (Cooke *et al.* in press). A modified Delphi approach was used to identify key guidelines, where after group discussions all authors submitted guideline recommendations for their fields, and a subgroup identified and refined the key guidelines and returned it to the consortium as a whole for comment. We address three broad, interlinked perspectives: sociocultural, environmental and economic. These three perspectives can be considered as 'the three pillars' of sustainability (Brunnschweiler 2010). Within each pillar, we discuss key facets of developing and sustaining a successful sportfishing industry from the points of view of sustainable livelihoods and environmental conservation. The paper (and Table 2) is structured in the temporal sequence we feel is the most risk averse. First, sociocultural considerations need to be addressed. This serves the dual purpose of gaining the necessary local support early on and identifying the key social and ecological issues that need to be addressed. Further, it is the most risk averse approach as none of the best practices, whether they be social, ecological or economic, can be effective in the long term without local support. Potential challenges and capacity need can also be identified at this stage, all of which will support the effective implementation of the best practices. Then, environmental aspects need to be understood, including the biology and ecology of the fish. Basically, after the local people are on-board, infrastructure needs to be set in place to manage the resources. Once the social and environment sections are on-track, business cases can be implemented. However, in reality, it is likely that those developing sportfisheries will often try and implement the business plan before

Table 2 Key considerations for developing best practice guidelines for sportfishing tourism. The table is set out in the broad temporal sequence (sociocultural, environmental and economic) we feel is the most risk averse. However, in reality some of the economic guidelines will more than likely be implemented while environmental information is being collected.

| Pillar | Best practice guidelines |
|---------------|---|
| Sociocultural | Develop a comprehensive understanding of the full spectrum of values (historical and cultural) of fisheries to local communities |
| Sociocultural | Understand, respect and comply with local governance (formal and informal) related to customary ownership and the use of natural resources and environments where sportfishing occurs |
| Sociocultural | Inform, consult and involve local communities in decisions related to sportfishing development |
| Sociocultural | If necessary, provide location-specific guidelines for culturally appropriate behaviour to sportfishing clients and operators |
| Sociocultural | Engage with local leaders to establish and support continuous and efficient lines of communication with local stakeholders (e.g. technical working groups or advisory committees) |
| Environment | Develop fundamental knowledge of the biology and ecology of the target species, the resources they rely on and the ecosystems in which they are imbedded, so that that information can be incorporated into effective management |
| Environment | Take every opportunity for training and engaging with local scientists, to enhance local fisheries manage capacity |
| Environment | Identify causes of mortality and incorporate into management stock assessments and management plans |
| Environment | Align research projects with sportfisheries to develop and implement best fishing, catch and handling practices, noting that these practices should be species specific |
| Environment | Where possible, use gear that reduces by-catch |
| Environment | Development of best handling practices should include by-catch species |
| Environment | Communicate the social and economic benefits that local communities are likely to derive from sportfishing operations to local people, to promote their understanding of the need to actively manage and to protect the sportfishing resource and the ecosystem it relies on |
| Environment | The sportfishing industry as a whole (in any given country or region) and its stakeholders should take a leading role in promoting and supporting sustainable use of the environment |
| Economic | Whenever possible, enterprises should employ local people, and locals should also be given the opportunity to sell local goods and services to both the enterprises and the tourists. Local people may need to be supported to develop their capacity for this type of financial engagement |
| Economic | Provide negotiated 'offsets' (compensation) if negative side effects (associated with access, environmental, social and cultural issues) are unavoidable |
| Economic | Develop appropriate and cost-effective marketing approaches |
| Economic | Consult with and assess individual locations/villagers to determine the best business model for each particular case, so that sportfishing tourism benefits local people |
| Economic | Implement a sustainable livelihood approach, which includes short-term coping mechanisms and longer-term capacity building |

gaining the appropriate knowledge on the environment and the fish. This may be seen as necessary to generate income as soon as possible or generate research opportunities (e.g. Cooke *et al.* in press), but will usually result in some of the economic guidelines being implemented while environmental information is being collected and, therefore, the business/fishery will be run without the crucial information to manage resources. For imperilled species, it is imperative that the environment component is accomplished prior to the economic being implemented, as scientific evidence is needed to demonstrate the fishery is sustainable (Cooke *et al.* in press). Monitoring of outcomes, both social and ecological (including feedbacks between

them), is essential, so that actions that are not working can be adjusted and ones that are can provide motivation and support for sportfishing and conservation.

Sociocultural considerations for developing best practice guidelines for sportfishing tourism

The introduction of values and practices from developed countries into traditional societies needs to be managed carefully. In general, fisheries management strategies, policies and best practice guidelines will depend on the way the fishery resource is used by local communities (Policansky

2002; Cova and White 2010; Acott and Urquhart 2014). Thus, understanding fishing communities as social structures and the historical value (both as a resource and cultural) of these fisheries to local communities should be taken into account when developing best practice guidelines for a sustainable sportfishery (Cova and White 2010; Acott and Urquhart 2014). While the need for research into local cultural norms and behaviour is recognized (e.g. Arlinghaus *et al.* 2007a; Hunt *et al.* 2013), it is under-represented in practice.

Indigenous attitudes to fishing often differ greatly to those in Western Societies. For example, many societies in the developing world view fishing as an integral part of their culture and/or necessary for spiritual fulfilment (Lyman 2008), perspectives that may be at odds with the Western attitude of fishing for pleasure. In developing countries where Western colonization may be resented, recreational fishing may come to symbolize the impacts of Western intrusions on indigenous peoples' lives (Lyman 2008). Ownership and tenure of natural resources and the space where sportfishing occurs also need to be fully understood in order to avoid conflict. This is not always a simple task because tenure is often not formally documented. Increasingly, indigenous people are seeking to reclaim colonized land, which increases competition for fishing resources (Kearney 2002). Sportfishers also need to be aware that some fishing sites may be sacred (Kearney 2002). Any best practice model for recreational fishing must acknowledge that there needs to be negotiation of land ownership and use, bearing in mind that attitudes will differ from community to community.

Although nature-based tourism has the potential to diversify or provide alternative livelihoods to communities dependent on dwindling natural resources, achieving this goal can be challenging, because adapting to tourism requires changes to social and cultural ways of life. For example, engaging fishers in livelihoods not related to fishing can be difficult as they may be unwilling to alter their way of life (e.g. Pollnac and Poggie 2008). Even involving local people in sportfishing as guides can fail if it is not implemented with due consideration of local context and needs (e.g. Schuhbauer and Koch 2013). Further, in very impoverished communities, where basic needs such as food, health and education are not adequately met, people often lack the capacity to

engage in any type of tourism-related activities. In such situations, sportfishing tourism may need to be complemented with other types of development such as health and sanitation, infrastructure development or sustainable farming. Moreover, leadership, as an important driver of change and innovation, is a critical element in achieving successful outcomes (Buttigieg and West 2013) and is a key component to addressing the 'crisis of sustainability' facing natural ecosystems in developed and developing nations (Evans *et al.* 2015). Thus, in village and community contexts, leadership may be important for maximizing the opportunities flowing from the growth of sportfishing tourism.

Guidelines for developing best practice

1. Develop a comprehensive understanding for the full spectrum of values (historical and cultural) of fisheries to local communities (see Table 2 for guidelines).
2. Understand, respect and comply with local governance (formal and informal) related to ownership and the use of natural resources and environments where sportfishing occurs.
3. Inform, consult and involve local communities in decisions related to sportfishing development.
4. If necessary, provide location-specific guidelines for culturally appropriate behaviour to sportfishing clients and operators.
5. Engage with local leaders to establish and support continuous and efficient lines of communication with local stakeholders (e.g. technical working groups or advisory committees).

Managing the resource and the environment

The allure of catching unique species in wild areas provides a continual incentive for sportfishing to penetrate further into pristine and more isolated areas, extending fishing impacts to a range of often unique species and habitats. This brings with it the need to understand the biology and ecology of these species, and the environments in which they live, as well as the ways that sportfishing will interact with, and influence, the species and their environment (FAO 2012). There is clearly a need for substantial scientific knowledge if these new sportfisheries are to be developed optimally. There are unique opportunities to develop sportfisheries

supported by informed and effective management that is underpinned by detailed, situation-specific research. In addition, there are opportunities for engaging with local scientists to enhance their ability to manage local fisheries.

Biology and ecology

The basic requirement underpinning profitable and sustainable tourism ventures that support local peoples' livelihoods is that there is an ongoing product to attract customers. For sportfisheries, that means healthy target fish stocks. Healthy fish populations depend on the availability of the necessary conditions and resources for feeding, reproduction, refuge and migration (FAO 2012), so each of these facets should be fully understood, preferably before exploitation begins, but at least as soon as possible thereafter. In particular, there should be detailed studies of life histories, physical and physiological requirements, reproductive patterns (age, timing, location), nursery ground requirements, habitat utilization for all life history stages, the temporal dynamics of habitat use and of the connectivities among habitats, and the requirements for migration at all scales (e.g. within and among days, within and among years). This information should extend to the key ecological components with which the fish interact, the components of the food webs that provide their food requirements, and their vulnerability to predators, especially when animals are stressed following capture (FAO 2012). In addition, detailed studies of the physiology and behaviour of the target species are required, particularly in relation to responses to capture, handling and disturbance of their abilities to avoid predators. Armed with this information, managers will be in a stronger position to put in place effective management of the fish, the fishery and the resources they rely on. In addition, this information will help identify threats and allow them to be managed.

Although obtaining this knowledge for understudied species in the remote locations may appear an overwhelming task, modern technologies and approaches to traditional fishery research allow this information to be gathered in a cost-effective manner, compared to the potential value of sportfisheries to the economies of the developing nations (Fedler and Hayes 2008; Southwick *et al.* 2013). In fact, the development of new sportfisheries in unstudied areas brings with it the

opportunity to understand critical aspects of the biology, the ecology and the fishery before substantial exploitation of the species and loss of habitat values occurs, an opportunity almost invariably missed during the previous sportfishery developments. That this has failed to occur in previous cases is disturbing, because this is exactly the information needed to ensure best practice management of the fish, their habitats and the fishery.

Guidelines for developing best practice

1. Develop fundamental knowledge of the biology and ecology of the target species, the resources they rely on and the ecosystems in which they are imbedded, so that that information can be incorporated into effective management.
2. Take every opportunity for training and engaging with local scientists, to enhance local fisheries manage capacity.

Managing the fishery

Ensuring there is a healthy and sustainable population of fish to catch also depends on the fishery operating to minimize its own impact. Recreational fisheries have the potential to negatively affect fish stocks, similar to commercial fisheries (Cooke and Cowx 2004, 2006; FAO 2012). Therefore, along with understanding of life history and natural mortality, information on fishing mortality (e.g. harvest and post-release mortality) is critical for informed management. To date, information of harvest rates and stock assessments from recreational fisheries are scarce or underdeveloped (FAO 2012), particularly for developing countries, which can often have the added pressure from artisanal or subsistence fishing (Cooke and Cowx 2004, 2006; Cooke *et al.* in press). The lack of such information has hindered our understanding of the magnitude of the recreational/sportfishing sector (Cooke and Cowx 2004; Cooke *et al.* in press).

Catch and handling practices

Catch and release is a common practice throughout most sportfisheries, but there is no getting around the fact that catching fish causes some level of stress and injury (Arlinghaus *et al.* 2007a, b, 2010), and a proportion of the catch may die (Bartholomew and Bohnsack 2005; Cooke and

Cowx 2006), for example a review of 32 taxa estimated on average 18% post-release mortality (Bartholomew and Bohnsack 2005). Consequently, a key contributor to the sustainability of the fish stock is the quality of catch and handling practices (Arlinghaus *et al.* 2007a, 2010), with carefully developed and instituted catch and handling best practices providing released fish with a better chance of survival, as well as reduced short- and long-term physiological impairments (for reviews see Cooke and Suski 2005; Arlinghaus *et al.* 2007a). Catch and release is popular with conservation-minded anglers because the captured fish is seen to swim away, presumably to continue its 'normal' life. However, if fish die after release, it defeats the purpose of a catch and release. Moreover, if post-release mortality is not recognized, it becomes a source of unassessed mortality that, in the long term, has the potential to severely compromise the sustainability of the fishery.

Negative effects after release range from sub-lethal fitness implications (e.g. reduced growth or reproductive ability) to mortality stemming directly from the fishing event or from increased vulnerability to predation (Bartholomew and Bohnsack 2005; Arlinghaus *et al.* 2007a; Cooke *et al.* 2013). General best practice protocols for catching and handling fish include the following: (i) limiting duration of the capture event, (ii) minimizing air exposure, (iii) avoiding angling during extremes in water temperature, (iv) using barbless hooks and specific hook types/sizes that reduce injury for the targeted species, and (v), for some species, refraining from angling in excessive depths (Cooke and Suski 2005; Arlinghaus *et al.* 2007a). However, although these protocols provide a guide for best practices, the response of different species to the different methods of capture and post-capture treatments varies, so the actual practices employed need to be taxon specific (Cooke and Suski 2005).

There has been only limited scientific research directly related to sportfishing, and most of that has focused on catch and release of North American freshwater sportfish (Cooke and Suski 2005; Arlinghaus *et al.* 2007a; Donaldson *et al.* 2008). For example, in 2005, there was a reasonable understanding of catch-and-release angling effects for only five freshwater species (Cooke and Suski 2005). A literature search (see supporting information for methods) found 408 studies that addressed the effects of sports/recreational fishing

on some aspects of fish health or behaviour and/or best practices for catch and release. Of the 229 species studied, only 10 species occurred in 10 or more studies (supporting information). Six of these are from the families Centrarchidae or Salmonidae, and these two families make up 57% of studies (Table 3). These families are mainly confined to temperate latitudes, so their conclusions are likely to be of limited relevance to developing sportfisheries in tropical regions. Although a larger number of marine species have been studied, many of these are only included in a single study, and freshwater/anadromous species still dominate the literature by the number of studies (Table S1). Bonefish (*Albula vulpes*, Albulidae) is the only fully marine species with more than 10 studies. As a group, Sparids are the most represented marine taxa (both in terms of the number of species and number of studies), but replication for each species is poor (Table 3). Of particular note, only 27 species have been studied in developing countries (supporting information). Of these, eight are freshwater species and 19 marine.

Guidelines for developing best practice

1. Identify causes of mortality and incorporate these into management stock assessments and management plans.

Table 3 Most common families studied. See supplementary material for detailed summary.

| Family | Species | Studies |
|-------------------------------|---------|---------|
| <i>Centrarchidae</i> | 8 | 127 |
| <i>Salmonidae</i> | 16 | 102 |
| <i>Sparidae</i> | 30 | 60 |
| <i>Sebastidae</i> | 28 | 38 |
| <i>Lutjanidae/Lethrinidae</i> | 13 | 34 |
| <i>Serranidae</i> | 15 | 31 |
| <i>Istiophoridae</i> | 5 | 25 |
| <i>Percidae</i> | 4 | 25 |
| <i>Sciaenidae</i> | 7 | 19 |
| <i>Esocidae</i> | 2 | 16 |
| <i>Labridae</i> | 11 | 14 |
| <i>Albulidae</i> | 1 | 12 |
| <i>Carangidae</i> | 9 | 12 |
| <i>Cyprinidae</i> | 7 | 12 |
| <i>Carcharhinidae</i> | 9 | 12 |
| <i>Scombridae</i> | 5 | 11 |
| <i>Cichlidae</i> | 5 | 5 |

2. Develop and implement best fishing, catch and handling practices, noting that these practices should be species specific.

By-catch

Sportfisheries impact both target and by-catch species. By-catch includes unwanted animals captured incidentally. This includes animals not desirable in a sportfishing context (e.g. non-target species or target species outside target size ranges), prohibited species, individuals that exceed the bag limit for the target species, and, where sportfishers are retaining their catch for food, inedible or less palatable species. Although some types of sportfisheries (e.g. sight fishing) are very selective and can be managed to produce negligible by-catch, most sportfisheries have some by-catch, which can constitute a high proportion of captures (e.g. Cooke and Wilde 2007). With high levels of by-catch comes the possibility of high post-release mortality (Cooke and Wilde 2007). As most fishing techniques have at least some by-catch, improving gear selectivity is important. If, despite their importance, there have been few comprehensive survival/health studies for targeted species (Table 3), much less is known about post-release mortality of the 'less valuable' by-catch species (Cooke and Suski 2005). Species-specific research into best handling practices for by-catch is required, and by-catch should be handled with the same level of care as the target species, a practice often neglected for by-catch species that are often considered 'junk fish'.

Management measures and legislation in developed countries may extend to by-catch species. Clubs and/or fishers may voluntarily follow best practices to avoid by-catch, but this will depend on education and sensitivity to environmental issues, i.e. on the ethics of each fisher. For example, clubs/individual fishers can opt for using different hook types/sizes, bait types, barbless hooks and different line strengths, limit fishing during extreme environmental conditions or use better handling techniques (e.g. 'environmentally friendly' landing nets, minimizing 'fighting' time and duration out of the water) to limit by-catch mortality. Minimizing by-catch mortality in developing countries is more challenging as there is generally a lack of legislation and a lack of environmental sensitivity.

Guidelines for developing best practice

1. Where possible, use gear or fishing methods that minimize by-catch.
2. Development of best handling practices should include by-catch species.

Environmental engagement

To ensure genuine sustainability, sportfishing operations should promote and engage all stakeholders in environmental best practice. In developing countries, where indigenous communities retain customary ownership of aquatic and terrestrial resources, it is critical that local communities support and benefit from a healthy sportfishery, and thereby have the incentive to sustain the fish and the ecosystem they rely on (Bell *et al.* 2006; FAO 2012). By providing livelihoods (e.g. through payments for ecosystem services (PES) and jobs), tourism can provide communities with the incentive to protect the resource (e.g. Brunnschweiler 2010). Developing incentives to protect key resources is particularly important in subsistence-level communities facing increasing food insecurity and population pressures, where conservation of resources is not conceivable without the alternative livelihood options (Bell *et al.* 2009).

In addition to engaging the local resource owners as stewards, a sustainable sportfishing industry should take a leading role in promoting potential social, environmental and economic benefits of the industry to the political leaders of the country or region. In many developing countries, sportfishing is likely to conflict with large-scale industries of high value to the national economy (e.g. mining, plantation agriculture) (FAO 2012; Wood *et al.* 2013; Sheaves *et al.* in press). In such situations, it is critical that the industry promotes the long-term benefits of environmental best practice so that conflicting interests of destructive industries are not given priority in the national agenda. For example, in North America, Ducks Unlimited was founded by duck hunters wishing to protect the wetlands that supported the ducks they hunted and has grown into the largest wetland conservation organization in the continent (Tori *et al.* 2002). Trout Unlimited, whose mission is to conserve, protect and restore North America's coldwater fisheries and their watersheds, has more than 400 000 members who drive fisheries restoration work at local, state and national levels (<http://>

www.tu.org). Likewise, there are a number of examples where engagement in conservation practices and/or research by the angling community has contributed (or driven) to conservation of endangered fish species (see Cooke *et al.* in press). Although sportfishing industry bodies in developing countries may lack the resources to fund large-scale habitat restoration, it is the pristine nature of these locations that attracts sport fishers, and the industry has an excellent opportunity to promote the wide-reaching social and economic benefits of protecting the environment before alterations, rather than trying to rehabilitate it later.

Guidelines for developing best practice

1. Communicate the social and economic benefits that local communities are likely to derive from sportfishing operations to local people, to promote their understanding of the need to actively manage and to protect the sportfishing resource and the ecosystem it relies on.
2. The sportfishing industry as a whole (in any given country or region) and its stakeholders should take a leading role in promoting and supporting sustainable use of the environment.

Maximizing economic benefits and developing business in developing countries

Worldwide, 220 million to 700 million people participate in recreational/sportfishing (Cooke and Cowx 2004; World Bank 2012; Bower *et al.* 2014), spending >US\$190 billion annually, a contribution of about US\$70 billion in sales impacts and US\$23 billion to the global gross domestic product (GDP), not counting large revenue streams for fishing tackle (World Bank 2012). Although most of the global expenditure is in developed countries, sportfishing has the potential to provide significant economic benefits to developing countries (Bower *et al.* 2014). For example, foreign anglers visiting Costa Rica generated US \$279 million in new capital in 2008 (over 2% of national GDP), and 63 000 jobs (Instituto de Investigaciones en Ciencias Economicas 2010). Sportfishing generated more than US\$25 million in direct expenditures (providing jobs for fishing guides and lodge staff) within the Belizean economy in 2007, but probably closer to \$50 million when including secondary expenditures (Fedler and Hayes 2008). Sportfishing tourism is an

important component of the Bahamian economy with bonefishing anglers spending close to US\$70 million on angling-related activities (Fedler 2010). In Panama, recreational fishers spend US\$97 million annually, contributing US\$48.4 million to GDP (US\$562 per visiting angler) and supporting 9500 Panamanian jobs (Southwick *et al.* 2013). Fifty years ago, Cabo San Lucas on the Baja Peninsula of Mexico was a poor village supported by a single tuna cannery. Recently, Cabo San Lucas hosts 350 000 foreign anglers annually, contributing US\$652 million to national GDP, >24 000 jobs and US\$245 million in tax revenues (Southwick *et al.* 2010). However, information about the economic impact of sportfishing in developing countries is sparse and mostly provides information on national or regional impacts on employment or income, rather than details on impacts at the local livelihood scale. Thus, it is not known whether the national income flows to just a few people or whether it reaches and benefits local communities.

If a tourist operator spends at least some of the income earned from tourists in other, regional, businesses or households (e.g. hiring extra labour), then those businesses and households will also see an increase in income (sometimes termed 'knock-on' benefits). If those businesses and householders also spend some of their extra income on regional goods, then more knock-on benefits will occur. The total regional economic impact of sportfishing-based tourism ventures will thus depend on (i) the amount of money that tourists spend in the local area and (ii) any additional knock-on benefits. If there are no local businesses or local workers, then there will be no opportunity for tourism ventures to 'respond' tourist revenues within local communities by hiring workers or making local purchases (Ashley 2000; Zapata *et al.* 2011), so there will be few, if any, knock-on benefits (Mbaiwa 2005; Stoeckl 2007; Fedler and Hayes 2008). Consequently, providing opportunities for local people to develop complementary ventures that can generate knock-on benefits will often be integral to the long-term success of sportfishing ventures and their support of local livelihoods.

Although providing opportunities for the development of local ventures is an obvious need, this is often inhibited by a disjuncture between indigenous and non-indigenous economic systems (Stoeckl *et al.* 2014). Usually, few (or no) businesses are owned or operated by indigenous

people, and few (or no) indigenous people are employed within local businesses, so there is no way for them to earn money and thus benefit when parts of the (non-)indigenous system expands (through, for example, tourism). Those who wish to enhance the regional economic benefits of tourism in rural and remote communities thus need to find ways of helping local people to engage with tourist ventures and new tourist ventures to engage with local communities, ideally by purchasing goods and services within local regions (perhaps even using barter systems if money is not widely used). Therefore, locals must be provided with opportunities to earn money, for example by working as local guides (Almeida *et al.* 2001) or providing other services such as boat maintenance (Gregory 2014). They also need to have the opportunity to acquire additional skills. This usually requires mentoring and support for local people. If enhanced skills and earnings are used as investment in other activities, such as agriculture (Ashley 2000; Gregory 2014) or running their own businesses, there could be substantive long-term benefits for many.

Economic development often imposes costs on local people, particularly in rural communities that depend heavily on natural resources and environment for their livelihoods and diet (Gray *et al.* 2005). Not only can 'development' erode sociocultural values, but it can degrade the natural environment, impact species that are highly valued by local people (Jackson *et al.* 2012) and/or prevent local people from being able to access to natural resources for other activities (Ashley 2000). Even if local people are able to earn some money from development, this money may be insufficient to compensate them for costs the development imposes (Stoeckl *et al.* 2013). If sportfishing tourism is to succeed as a community development tool, effort must also be made to identify and mitigate its negative impacts. For example, effort must be made to negotiate access rights in a fair and socio-sensitive way (Jackson *et al.* 2014), to ensure that cultural protocols are followed (Higgins-Desbiolles *et al.* 2014) and to safeguard against environmental damage, such as loss of key species. If negative impacts cannot be entirely avoided, appropriate offsets must be negotiated, with the possibility to renegotiate in case of changed circumstances.

A challenge for remote sportfishing ventures in developing countries is marketing their

product. For example, an eco-lodge in Rewa Village, Guyana, struggled to attract tourists because the villagers could not access a market for their product (R. Brummett - World Bank brief 2013, personal communication). In the case of Rewa, a private company assisted with marketing. Marketing is expensive, and few villages can have donors to assist with marketing. Even where operations are supported by associated tour operators, marketing budgets are still likely to be limited. Consequently, simple, financially viable, self-sustaining strategies are needed, as for instance strategies that take advantage of relatively freely accessible technology such as the World Wide Web. For example, engaging with online consumer communities can greatly assist with marketing (Kozinets *et al.* 2010). Online consumer communities are formed when members with similar interests form virtual or real groups. In the modern environment, this is increasingly facilitated through social media platforms such as various websites, Facebook, Instagram, Twitter and online forums (Cova and White 2010). Given that sportfishing enthusiasts are part of a particularly large community that uses social media and web-based forums extensively, marketing via social media would appear to be an ideal and cost-effective strategy for developing countries. The basic infrastructure requirements are accessibility to and knowledge of simple internet services. The collaboration of villagers and tourism operators (and, if possible, government representatives in some locations) may be required to facilitate the engagement with online communities. Other forms of engaging with consumer communities include hosting fishing competitions and TV fishing shows. Fishing shows increasingly promote remote destinations (Table 1), which then become 'must visit' locations for sport fishers around the world, making engaging with fishing shows an obvious promotion strategy.

Guidelines for developing best practice

1. Whenever possible, sportfishing ventures should employ local people, and locals should be given the opportunity to sell local goods and services to both the sportfishing ventures and their clients. Local people may need to be supported to develop their capacity for this type of financial engagement.

2. Provide negotiated 'offsets' (compensation) if negative side effects (associated with access, environmental, social and cultural issues) are unavoidable.
3. Develop appropriate and cost-effective marketing approaches.

Sportfishing tourism as a community development strategy

Sportfishing tourism has been variously proposed as a community development strategy (Carter *et al.* 2012), a tourism marketing option (Borch 2004) and/or a mechanism to support natural resource management (Colton 2005). The underlying argument that sportfishing tourism (especially catch and release) provides an alternative use that both allows conservation and offers a way to generate financial gain and enhance other aspects of community well-being is based on three core assumptions: (i) that sportfishing is a commercially viable and competitive tourism business option, (ii) that sportfishing tourism can be developed to, and is sustained (long-term) at, a scale that can generate sufficient financial capital to achieve its aims, and (iii) that sportfishing tourism can be managed in such a way as to provide overall net benefits to the host community and the environment.

There are often concerns about the difficulties in sportfishing tourism succeeding as either a commercial activity or a community development tool (e.g. Hanazaki *et al.* 2007; Schuhbauer and Koch 2013; Gezon 2014). A number of factors and challenges need to be considered when evaluating sportfishing as a viable tourism business for locals in developing countries. These include variations in tourist numbers (e.g. no fishing in the wet season), and a competition for tourists at local, regional and global scales (Chaperon and Bramwell 2013). Tourism is strongly market driven (Moscardo and Murphy 2014) and requires that local operators and host communities have an understanding of tourists and their expectations (Bennett *et al.* 2012), and can market the product. It often requires high capital investments in infrastructure, making it difficult for local residents to be meaningfully engaged in tourism businesses (Zapata *et al.* 2011). Compounding this, the lack of education/skills of local people again means that profits are typically retained by individuals or businesses either external to the host community or in elite positions within the community (Schey-

vens 2011). Moreover, tourism ventures are usually based on Western capitalist business models that assume private ownership of assets. This can be a poor fit to communities with different approaches to resource ownership and exchange relationships (Bunten 2010). These factors may be pertinent or redundant depending on the location/village, and local leadership structures may be particularly important/influential in the success of tourism operations.

One way that community capacity can be built is by implementing a sustainable livelihood (SL) approach (Hao and Wall 2008). The SL approach is focused on community-level actions that extend local peoples' normal practice of supporting their livelihoods through a diversity of activities (fishing, agriculture, roadside stalls, etc.). The SL approach involves the development of short-term coping mechanisms and longer-term capacities to deal with changing circumstances (Chambers and Conway 1992). It is directed towards developing ways in which villagers can utilize their inherent capacities for integrating earnings from multiple sources to meet basic and ongoing needs (Walker *et al.* 2001).

There are many possible business models for the involvement of local communities in sportfishing operations, with appropriate options for a particular location depending on local circumstances. Possible models include the following: Model 1 – payment for use of village fishing grounds (PES), which can be monetary or in goods and/or services; Model 2 – employment with tourism operators and other facets of the tourism industry (e.g. lodges); Model 3 – small-scale complimentary entrepreneurial ventures (e.g. nature walks, village life experience, cultural sites, selling of crafts and souvenirs, traditional fishing, and storytelling), and Model 4 – training local people to own/manage higher end (potentially most profitable) businesses (e.g. operating sportfishing ventures, hotels or restaurants). At a minimum, Model 1 should be achievable at most locations, at least as a short-term coping mechanism. Additional models can be added over time (longer-term capacity building) if they suit conditions in individual villagers/locations.

Guidelines for developing best practices

1. Consult with and assess individual locations/villagers to determine the best business model for each particular case, so that sportfishing tourism benefits local people.

2. Implement a sustainable livelihood approach, which includes short-term coping mechanisms and longer-term capacity building.

Discussion

Sustainability is paramount to achieving a type of wildlife tourism that ensures both long-term livelihoods and conservation. Interdisciplinary research can help develop best practices required to meet sustainability objectives. Focusing on the 'three pillars' of sustainability (sociocultural, environmental and economic) can provide an effective framework to assist ecotourism/sustainable tourism in promoting and participating in the preservation of a species, group of species, habitats or areas (Brunnschweiler 2010). Logically, it can also provide a framework for developing sportfisheries in ways that enable them to support sustainable livelihoods. Nature-based tourism has sometimes been regarded as a panacea for creating sustainable livelihoods in developing countries because it creates value from biodiversity, thus generating stimulus to preserve and manage natural assets (Chok *et al.* 2007; Brunnschweiler 2010). This linked incentive strategy (biodiversity/conservation linked to alternative livelihoods model) was tested by Salafsky and Wollenberg (2000) across Asia and Melanesia, and it was shown that ecotourism provided the strongest 'win-win' linkages and enterprise longevity compared to harvest-based initiatives or strict (no use) protected area strategies.

In developing countries, sportfishing has the potential to provide more than just benefits for individuals (or families) through employment, and it has the potential to enhance social cohesion of communities by enabling young people to remain in villages rather than moving away from traditional land to seek employment. Despite the potential for sportfishing to positively impact livelihoods, little research has focused on the processes of achieving this. For instance, the concept of villages 'renting out' their fishing rights or some of those rights (e.g. access to specific species or habitats) to sportfishing ventures has not been widely evaluated in the literature (Wood *et al.* 2013). This concept, payments for ecosystem services (PES) (Model 1), has been applied to the terrestrial environment (e.g. Pagiola 2008; Osano *et al.* 2013). For example, in Kenya, pastoral landowners excluded grazing livestock and resettled from their

lands in exchange for annual monetary payments by tourism operators who use their lands for wildlife ecotourism (Osano *et al.* 2013).

A successful example of PES being applied in the marine environment is the Shark Reef Marine Reserve in Fiji, an ecotourism project that protects a reef patch and its fauna while contributing to the livelihood of local communities (Brunnschweiler 2010). The main attraction at the Shark Reef Marine Reserve (SRMR) is diving with a large numbers of sharks (Brunnschweiler *et al.* 2014). Income is generated through diver/user fees and distributed to local villages that have exchanged their traditional fishing rights in the marine reserve for this alternative source of income (see Brunnschweiler 2010). A number of the best practice guidelines developed in this review were employed in setting up Shark Reef tourism project: sociocultural needs were considered, locals were consulted and included in decision-making, and the tourism operator facilitated marketing. After the successful implementation of the SRMR, neighbouring villages requested the expansion of the protected area and a share of the tourism revenue. In total, three villages traded fishing on some of their fishing grounds for a share of the tourist levy. In addition, the three villagers prohibited shark fishing in their respective areas, resulting in approximately 30 miles of coastline known as the Fiji Shark Corridor (Brunnschweiler 2010). Tourism in the Shark Reef area (Pacific Harbour) also uses Model 2, with local people trained and employed by the tourist operator, and employment in other sections of the tourism industry. Vianna *et al.* (2011) estimated that the shark-diving industry contributed US\$42 million to the Fijian economy in 2010, with a minimum of US\$4 million going to local community, US\$3.9 million in salaries and US\$124 200 from the community levy for the usage of the reef (Vianna *et al.* 2011). Dive operations at Pacific Harbour alone (which incorporates SRMR) provided approximately US \$5.3 million in revenue in 2010. It is in the long-term interest of all stakeholders (villages, local community, dive operators, tourists) that shark numbers remain healthy and that Fiji dive sites remain destinations worth visiting.

There are certainly a number of challenges in implementing a similar ecotourism model for sportfishing ventures in developing countries. For example, would locals completely stop fishing if they earn enough money to meet their food

security and living expenses? If locals continue to fish for their main source of protein, would they adopt catch-and-release policies when capturing the main sportfishery species? As pointed out in the sociocultural and tourism sections, not all locals/villagers will be interested in participating in these partnerships. However, given the fears for future food security in developing countries, and the undeniable spread of sportfishing tourism into remote areas (Bower *et al.* 2014), local people should be given the opportunity to benefit from this industry. In some instances, it may be important for the long-term future of villages. As seen in the Fijian example, if a neighbouring village benefits from tourism, others may see its advantages and want to follow.

To better evaluate how successful sportfishing can contribute to poverty alleviation, sustainable livelihoods and conservation, the World Bank has identified a critical need for a series of case studies, whereby successes and failures can be measured (R. Brummett, personal communication). Although there is very little published in the main literature, there are some examples of sportfishing enterprises in developing nations with apparent livelihood benefits. For example, sportfishing for bonefish is long established in the Bahamas. The first bonefishing lodge was opened in the 1940s, and 20+ years later, the first Bahamian owned a lodge (reaching Model 4 presented in the tourism section). The industry has grown steadily, and in 2010, there were more than 50 bonefishing lodges and 200 guides in the Bahamas (Fedler 2010). Bahamians make up 87–95% of the non-managerial lodge employees, and bonefishing-related jobs provide >1% of the country's employment (Fedler 2010). However, most lodges are set up through overseas investors, and it is unknown what proportion of income goes into local communities.

Another recent example is sportfishing in central Guyana. Rewa Village opened a sportfishing lodge in 2005 targeting arapaima (Family Arapaimidae), one of the world's largest freshwater fish. Local conservation efforts that banned consumption led to fivefold increase in arapaima population. However, despite the high numbers of the target species the eco-lodge struggled because the villagers did not know how to market their operation (Carana Corp, personal communication). In 2010, an international aid organization donated supplies, equipment and technical assistance in hospitality services, and Costa Sunglasses

Inc. provided about US\$400 000 for international publicity. After these efforts, lodge bookings increased, and the lodge is now profitable (Carana Corp, personal communication). The people of Rewa Village own and operate the eco-lodge, another example of local people reaching Model 4, employing ~80% of the village. Other sportfishing lodges have opened in the interior of Guyana, and many are now fully booked for months in advance in the high season (Carana Corp, personal communication).

Both the FAO and European Inland Fisheries Advisory Commission provide codes of practice or technical guidelines for responsible recreational fishing (European Inland Fisheries Advisory Commission 2008; FAO 2012). The European Inland Fisheries Advisory Commission (2008) outlines standards of environmentally friendly, ethically appropriate and socially acceptable recreational fishing and its management. The FAO similarly has guidelines on ethics, management, policy and practices. The FAO (2012) also has a section that considers recreational fishing in developed countries, which touches on economics and socio-cultural components. The current review builds on this with a focus on economic and sociocultural issues in regard to sustainable livelihoods.

The long history of recreational/sportfishing in developed (industrialized) countries provides context (experience) for predicting and dealing with potential problems in developing countries if proposed sportfishing best practice guidelines are neglected or alternative guidelines not implemented. Developing countries probably have management goals and stakeholder desires that are specific to their own social and cultural context (FAO 2012). However, the environmental science (biological and ecological) that underlies assessment and management is universal (FAO 2012). Historically, recreational fishing has not been seen as a conservation issue, and in the developed world, the impact of recreational fishing is typically addressed by curing symptoms rather than by addressing underlying causes (Cooke and Cowx 2004). Added to this, few documented declines in fish stocks are attributed to recreational fishing, or declines are largely unnoticed (Post *et al.* 2002; Cooke and Cowx 2006). At present, this is a problem for recreational fisheries in general because essential information (e.g. effort and catch) is not generally available (FAO 2012). However, given the nature of sportfishing tourism

in developing countries, i.e. tourist fish with operators/guides (as opposed to developed countries where many fishers have access to fisheries without operators), once stock assessment programmes are initiated, monitoring parameters such as catch and effort are relatively straightforward because the exact number of customers (fishing days/hours, lines, etc. = effort) can be determined, and guides can record catch (and its fate). However, the development of sportfish will inevitably lead to locals taking up the pastime, so approaches to monitoring the complete spectrum of catch and effort need to be built in at early stages of development. A pressing problem is not knowing the catch from subsistence fishing, as this can be a significant mortality parameter in stock assessments. Given that economic gains can be higher in recreational fisheries than commercial fisheries (Ihde *et al.* 2011; FAO 2012), gaining such information is imperative for the implementation of environmental guidelines early in the sports fishery to avoid conservation and management issues in the future.

Neglecting key sociocultural and economic considerations could also lead to future problems, e.g. if financial opportunities are not given to locals (e.g. jobs and/or purchasing from local suppliers), few financial benefits will flow to local residents and that may contribute to resentment towards the industry in the longer term, thus reducing prospects for long-term sustainability. If goods and services are not sought within country, local economies will not reap the full benefit from the fishery. For example, Puerto Ricans profiting from sportfishing spent a large proportion of the wealth generated from billfish tourism in purchasing imported goods and services from the USA. Thus, profits from billfish tourism had a low economic impact on the Puerto Rican economy (Holland *et al.* 1998). In contrast, economic impact from billfish tourism in Costa Rica is high because expenditures for goods and services remain in the national economy for several rounds of spending ('knock-on' benefits) (Holland *et al.* 1998).

Given the current interest and likely growth of sportfishing in developing countries in the near future, and the potential for new business ventures and research projects, these guidelines can help a range of end users manage, conserve and maximize livelihood benefits from their fishery (Wood *et al.* 2013; Sheaves *et al.* in press). End users include government, tourism operators, local

economies, funders (NGOs, foundations, etc.), and researchers. Indeed, management constantly evolves (FAO 2012), and with this growth in sportfishing, a number of case studies should become available over time (a priority identified by the World Bank), which will help to further, develop and refine guidelines.

Conclusion

Locally based sportfisheries have the potential to provide alternative or diversified livelihoods and food security for coastal villages as a result of the increased income they generate. At the same time, they can generate significant environmental benefits by creating incentives to conserve targeted species and their key habitats. However, many limitations and potential challenges need to be managed. These may include the following, among others: local capacity and willingness to participate, lack of experience in business commercialization, fluctuating tourism markets, and conflicting values and rights to natural resources. These problems are evident in many ecotourism ventures, particularly in the terrestrial environment (e.g. Lamers *et al.* 2014). Often, the problems will seem insurmountable, but will need to be overcome because ecotourism ventures are often one of the few alternatives for enhancing sustainable livelihoods without completely changing the traditional ways of life. In such cases, the best way forward is to continually develop and implement best practice guidelines and, in particular, to flexibly develop them to suit individual cases. Ultimately, local people will determine the level of involvement that best suits them. Tangible, culturally appropriate socioeconomic goals need to be identified, including site-specific market analysis and research on the linkages between tourism goals and community responses. Importantly, at a more fundamental level, the ecology and biology of the fish and the fishery need to be understood so that the resources on which commercial success depends can be appropriately managed. For example, information such as size at maturity and reproductive cycle, habitat-use patterns including spawning sites and foraging behaviour is essential for management. Information on the species physiology and, in particular, its ability to recover after the stress of capture also needs to be considered. If animals of a particular species are fragile or vulnerable to certain fishing practices, then the

best catch, handling and release practices need to be developed and adopted fishery wide. Thus, information from a range of disciplines should be considered and combined in order to develop sustainable management strategies and inform policy decisions.

With the increasing number of people participating in sportfishing in developing countries (Bower *et al.* 2014), research is urgently required to ensure the development of best practice. One potential source of sportfisheries funds is from fishing licenses and fees. Although most developing countries do not have licensing fees, tourists could pay a small fishing fee, or a fee could be inbuilt in the charter costs (see Mongolian taiman example in Cooke *et al.* in press). For highly profitable fisheries in developing countries with flow-on benefits to a range of stakeholders and the economy, the government/fisheries management could fund research to ensure the sustainability of the fishery and, therefore, livelihoods.

There is no one-fits-all recipe to establishing successful ecotourism ventures in developing countries, as what is needed to achieve a successful project will differ according to the cultural, social, environmental and economic beliefs and needs of individual people, areas or situations (Wood *et al.* 2013), thus requiring a case-by-case analysis. Nevertheless, in all cases, if sportfishing is to be sustainable as a tourism industry, it must develop in a way that is socially, environmentally and economically appropriate. In general, it appears the most useful approach is to develop best practice guidelines around a sustainable livelihood framework, which includes short-term coping mechanisms and longer-term capacity building. Best practice guidelines for sportfishing that do not address these dimensions cannot result in a viable industry. Sportfishing development that upholds ecological and socially orientated criteria, founded in site-specific research that captures local environmental and social complexities, has the potential to provide mutual benefits to tourists and local people, fuelling community development and enhancing the cultural experience of tourists.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Table S1. Publications addressing the consequences and best practices of hook and line catch & release fishing.