THE ROLE OF ANGLING-GUIDES IN PROMOTING PRO-ENVIRONMENTAL CATCH-AND-RELEASE ATTITUDES AND BEHAVIOURS IN THE RECREATIONAL ANGLING COMMUNITY

A Dissertation

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Abstract

Angling-guides are respected as opinion leaders of the recreational angling community, but nothing is known of their influence on angler behaviour. Given their social-standing, angling-guides may be perceived as role-models by angling-clients – thereby promoting the adoption of best and/or poor catch-and-release (C&R) practices, depending on their individual knowledge, attitudes and behaviour. It is critical to understand their potential influence, their knowledge and their behaviours to inform effective intervention strategies which could exploit their extensive networking potential. The aim of this thesis was to better understand the potential utility of angling-guides in efforts to improve angler behaviour. Firstly, this was done by investigating whether angling-guides are perceived as role-models by angling-clients (Chapter 2). Secondly, it was done by assessing the current level of knowledge, attitudes and behaviours of angling-guides from around the world (Chapter 3). Thirdly, it was done by exploring the relationship between angling-guide knowledge, attitudes, intentions and actual behaviour in a case-study of guided-angling trips (Chapter 4). Lastly, it was done by exploring intervention frameworks and incorporating insights into potential strategies for promoting pro-environmental angling behaviours to angling-guides (Chapter 5).

To understand if angling-guides are perceived as role-models by the recreational angling community (Chapter 2), a digital survey was designed to assess previous angling-clients' attitudes towards angling-guides serving the three role-model functions proposed in the Motivational Theory of Role-Modelling, namely as *Behavioural models*, *Representations of the Possible* and *Inspiration*. Of the 492 angling-clients (27 countries), most agreed that angling-guides were competent, skilled, and worth emulating (91.1%), suggesting they are perceived as *Behavioural Models*. Less agreed that angling-guides were *Inspirational* or *Representations of the Possible* (54.8%), suggesting they are less likely to motivate anglers to adopt and/or pursue new goals. As *Behavioural Models*, angling-guide C&R practices are likely to be emulated, which is of both utility and concern to managers.

As angling-guides are likely to be emulated, a digital survey was designed to assess their knowledge, attitudes and behaviours (particularly C&R best-practices) (Chapter 3). Of the 342 angling-guides (47 countries), few had accredited training (9.4%). However, most were deemed "knowledgeable of best-practices" (69.0%), but pervasive misconceptions of key C&R best-practices were observed. Attitudes towards best-practices were generally pro-environmental, and those deemed knowledgeable had significantly more pro-environmental

attitudes (p = 0.003). Most angling-guides had pro-environmental attitudes towards their environmental responsibilities (87.1 - 89.5%), but these broad attitudes cannot predict specific pro-environmental behaviours during guided-angling trips where angler satisfaction is often at odds with best-practice. Angling-client satisfaction has important financial implications for angling-guides, and even those with pro-environmental intentions may struggle to adhere to C&R best-practices with inherent sacrifices for the angling-client's enjoyment.

Observation of behaviour in context is critical for understanding the behaviour to be changed. To explore the relationship between angling-guide knowledge, intentions and actual behaviour (Chapter 4), five angling-guides were observed (and filmed) interacting with groups of angling-clients during their guided-angling trips over a 30 day period. Five angling *behaviours of interest* were identified, and a survey focussed on these behaviours was disseminated (18 months later) to the five angling-guides previously observed to assess their knowledge, attitudes, reported behaviours and perceptions of the norm. Generally the subjects' *reported behaviours* aligned well with their *knowledge of best-practice*, but their *actual behaviour* was not well aligned (24.4%). Instead, their *actual behaviour* aligned better with their *perceptions of the norm* (80.9%), which was generally a "worse" practice than what they *reported*. Angling-guides appeared to favour client-satisfaction over pro-environmental behaviour.

Gaps between angling-guides' *knowledge of best-practice* and their *actual behaviour* indicate that there may be obscure and complex barriers to pro-environmental angling-guide behaviour. Many barriers are seemingly impossible to overcome, such as economic limitations and financial disincentives. These barriers may limit the efficacy of traditional knowledge-attitude-behaviour (KAB) change interventions. The strong alignment of angling-guide behaviour with social norms, and the strong community orientation of recreational angling suggests that the Community-Based Social Marketing (CBSM) approach may be a more effective framework for interventions that aim to promote pro-environmental catch-and-release behaviours at angling-guide level. The CBSM approach allows interventionists to leverage a larger suite of cognitive biases than KAB approaches, provided that sufficient understanding of the context, barriers and benefits for a given segment of the angling-guide community (likely defined by style-of-participation) are obtained. Furthermore, the success of the CBSM approach will depend on the ability of interventionists to effectively recruit and incentivise disjunct and isolated communities of angling-guides to participate in training and workshops in order to achieve the important in-person contact on which the CBSM approach depends.

"One of the penalties of an ecological education is that one lives alone in a world of wounds.

Much of the damage inflicted on land is quite invisible to laymen. An ecologist must either

harden his shell and make believe that the consequences of science are none of his business,

or he must be the doctor who sees the marks of death in a community that believes itself well

and does not want to be told otherwise."- Aldo Leopold

Acknowledgements

Figure i: Word cloud showing the 15 most common words and terms used in this thesis.

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AEB – Attitudes towards Environmental Behaviour

AER – Attitudes towards Environmental Responsibility

Angler(s) – used synonymously with recreational-angler.

Angling-clients – anglers who pay (or have paid) for teaching, guidance and/or equipment provision during guided-angling trips.

Angling-guides – individuals who receive (or have received) remuneration from recreational anglers in exchange for teaching, guidance and/or equipment provision during guided-angling trips.

Antecedent(s) – the stimuli or situation that has prompted a behaviour.

Anthropocentric – a human centred ideology. When describing the motivations for conservation or pro-environmental behaviour: that favouring conservation for the future benefit of the self or other humans.

Attitudes – a mindset or a tendency to act in a particular way due to both an individual's experience and temperament. "Attitudes are a complex combination of things we tend to call personality, beliefs, values, behaviours, and motivations" (Pickens 2005).

Behavioural intention(s) – conscious behavioural plans for the attainment of a behavioural goal, fundamentally comprised of three antecedents, namely: attitude towards behaviour, subjective norms and perceived behavioural control.

Best-practice(s) – the most pro-environmental choice, behaviour or practice in a given angling-specific situation. The practice which achieves the best trade-off between requirements for sporting enjoyment and sustainability of resource.

BHM – *Behavioural Model* (Factor 2)

Biocentric – an ethical standpoint which extends inherent value to all living things. When describing motivations for conservation or pro-environmental behaviour: borne of a high moral regard for the intrinsic value of nature and its' integrity.

C&R – Catch-and-Release

Cognitive dissonance – the state of psychological discomfort experienced when an individual holds competing or hypocritical attitudes, beliefs or behaviours.

Community-Based Social Marketing (CBSM) – describes an approach to behaviour change described by McKenzie-Mohr (2011) in "Fostering Sustainable Behaviour: An Introduction to Community-Based Social Marketing".

Community of Practice (COP) – in angling: groups or communities of anglers with commonalities in their angling techniques, target species, catch-related goals or localities (i.e. Style of Participation).

Conformity – the matching of attitudes, beliefs, and behaviours to group norms, politics or being like-minded.

Environmental behaviour(s) – behaviours with direct environmental impacts. In this study context, either catch-related or other behaviours with environmental impact, which may be exhibited during guided-angling trips.

Ethics – individual moral principles which guide behaviour.

Gap(s) – in relation to behaviour: where there is an observable dissonance or disharmony between, or misalignment of, psychological constructs of behaviour (attitudes, values, perceptions, beliefs) and/or actual behaviour.

Guided-angling trip(s) – a trip where one or more anglers embark on angling-activities under the supervision of one or more angling-guides.

Intervention(s) – when regarding environmental behaviour: structured effort to change human-behaviour by various means.

IRP – *Inspiration Representation of the Possible* (Factor 1)

KAB – Knowledge-Attitude-Behaviour (in reference to approach)

KAP – Knowledge-Attitude-Practice (in reference to gaps)

KBP – Knowledge of Best-Practice

MTRM – Motivational Theory of Role-Modelling (as per Morgenroth et al. 2015)

Perception(s) – closely related to attitudes: the process by which organisms interpret and organize sensation to produce a meaningful experience of the world (Lindsay & Norman 1977). As a result of interpretation and organization, perception may differ significantly from reality.

Practice(s) – when related to angling: specific angling-centric behaviours exhibited during catch events.

Pro-environmental – (*adjective*): that which favours environmental integrity.

Pro-environmental behaviour(s) – behaviour which consciously seeks to minimize impact on the environment. In this thesis when referring to angling practices, this term is synonymous with catch-and-release best-practices.

RA(s) – Recreational Angler(s)

Rock-and-surf – shore-based angling facet common along southern African rocky and sandy surf zones.

Role-aspirant(s) – those who are aspirant of the role modelled to them by an individual they perceive as a behavioural model, a representation of the possible and/or inspiring.

Role-model(s) – those who may influence role-aspirant goals, motivations and behaviours by acting as behavioural models, representations of the possible and by being inspirational.

Role-modelling – (*verb*): the process by which role-models influence role-aspirants goals, motivations, behaviours.

Social-impact – any of the great variety of changes in physiological states and subjective feelings, motives and emotions, cognitions and beliefs, values and behaviour, that occur in an individual, human, or animal, as a result of the real, implied or imagined presence or actions of other individuals (Latané 1981).

Social marketing – outreach using commercial marketing techniques primarily aimed at changing human-behaviour for the common good of the physical, social and economic environment in which they live.

Socially-desirable – (*adjective*): description of something (e.g. behaviour or attitude) that an individual believes to be desired by others with the ability to create social-impact.

Shore-based game-fishery – to describe a style of angling participation where anglers cast lures and baits to marine game-fish from the shore.

Style of Participation (SOP) – in angling: a contextual typology or characterization of angler participation based on how, where and with what (e.g. shored-based, saltwater lure angler).

TPB – Theory of Planned Behaviour (Ajzen 1991)

Values – Individual notions as a result of how humans evaluate the "value" and/or "goodness" of ideas, objects, behaviours or people, which guide how humans behave in relation to those ideas, objects and/or people.

Chapter 1

General Introduction

"Ethical behaviour is doing the right thing when no one else is watching – even when doing the wrong thing is legal." – Aldo Leopold

Angling recreationally is an important past-time around the world, with as much as 10.6% global participation (Arlinghaus et al. 2015). Recreational angling, defined as that which takes place outside of work hours, and for reasons other than subsistence (Cooke et al. 2017; FAO 2017), is of tremendous social (Arlinghaus & Cooke 2009), cultural (Arlinghaus et al. 2015) and economic value (Tisdell 2003; Saayman et al. 2017; FAO 2017) to both coastal and inland communities around the world (FAO 2017). Unlike those of commercial fishers, the motivation for recreational anglers is not profit (Kleiven et al. 2020), but rather a complex suite of social, personal, leisure and food-orientated factors which vary considerably between individuals (Chipman & Helfrich 1988; Finn & Loomis 2001; Arlinghaus et al. 2015; Cooke et al. 2017). These may include catch-related motivations, such as to catch a certain number or species of fish, and other non-catch-related motivations such as relaxation (Hunt & McManus 2016), sense-of-place (Farnum et al. 2005) or perhaps as a manifestation of humanities innate desire to connect with nature (*biophilia hypothesis* – Kellert & Wilson 1993). While not strictly for subsistence, recreational angling may also have a strong food-orientated motivation, and represents a source of protein security for some communities (Cooke et al. 2017). As such, the motivations for recreational angling are as diverse as the participants, but there is agreement that recreational-angling quality and enjoyment (i.e. satisfaction) is directly related to fishery health (i.e. catch rate & size of fish caught), even if only partly (Birdsong et al. 2021).

The consensus that much of what anglers deem to be "angling-success" depends critically on fishery health has led many recreational anglers to travel far in pursuit of better-quality fishing. Also, anglers' desire to catch iconic and charismatic species endemic to other regions, or perhaps to explore new angling experiences leads many to seek those specific opportunities. Many recreational anglers will travel locally and/or internationally in pursuit of fish and fishing experiences, and as such there is an entire industry which caters for this endeavour. Much like the wilderness safari industry, there is a network of outfitters, booking agents, lodge/camp operations and angling-guides which cater for the travelling angler, and assist with access,

equipment, logistics, accommodation, information and the angling-specific know-how required to achieve the anglers' goals. Whether in pursuit of an endemic species in another country, or simply to gain access to a boat for fishing offshore, many anglers will pay for the services of an angling-guide in an effort to improve their chances of angling-success, or to overcome some other impediment such as access to an angling-concession. While not all angling motivations are catch-orientated, manifestations of angling-success are usually typified by catch-specific goals such as species, number, size and even angling method. These goals are often the product of the angler's Style of Participation (SOP; e.g. boat-based fly-fishing) or their Community of Practice (COP; e.g. rock-and-surf anglers). As a result, there are outfitters and angling-guides who specialize in certain SOPs, and may even market specific angling-opportunities on that basis. Once the angler has decided to book a guided-angling trip, their angling-guide is ultimately responsible for their success and enjoyment (Figure 1.1).

Figure 1.1: Photograph of an angling-guide (centre) overseeing the activities of angling-clients during a guided-angling trip at a recreational shore-based game-fishery in southern Angola.

Angling-guides are respected members of the recreational angling-community (Smith 2011), and enjoy the widely held belief that they are accomplished and capable anglers themselves. As a result, they are opinion leaders in the recreational angling space (Smith 2011), and many anglers will readily absorb their teachings on the basis of this assumed competence. On guided-

angling trips, anglers will have varying skill levels, and may require assistance with simple tasks, such as knot-tying, or more complicated practices such as fly-casting. In these scenarios, hands on demonstration is a powerful teaching tool for inexperienced anglers, especially as angling has a steep, skill-centric learning curve. Alternatively, anglers might be technically capable, but have little understanding of how the target species interacts with a particular aquatic environment (e.g. ambush points of predatory fish in a river). As such, an angling-guide's knowledge and their ability to instruct their angling-clients may be critical to their joint success (Figure 1.2). Additionally, angling-clients may be expert anglers themselves, and require nothing more than the angling-guide's equipment or their local insight into the minutia of seasonal feeding-patterns in order to achieve a nuanced catch goal. As such, angling-guides may assist anglers through direct demonstration and/or education, and therefore may influence how anglers utilize and interact with fisheries resources.

Figure 1.2: Photograph of an angling-guide (left) instructing an angling-client (right) where to cast and how to retrieve the lure during a guided-angling trip at a recreational shored-based game-fishery in northern Angola.

Recreational fisheries are of growing ecological concern given their impact on world fisheries resources (Cooke & Cowx 2004; Coleman et al. 2004; Hyder et al. 2014). It is widely acknowledged that recreational fisheries have been historically overlooked (Cooke & Cowx

2004), and growing consensus suggests that their impact has been greatly underestimated, and may be on par with that of commercial fisheries in some regions (Coleman et al. 2004; Hyder et al. 2014). Like many ecological problems, human behaviour is at the core of this ecological concern (DuNann Winter & Koger 2004; Gardner & Stern 2002; Vlek & Steg 2007), as angler behaviours have a direct impact on fishery resource health (Davis 2002; Arlinghaus et al. 2007; Cooke & Schramm 2007; Brownscombe et al. 2017). While there is evidence that growing awareness of ecological problems, such as fishery decline, has led some pro-active recreational anglers to adopt pro-environmental behaviours, such as voluntary catch-and-release (C&R), there are many who have not (Brownscombe et al. 2017). Angling-induced-mortality is not restricted to harvest, as the mandatory or voluntary release of an angler's catch does not guarantee its survival (Brownscombe et al. 2017). Even amongst those anglers who practice C&R, some may do so poorly, inadvertently contributing to the considerable, yet obscure post-release mortality (Muoneke & Childress 1994; Cooke & Phillip 2003; Raby et al. 2014) or associated sub-lethal reductions in fitness (Suski et al. 2003; Klefoth et al. 2011; Richard et al. 2013; Brownscombe et al. 2017). Lethal and sub-lethal effects on fishes caught-and-released are being increasingly documented, and the mortality rate appears to be higher than previously estimated. Given that as much as 63.7% of fish caught recreationally are released (Cooke and Cowx 2004), anglers' C&R practices may have considerable bearing on resource health. As such, angler-behaviour represents a principal stumbling-block for sustainability goals, but changing those same behaviours may be key to the achievement of those goals.

Changing human behaviour is touted as the panacea for many of the world's ecological problems, given that technological innovation can no longer sufficiently remediate the impact of a growing population on our resources (Steg & Vlek 2009). In fisheries management, there has been a shift in focus away from managing the resource, and towards managing its users (Hilborn 2007). Traditional top-down regulatory management strategies which rely on compliance and enforcement certainly have merit in fisheries conservation, because they restrict and/or alter resource use behaviour through fear of penalty. However, these approaches fall short where enforcement capacity is weak and the culture for compliance is low, such as in marine-shore-based fisheries in South Africa (Bova et al. 2017; Potts et al. 2020). Additionally, simple compliance with bag limits and area restrictions may be insufficient to combat the impact of recreational angling on the resource, because even legal practices may be considerably deleterious. For example, restrictions enforcing mandatory release do little to limit mortality and remediate other sub-lethal effects if anglers do not value fish health, and do

not take sufficient steps to ensure the survival of caught-and-released fishes. Some best-practices can and have been legislated, such as only barbless hooks (Alberta, Canada) and no photos of out-of-season fish (OFW Regulations 2019). However, it is impossible to enforce the attitudes, values and ethics which lead to the pro-environmental angling behaviours needed to sustainably utilize fisheries resources, such as high regard for fish welfare or concern for the environment. As such, sustainability in recreational fisheries requires alternative solutions for promoting the adoption of unenforceable attitudes and behaviour.

Encouraging anglers to adopt ethical behaviours, even in the absence of social or legal scrutiny, is essential to achieve sustainability goals in global recreational fisheries. A firm understanding of the social and behavioural dimensions is a pre-requisite if we ever hope to be able to effectively improve angler behaviour. Understanding human behaviour is a growing field which draws on many disciplines such as health science, but is being increasingly applied to the environmental behaviours context. There are many models used to describe environmental behaviour, perhaps the most common of which is the Theory of Planned Behaviour (TPB). The Theory of Planned Behaviour (Figure 1.3; Ajzen 1991) is a rational choice model that suggests that the intention to exhibit a behaviour is the product of three antecedents, namely: attitude towards the behaviour (*how positive do I feel about the behaviour*), subjective norms (*what do other people expect me to do*) and perceived behavioural control (*how easy is it for me to do this behaviour*) (Ajzen 2001). When attitudes and subjective norms are favourable towards the behaviour in question, and perceived behavioural control is high, the intention to perform said behaviour should also be high (Ajzen 1991). Given contextual limitations and barriers, behavioural intentions do not automatically result in behaviours being performed (Ajzen 1991; Nilsson et al. 2020), but they are a strong predictor (Ajzen and Fishbein 2005; Salzborn et al. 2012). The three determinants may make varying, independent contributions to overall behavioural intention, depending on the context. In some cases, attitudes may be the primary contributor, whereas in other cases only two of the three determinants may be responsible (Ajzen & Fishbein 2005; Salzborn et al. 2012). The understanding that knowledge shapes attitudes, and attitudes guide behaviour has led many intervention efforts to improve knowledge as a means to improve environmental behaviour. The knowledge-attitude-behaviour strategy has the benefit of being relatively simple to employ, but although this strategy is commonly applied to ecological problems it has rarely been successful (Steg &Vlek 2009).
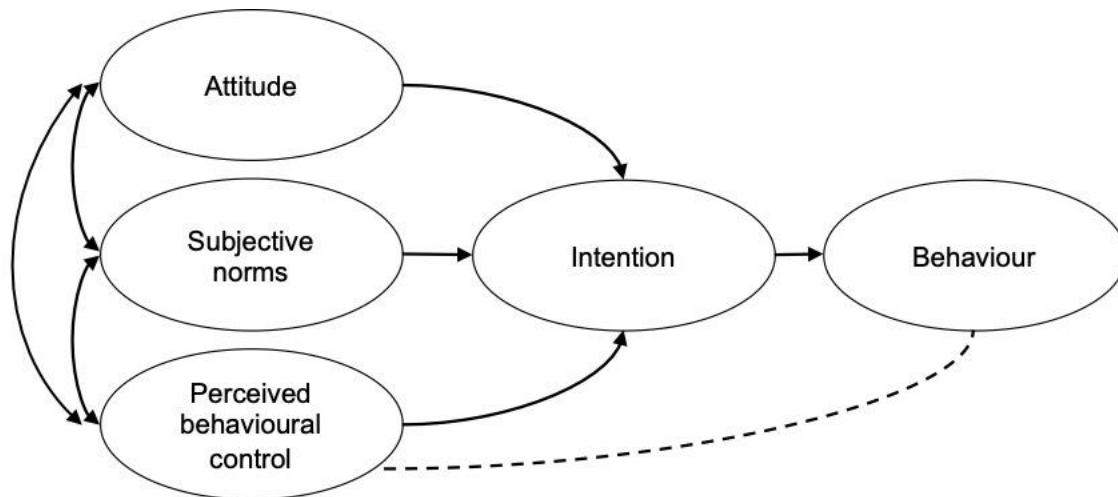
Figure 1.3: Illustration of the Theory of Planned Behaviour proposed by Ajzen (1991).

Behavioural interventions have been applied to all manner of social and ecological problems with roots in human behaviour, including recycling (Gainforth et al. 2019), improving personal health care (Murphy & Brubaker 1990; Liu et al. 2016), household energy consumption (Abrahamse et al. 2005), speed limit compliance (Parker et al. 1996) and seatbelt use (Geller & Lehman 1991). The success of a behavioural intervention depends on what behaviour is targeted and how it is addressed (Geller 2002). With respect to environmental behaviours, interventions relying only on education and the knowledge-attitude-behaviour approach (Bettinghaus 1986; Chung & Park 2019) have been applied with varying levels of success (Abrahamse at al. 2005), and considerable gaps between problem awareness and actual behaviour have been documented in many contexts (Kollmuss & Agyeman 2002; Dihr et al. 2021). These gaps highlight that awareness alone may be insufficient to incur behaviour change, as there is a myriad of other personal, social and contextual barriers to pro-environmental behaviours.

Understanding the psycho-social pre-determinants of pro-environmental behaviour is critical for efforts to promote these behaviours to resource users. Motivations to behave pro-environmentally include a combination of self-interest (e.g. minimize own health risk) and pro-social motivations (e.g. preserve resources for future generations) (Bamberg & Moser 2007). On that basis, it is clear that the decision to behave pro-environmentally can be a rational choice based on self-interest (as per Theory of Planned Behaviour – Ajzen 1991), or the result of social pressures like norms or moral obligation (as per Schwartz 1977). Based on this understanding, Bamberg & Moser (2007) expanded on the Theory of Planned Behaviour to propose four more psycho-social pre-determinants of pro-environmental behavioural intention, namely:

awareness of the problem, *internal attribution of the cause*, *feelings of guilt* and *social norm*. Similarly, there are several common barriers to pro-environmental behaviour, such as *lack of internal incentives*, *lack of external incentives or possibilities*, *old behaviour patterns* (e.g. habit – Verplanken & Wood 2006), *lack of environmental consciousness* and *insufficient feedback about behaviour* (Kollmuss & Agyeman 2002). While likely impractical to synthesize into one relevant framework, these works provide a basis on which to structure effective pro-environmental behaviour interventions which target motivations and address barriers.

The effectiveness of a behavioural intervention relies on which behaviours are targeted and how they are addressed. Geller (2002) identified four key steps in the design and execution of an effective pro-environmental behavioural intervention: (1) careful selection of behaviours which need to be changed; (2) careful examination of the underlying factors causing those behaviours, such as their barriers, motivations and benefits; (3) application of a well-tuned intervention which targets said behaviours and their antecedents; (4) systematic evaluation of the effects of the intervention on the behaviours, their antecedents and the environment affected (Geller 2002; Steg & Vlek 2009). This structure is similar to that of the Community-Based Social Marketing (CBSM) approach (McKenzie-Mohr 2000; McKenzie-Mohr 2011), which employs commercial marketing techniques in a social marketing intervention implemented at the community level. Social marketing incorporates commercial marketing techniques with other approaches for behaviour change and the common good (Kotler & Lee 2008). These long-term, structured behavioural intervention approaches are important for overcoming common problems with promoting pro-environmental behaviours using traditional information-based approaches.

Few studies have applied these structured behavioural intervention strategies to a recreational fisheries context. However, Mannheim et al. (2018) documented the implementation of this strategy to develop a structured intervention to improve the C&R behaviour of anglers in a competitive angling context (Rock and Surf Super Pro League [RASSPL] – South Africa) by the Southern African Fisheries Ecology Research (SAFER) Lab. This long-term intervention showed promising improvements in angler C&R behaviours, and resulted in significant improvements in fish health (Butler et al. 2017; Mannheim et al. 2018). In this scenario, the formal nature of the competition provided a structure within which to demonstrate, educate, provide incentives, give feedback, reform C&R rules, and incentivise pro-environmental behaviour. Similarly, Bova et al. (2017) evaluated a social-norms approach for improving

angler compliance with regulations in the South African marine-shore-based fishery where enforcement capacity is lacking (Bova et al. 2017; Potts et al. 2020) and compliance with regulations is low (56% non-compliant – Bova et al. 2017). In this case, the omnipresent pressure of social norms could be exploited to encourage compliance in the absence of enforcement, highlighting the potential power of social norms in self-regulation. Similarly again, Kramer et al. (2017) investigated recreational shore-angler' attitudes towards, and awareness of, line-fish management in South Africa in an effort to better understand the factors driving their poor resource use behaviours. These intervention strategies highlight that a practical and holistic understanding of contextual (social and behavioural) factors is essential to produce meaningful changes in behaviour.

Humans are social creatures, and much human behaviour is shaped by how they believe they are perceived by others (*"conformity"* – Asch 1955; Social Impact Theory – Latané 1981; Latané & Nida 1980; Jackson 1987). As a result, what they construe to be socially-desirable can be influenced by others in their community (e.g. social norms – Deutch & Gerard 1955), those they find inspiring (e.g. inspirational leadership – Steinman et al. 2018), those they hold in high regard (e.g. role-models – Bandura 1977) or simply those they deem as having desirable traits (e.g. celebrities – McGraken 1989; Brace-Govan 2013). Individuals may go to great lengths to adjust their behaviours to ensure they are socially desirable, and therefore those "others" may significantly influence their behaviour. The power of social influence is commonly used in commercial marketing, whereby socially desirable individuals are portrayed in a manner intended to sway consumer behaviours for profit (e.g. brand endorsements by celebrity athletes). Similarly, highly regarded individuals (e.g. celebrities or community leaders) are often used for environmental messaging in social marketing to the public (e.g. celebrity narration in activist documentary "Kiss the Ground"; Tickel & Tickel 2020). Social influence has tremendous impact on human behaviour, and structured behavioural interventions to encourage resource conservation which incorporate some form of social influence approach are shown to be more effective (Steg & Vlek 2009). This highlights the power of social learning, social comparison and social norms in shaping what people deem to be socially desirable, and therefore have utility in pro-environmental interventions.

The understanding that angling-guides are highly regarded members of the recreational angling community suggests that they may be socially influential. This has potential utility in interventions focussed on angler-behaviour, because angling-guides and their clients are

already in a teaching relationship, which suggests that anglers may be receptive to their influence. Given that angling-guides may interact with many different clients from around the world in a given season, their influence on angler-behaviour may have far-reaching consequences when those clients return home. Additionally, those clients may continue to share that information and set the example within their social circles, and as such small efforts to exploit the influence of a single angling-guide may have exponentially greater social diffusion in the recreational angling community. It is perhaps axiomatic to suggest that angling-guides might be able to change how anglers practice the sport, given that they often teach angling techniques. However, their status in the community suggests that they might be able to do more than simply show anglers how, but also influence their attitudes and values by shaping what they deem to be socially desirable. To date, most efforts to improve angler-behaviour have relied on the knowledge-attitude-behaviour strategy by simply disseminating information about C&R best-practices to the recreational angling community (Mannheim et al. 2018). Based on the pre-existing guide-client relationship, and their potential social-influence, angling-guides might be able to not only improve C&R practices by teaching best-practices directly, but also motivate and inspire in their clients a responsible angling-ethic which may lead to pro-environmental behaviour that extends beyond simple C&R practices.

While angling-guides are potentially powerful tools for outreach in pro-environmental behaviour interventions, their social influence may also be exacerbating the ecological issues at hand. Firstly, angling-guides with poor knowledge may be teaching their clients poor angling-practices, and could be demonstrating behaviours which have little regard for the lethal and sub-lethal effects of C&R angling. This suggests that anglers who learn from angling-guides with poor knowledge and poor practice may themselves continue to behave in the same manner. Additionally, assuming that angling-guides are able to influence anglers' attitudes and values, they may encourage the adoption or reinforcement of an irresponsible angling ethic (e.g. low regard for fish health) in their clients by setting a poor moral norm. Considering the internationality of guide-client interactions, this negative impact may be far-reaching and exponentially deleterious. Consequently, the role angling-guides play in shaping angler-behaviour deserves research attention, not only because they might be a powerful tool for incorporating a social-influence approach into pro-environmental angler-behaviour interventions, but also because they may well be perpetuating the problem.

The aim of the research presented in this thesis is to better understand the role angling-guides might play in efforts to improve recreational angler resource use behaviours. This thesis presents three contributions towards understanding how angling-guides interact with resources and other anglers in an effort to establish the basis from which to explore potential interventions. Chapter 2 aims to determine whether angling-guides are perceived as role-models by their clients, which is an essential pre-requisite to their potential utility as agents of behavioural change. Chapter 3 aims to assess the current level of knowledge, attitudes and angling-practices of angling-guides around the world, which is critical for baseline understanding of the issue at hand. Chapter 4 aims to assess the relationship between angling-guides' knowledge, attitudes, intentions and their actual behaviour on guided-angling trips, which is important to understand the contextual barriers to pro-environmental behaviour. Lastly, Chapter 5 presents a general discussion of how pro-environmental interventions might be designed and executed given the information presented in the previous chapters.

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Chapter 2

Are recreational angling-guides role-models for their clients?

"They must consider that great responsibility follows inseparably from great power." –
Unknown, 1793

Introduction

The term role-model frequents todays language, and is so positively viewed by most for its purported positive impacts, especially on the young and marginalized (Verdugo 1995), that it remains largely undisputed in the literature (Brace-Govan 2013). The term "modelling", originally by Merton (1957), was incorporated into Social Learning Theory (Bandura 1977) to explain how we learn from others by observation and emulation. Of course, this understanding has been applied to education and occupation settings, where role-models are seen as those who *"…teach by example…"* and promote *"…learning through imitation…"* (Murray & Main 2005). Early understandings of role-modelling were focussed on learning and competence, and were seen as a way to teach and demonstrate the skills and understanding necessary to fulfil that same role (e.g. educators – Lunenberg et al. 2007; Martino 2009; nurses – Cunze & Van Rensburg 2016; Jack et al. 2017). Role-models are touted as powerful tools for training in skill-centric occupations such as medicine (e.g. Wright 1996; Wright et al. 1997; Wright et al. 1998) and management (e.g. Weaver et al. 2005). However, there is growing consensus that simple, direct learning is not the only way that role-models may influence others. The impact of potential role-models is, in fact, subject to several personal, inter-personal and social factors, such as shared group membership, similarity of attributes and the role-aspirant's current level of achievement and their reasons for it (Morgenroth et al. 2015). Furthermore, role-model influence can be the result of direct interaction (i.e. teachers and mentors) or indirect interaction (i.e. celebrities and athletes; Brace-Govan 2013) with the role-model. Therefore, it appears that role-models not only influence the "how" to achieve goals, but also their "what" and "why", and therefore may have tremendous utility for changing attitudes and behaviour.

There appears to be great potential for the use of role-models to change attitudes and behaviour. In the medical field, role-modelling was suggested as a means to instil *"…professional values,*

attitudes, and behaviours in students and young doctors…" (Paice et al. 2002). Similarly, Weaver et al. (2005) proposed that ethical role-modelling by high-level members of organisations was a key opportunity to promote ethical conduct in the workplace. In business, the influence of role-modelling has been associated with increased entrepreneurial intention and motivation to own a business (Van Auken et al. 2006; Bosma et al. 2012). In education, Armour and Duncombe (2011) explored the potential utility of motivational athletic role models for a school-based intervention to improve behaviour, attendance and self-esteem in students. In industry training, role-modelling was identified as essential to the development of specific managerial traits that were otherwise troublesome to teach traditionally (Warhurst 2011). Furthermore, the understanding that role-models are vicariously impactful has led many to explore their potential utility in both commercial and social marketing (e.g. Shannahan et al. 2011). In commercial marketing, the use of role-models, such as celebrities (Seno & Lucas 2007) and athletes (Stevens et al. 2003; Peetz et al. 2004; Bennet et al. 2006) for product and brand endorsement is a popular strategy to shape consumer behaviour for profit (Brace-Govan 2013). In social marketing, a similar role-modelling approach is commonly used (Kotler et al. 2002) to change consumer behaviours (e.g. Andreason & Kotler 2003; Hastings 2003). It is therefore apparent that role-models can influence role-aspirants in a variety of ways, depending on the attributes of the role-model and the role-aspirant in context.

Given the diversity of individuals and contexts, it is perhaps axiomatic to suggest that interactions with role-models are likely to vary considerably. This is evident in the literature, which addresses role-modelling from the varying perspectives and understandings of many disciplines, including marketing, management, sociology, education, social psychology and youth research (Brace-Govan 2013). There has historically been little consensus over the exact definition of a role-model and the mechanisms by which role-models impact others (Irvine 1989). Effort has been made to clarify the confusion, such as typifying the different interactions between role-models and role-aspirants for marketing purposes (e.g. Brace-Govan 2013). In the Motivational Theory of Role Modelling (MTRM; Figure 2.1), Morgenroth et al. (2015) proposed that there are three persistent themes in how the literature defines role-models, which account for the three mechanisms by which they can impact role-aspirant's motivations, goals and behaviour. In most scenarios where role-modelling may take place, the potential for influence is taken for granted (Warhurst et al. 2011), and is often seen by policy makers as a

Potential sources of improvement in recreational angler behaviour

ROLE ASPIRANT ATTRIBUTES
(i.e. angling-client attributes: competence, knowledge, pre-existing goals, values, ethics, etc.)

ROLE-MODEL ATTRIBUTES
(i.e. angling-guide attributes: competence, knowledge, attitudes, values, ethics, attitudes towards environmental responsibility, etc.)

Focus of a potential angling-guide level intervention for behaviour change

GOAL EMBODIMENT
(angling-guides being perceived as suitable behavioural models for angling success or other angling-related goals)

ATTAINABILITY
(angling-guides being perceived as representations of the possible successes an angler may achieve)

DESIRABILITY
(angling-guides being perceived as desirable, admirable and inspiring)

Vicarious learning

Changing self-stereotyping

Changing perceived barriers

Admiration

Identification and internalization

EXPECTANCY
(i.e. the angling-client's perceived likelihood that the desirable outcome is achieved through the particular behaviour or action)

VALUE
(i.e. how much value the angling-client places on the desirable outcome)

SKILL ACQUISITION
(i.e. angling catch-and-release practices, both best and worst, correct or incorrect)

MOTIVATION
(i.e. impetus or "energy" to pursue new behaviours and goals, both pro-environmental and/or not)

GOAL ADOPTION
(i.e. the adoption of new angling related goals and behaviours, with associated best and worst practices and environmental consequences)

GOAL REINFORCEMENT
(i.e. the reinforcement of pre-existing goals and behaviours, both pro-environmental and/or not)

Perceptions of the role-model
(i.e. how angling-guides are potentially perceived as role-models by their role-aspirant angling-clients

Role-modelling process
(i.e. the processes by which angling-client's perceptions of the angling-guide bring about psychological change)

Perceptions of goal and goal related behaviours
(i.e. how angling-guides change the angling-clients perceived expectancy and value of angling related goals and behaviours)

Role-modelling outcomes
(i.e. potential psychological outcomes of the role-modelling process for the angling-client)

Figure 2.1: An illustration of the Motivational Theory of Role-Modelling (MTRM) proposed by Morgenroth et al. (2015) adapted from the same publication (Morgenroth et al. 2015) to include contextual insight for the potential role-modelling relationship between angling-guides and their angling-clients.

"silver bullet" for social and behavioural issues (Brace-Govan 2013, Morgenroth et al. 2015). The MTRM perhaps provides the most complete synthesis of role-model function by which to critically assess if role-modelling will take place in a given context, and if so, by what mechanisms. This understanding is essential before the potential for role-model utility can be explored and most efficiently exploited.

The three mechanisms by which role-models influence role-aspirants in the Motivational Theory of Role Modelling (Figure 2.1) (Morgenroth et al. 2015) are: firstly, they function as *Behavioural models*, demonstrating the skills and competence required to achieve a pre-conceived goal through "goal embodiment"; secondly, they function as *Representations of the Possible*, whereby they encourage the adoption of new goals by increasing their "attainability", and lastly, they function as *Inspiration*, whereby they supply the motivation required to pursue those goals by increasing their "desirability". These three drivers make varying contributions to overall role-model influence, and in some cases may not contribute at all (Morgenroth et al. 2015). Together, these three mechanisms, or role-model functions, drive the "expectancy" and "value" (expectancy-value theory – Vroom 1964; Eccles & Wigfield 2002) of goal related behaviours to produce the four role-modelling outcomes, which are "skill acquisition", "motivation", "goal reinforcement" and "goal adoption" (Morgenroth et al. 2015). Given the goal-orientation of recreational angling (even if only partly), and the growing research interest in angler-behaviour (e.g. Cooke et al. 2013; Fenichel et al. 2013; Ferter et al. 2013; Brownscombe et al. 2017) and motivations (e.g. Arlinghaus 2006; Hunt et al. 2013; Birdsong et al. 2021), it appears the MTRM provides a suitable framework to explore the potential for role-modelling during guided-angling trips.

Angling-guides are highly regarded members of the recreational angling community and have considerable influence as opinion leaders in this space (Smith 2011). Given that the guided-angling industry is predicated on the stereotype that angling-guides are skilled and competent anglers, it is likely that they are inherently perceived as rudimentary *Behavioural Models*. The angler would likely have some pre-conceived goal of angling success, and would make use of an angling-guide to assist in the achievement of that goal. Given that the journey towards angling success typically has a considerable skill-centric learning curve, the desire to learn is likely a fundamental pre-cursor to actually going on a guided-angling trip. However, this potential for role-model influence cannot be assumed, and it remains unclear in which other ways an angling-guide might affect an angler's motivations, goal adoption and goal

reinforcement. Understanding how angling-clients are influenced by their angling-guides will also help shape effective interventions, depending on the nuances of the behaviours of interest. The potential utility of angling-guide influence has implications for broader social-intervention, given that angler-behaviour is at the core of many problems facing recreational fisheries resources (Brownscombe et al. 2017). As such, the aim of this study is to determine whether angling-clients who have been on guided-angling trips perceive their angling-guides as role-models. To achieve this, we measured the attitudes of angling-clients in response to questions portraying angling-guides serving the role-model functions proposed by Morgenroth et al. (2015) in the Motivational Theory of Role Modelling.

Methods and Materials

Data collection

Data were collected with an online survey using Google Forms®, distributed directly to anglers by email and using the social media platform Facebook® (Rhodes University Ethics Clearance Registration Number REC-241114-045). For this study, the target population was any English literate angler (18 years or older) from any country who had previously been on at least one guided-angling trip. Assuming a global population of 7.8 billion (UNPD), of which 70.7% are over 18 years old (Central Intelligence Agency), 4.8% speak English (Central Intelligence Agency) and 10.6% participate in recreational angling (Arlinghaus et al. 2015), we can approximate that there are 28 058 285 English speaking recreational anglers in the world. Of those, it is difficult to ascertain what proportion have been on guided-angling trips, but adopting a likely over-estimate of 33% based on saltwater anglers in Texas (Tzeng et al. 2006; Lietz & Grubbs 2008), we assume that the survey target population was 9 352 762 English speaking recreational anglers who had been on at least one guided-angling trip. Based on these approximations, to maintain a 95% level of confidence and 5% margin of error, a minimum of 385 survey responses was required (Daniel 1999). While this power analysis is most applicable to the results of a probability-based sampling regimen, 385 responses was chosen as a minimum target.

Respondent recruitment

While identifying recreational anglers is possible, it is far more difficult to identify a sampling frame for those who have been on guided-angling trips, without access to client databases from angling-guides, booking-agents or outfitters. This information is not readily available, and as such the target population was difficult to reach because of both low-incidence and obscurity.

Given this, it was deemed too costly to employ a random sampling approach (Sweetland 1972; Marpsat & Razafindratsima 2010; Shaghaghi et al. 2011). As such, non-probability sampling methods were chosen, given their low cost, low demand for human resources, simplicity and suitability for recruiting participants from obscure communities (Faugier & Sargeant 1997; Browne 2005; Vehovar et al. 2016). Initially, samples were collected by non-random snowball sampling (Vogt 1999), but trouble was experienced with initiating the chain referral methodology, given that many respondents were hesitant to supply the contact information of their peers to researchers. Additionally, the chain of custody of referrals was broken when some respondents shared the survey with others unknown to the research team. Thereafter, sampling adopted a non-random purposive approach (Vehovar et al. 2016), whereby potentially eligible respondents were petitioned for their participation (directly and on Facebook® groups) and after participation, were encouraged to share the survey with others in their social circles, rather than asking them to divulge the contact information for those individuals. Thereafter, subsequent responses were assessed for eligibility based on the compulsory screening criteria (i.e. must be 18-years or older, must have been one or more guided-angling trips). Additionally, volunteer (self-selection) sampling was conducted by banner-recruitment using appeals for participation made on 77 popular angling-centric Facebook groups identified by researchers (see Appendix 2.1), with a follow-up appeal made on the same groups two weeks after first contact. As a result, sampling incorporates elements of snowball sampling (Vogt 1999), purposive (judgmental) and volunteer sampling (Vehovar et al. 2016), and a degree of scrounging (Groger et al. 1999) to reach as much of the target population as possible. It is, therefore, impossible to distinguish by what means each respondent first came to know about the survey, and therefore survey response rates are impossible to calculate. This approach favours broad, diverse representation for qualitative, exploratory purposes at the expense of the generalizability of results for quantitative inferences.

Survey questionnaire

As survey response fatigue and non-response bias was a concern (Steeh 1981; de Heer 1999; Porter et al. 2004), the questionnaire was kept as short as possible. Respondents were given a brief summary of the research project, and its importance to provide impetus for participation (see Appendix 2.2). Respondents were then informed of the research intention (to increase transparency) and assured of their anonymity to increase honesty and to alleviate concerns regarding the misuse of personal information (see Appendix 2.2). All questions were voluntary, apart from the question pertaining to number of guided-angling trips, which was essential to

screen respondents who had not been on any guided-angling trips, and therefore did not qualify. Demographic information included age, gender, level of education, country of residence, guided-angling trip destinations and how many guided-angling trips they had been on (nominal data). Thereafter, respondents were presented a nine-question survey scale designed to assess their attitudes towards angling-guides serving role-model functions (interval data) (see below).

Survey scale design

The composite role-model perception scale was based on the assumption that role-models are:

"...individuals who influence role aspirants' achievements, motivation, and goals by acting as behavioural models, representations of the possible, and/or inspirations." (Morgenroth et al. 2015).

Three questions were developed for each of the three role-modelling functions proposed in this definition. Questions related to the attitudes a role-aspirant angler would have towards a role-model angling-guide with respect to each of the functions proposed in the MTRM (Figure 2.1; Morgenroth et al. 2015):

1. Angling-guides function as <u>*Behavioural Models*</u>

   ⇒ <u>*...angling-guides have the competence, knowledge, skills, behaviours and know-how essential for success, and are worth emulating and learning from.*</u>

   a) *Angling-guides are more skilled and competent anglers than the average recreational angler.*

   b) *Angling-guides have the necessary angling skills and local knowledge to help you have a successful guided-angling trip.*

   c) *Emulating/copying an angling-guide's techniques and tactics on a guided trip will make you a more successful angler.*

2. Angling-guides function as <u>*Representations of the possible*</u>

   ⇒ <u>*...angling-guides show me that success is possible, and are good examples of the kind of success I can have if I know how to achieve it.*</u>

   a) *My angling-guide(s) have showed me new tactics and techniques which could make me a better angler.*

> b) *My angling-guide(s) shared information with me that has changed the way I think about fish and fishing in some way.*
>
> c) *Seeing the angling success that my guide has had (e.g. photos of fish caught or previous reports) shows me that I can also have that kind of success.*

3. Angling-guides function as <u>*Inspiration*</u>

> ⇒ <u>*...angling-guides are admirable and inspiring, and motivate me to perform the kind of behaviours needed to achieve my goals.*</u>
>
> a) *My angling-guide(s) motivated me to try and improve myself as an angler.*
>
> b) *I admire my angling-guide(s).*
>
> c) *I will likely use the tactics, skills, techniques and information from my guide(s) when fishing on my own.*

Given the definition and proposed role-model functions, there were several inherent assumptions in the development of this role-model perception scale. As recreational angling is driven largely by the achievement of the individual's pre-determined goals, it was assumed it fitted best into role-modelling literature associated with (but not confined to) achievement driven settings. In doing so, it was assumed that recreational anglers have individual, pre-conceived goals, and personal ideas of what constitutes success, ability and achievement based on activity-specific elements related to their style of participation (SOP) (Smith 2011) and community of practice (COP). For the purpose of this study, anglers' goals could include cognitive constructs of typical angling success with distinct end points, such as "…*to catch a tarpon*". They may also include more nuanced ideas with indistinct end points, such as positive possible selves (Markus & Nurius 1986) like "…*me as a great angler*" or perhaps even "…*me as a responsible catch-and-release angler*".

It was further assumed that anglers' responses (measured on an attitude scale; Likert 1932) to questions portraying angling-guides serving role-model functions were a suitable proxy for their attitudes (Ajzen 2005; Krosnic et al. 2005) towards angling-guides as functional role-models. Thus, anglers' attitudes towards angling-guides as role-models were measured using a five-point Likert scale (Likert 1932) comprised of five levels of agreement with corresponding numerical values, namely: strongly disagree (1), disagree (2), neither agree nor disagree (3), agree (4) and strongly agree (5). We further assumed that a higher Likert scale score as a result of a higher level of agreement was associated with a more positive attitude (Ajzen 2005; Krosnick et al. 2005), which was associated with increased likelihood (Ajzen &

Fishbein 2005) of perceiving an angling-guide as a role-model. We finally assumed that only responses demonstrating agreement (Likert scale: (4) agree and (5) strongly agree) with each question could be considered indicative of a positive attitude held by a role-aspirant angler, with indifference (Likert scale: (3) neither agree nor disagree) and disagreement (Likert scale: (1) strongly disagree and (2) disagree) being treated equally as attitudes held by an angler who was unlikely to perceive an angling-guide as role-model, and therefore unlikely to be receptive to their role-model influence.

Data Analysis

All analyses were performed using various packages in R (version 4.0.2 – R Core Team 2020). The Likert scale score for a particular question was calculated by converting the Likert agreeability scale to corresponding numerical values (1-5). Similarly, the composite Likert scale score for each respondent was calculated by summing the Likert scale scores for each question in the composite test, and this composite role-model scale score was treated as a continuous variable for all analyses (Sullivan & Artino 2013). The association between the composite role-model scale score and each of the demographic variables (gender, age, education, trip regularity) was assessed. To assess the relationship between age and the composite role-model scale score, a Kendall Rank Correlation (τ_b) was used as the age variable was ordinal (Khamis 2008). Similarly, to assess the relationship between education and the composite role-model scale score, a Kendall Rank Correlation (τ_b) was used as the education variable was ordinal (Khamis 2008). The correlation effect sizes were interpreted using the levels proposed by Cohen (1988). To determine whether the mean composite role-model scale score differed between those who regularly went on guided-angling trips ($\geq$ 5 trips) and those who did not ($4 \geq$ trips), an unpaired, two sample t-test was performed using the "t.test" function in the "stats" package (R Core Team 2020). Cohen's *d* was calculated using the "cohen.d" function in the "effsize" package (version 0.8.1 - Torchiano 2020). The relationship between gender and composite role-model scale score was not assessed due to the extreme difference in sample sizes.

For assessments of the reliability and internal consistency of the composite role-model perception scale, Cronbach's Alpha (Cronbach 1951) and McDonald's Omega (McDonald 1999) were calculated using the "alpha" and "omega" functions from the "psych" package (version 2.0.8 – Revelle 2020). Exploratory and parallel (Horn 1967) factor analysis was conducted using the "nfactors" and "fa.parrallel" functions respectively. The number of factors

to be retained was determined using both the "scree-plot" (Field 2000) and the "total variance explained" methods (Kootstra 2004). Factor extraction was performed using the "fa" function set for two factors, using minimum residuals and an oblimin rotation. Factor scores were calculated for each respondent using the weighted-sum scores approach (DiStefano et al. 2009). To classify respondents into groups based on weighted-sum factor scores, a hierarchical agglomerative cluster analysis was performed using the "hclust" function in the "cluster" package (version 2.1.1 – Maechler et al. 2021) on a dissimilarity matrix of Euclidean distances using Ward's minimum variance method for clustering similarities.

Results

In total, 492 complete responses were obtained from 29 countries, including: South Africa (38%), United States of America (25.4%), United Kingdom (12.4%), Australia (4.7%) and Canada (2.7%) (Figure 2.2). Most respondents were tertiary-educated (79.5%) and male (97.4%). Just over half of respondents were from a developed country (57.5%; UNSD M49 Standard), most had been on five or more guided-angling trips (59.4%), and most had travelled internationally to do so (65.2%) (Table 2.1). While only 13.1% of respondents had been on guided-angling trips both internationally and in their own countries, most respondents had only ever fished with an angling-guide while abroad (52.1%) (Table 2.1). Respondents listed 99 geographically distinct guided-angling trip destination countries, with most angling trips taking place in: United States of America (14.1%), South Africa (13.1%) and Mexico (5.1%) (Figure 2.2).

Responses to each of the nine questions of the role-model perception scale were similar, with the majority of responses to each question being either "Agree" or "Strongly Agree" (Table 2.2). The scale showed high internal-consistency, highlighted by the similar distribution of responses and similar modal and mean Likert scale scores across the nine questions in the role-model perception scale (Table 2.2). This strong intercorrelation yielded high reliability coefficient scores, with Cronbach's alpha = 0.92 and McDonald's Omega = 0.94, which suggested "excellent" internal consistency and reliability (Cronbach 1951; McDonald 1999).
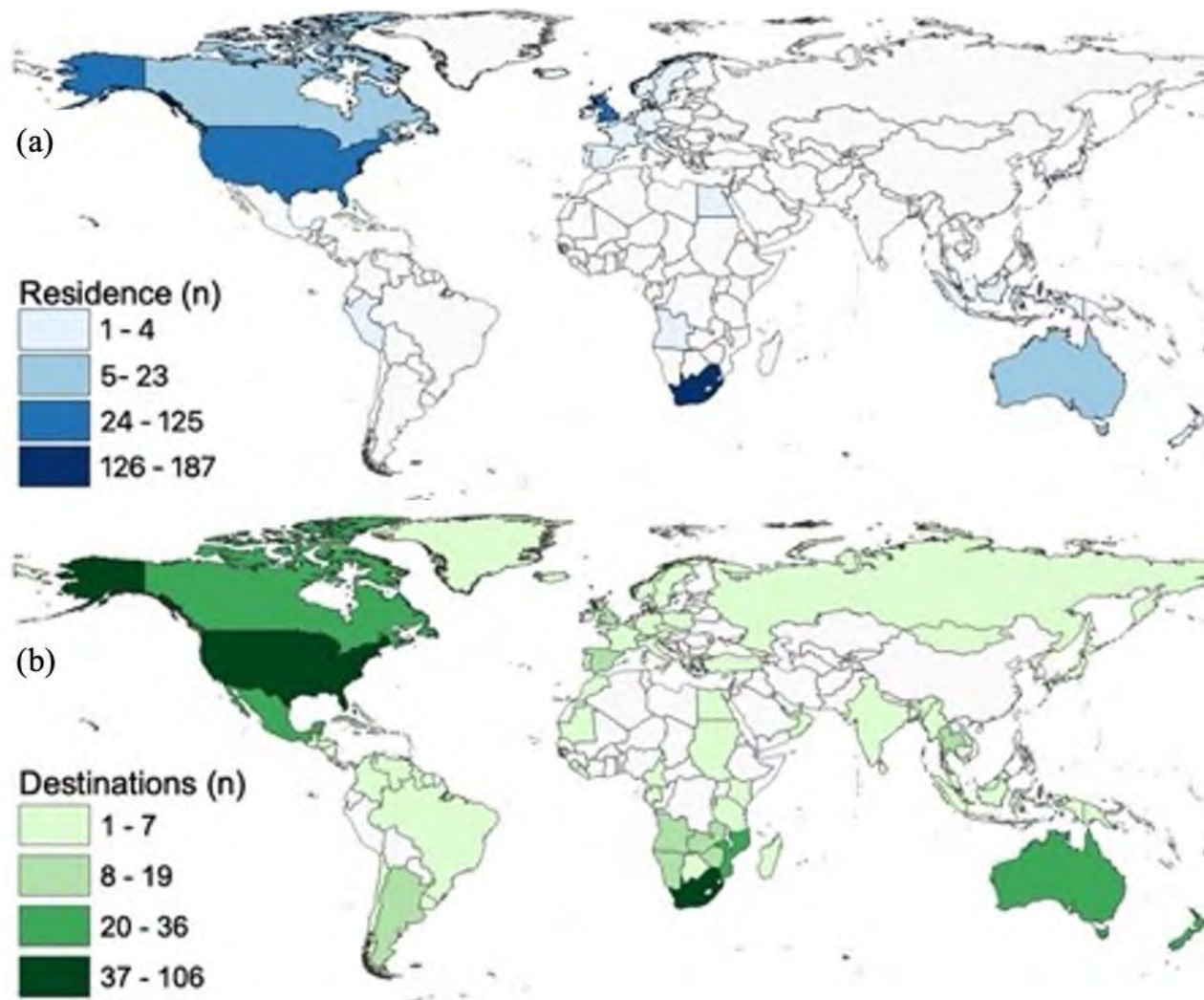
Figure 2.2: Map showing the frequency distribution (n) of angling-client responses to the survey about how anglers perceived their angling-guides from previous guided-angling trips, classified by the respondent's country of residence (a; blue) and destinations of previous guided-angling trips (b; green).

Table 2.1: Proportion of recreational anglers (n & %) who responded to the survey about how they perceived their angling-guides from previous guided-angling trips, summarised by demographic and categorical variables.

Variable	Category	n	%
Gender (n = 492)	Female	12	2.4
	Male	479	97.4
	Prefer not to say	1	0.2
Residential Country Developmental status (n = 447)	Developed	257	57.5
	Developing	189	42.3
	Least developed	1	0.2
Trip regularity (n = 492)	Occasional (1-4 trips)	200	40.7
	Regular (5+ trips)	292	59.3
Trip destinations (n = 305)	Local	146	47.9
	International	199	65.2
	Local & international	40	13.1
	Local only	107	35.1
	International only	159	52.1
Education (n = 492)	High School	99	20.1
	Certificate or Diploma	132	26.8
	Associates / Bachelor's degree	176	35.8
	Master's degree	64	13.0
	Doctoral degree	19	3.9
Age (n = 492)	18-24 yrs.	47	9.6
	25-29 yrs.	38	7.7
	30-34 yrs.	71	14.4
	35-39 yrs.	61	12.4
	40-44 yrs.	43	8.7
	45-49 yrs.	53	10.8
	50-54 yrs.	40	8.1
	55-59 yrs.	52	10.6
	60-64 yrs.	44	8.9
	65+ yrs.	43	8.7

Respondents who had regularly been on guided-angling trips (≥ 5 trips) had significantly higher composite role-model scale scores (mean = 4.15; $p < 0.00$; t = -4.01) than those who only occasionally ($4 \geq$ trips) went on guided-angling trips (mean = 3.93), although the effect was small (Cohen's d = 0.21). While there was no apparent relationship between composite role-model scale score and level of education, it did appear to have a significant negative correlation with age ($p = 0.01$; z = -2.5), suggesting that higher age was associated with lower levels of agreement with scale questions, although the size of the effect (Kendall's τ_b = -0.08) was very small (Cohen 1988).

Table 2.2: Frequency distribution of anglers' Likert scale responses (SD *Strongly disagree*; D, *Disagree*; NAND, *Neither agree nor disagree*; A, *Agree*; SA, *Strongly agree*), Likert Scale scores (1 − 5) and attitudes (*Negative*, *Indifferent*, *Positive*) to the nine questions of the composite role-model perception scale distributed in the survey. The nine questions were divided into three sets of three questions, with each set focussed on one of the role-modelling mechanisms proposed by Morgenroth et al. (2015), namely: *Behavioural Models* (*BehMod1, 2, 3*); *Representation of the Possible* (*ReprPoss 1, 2, 3*) and *Inspiration* (*Inspir 1, 2, 3*).

N = 492		Likert scale response frequency (%)					Likert scale score (1-5)		Attitude response frequency (%)		
Survey item	Survey instrument questions	SD (1)	D (2)	NAND (3)	A (4)	SA (5)	Mode	Mean	Neg.	Ind.	Pos.
BehMod2	*Angling guides have the necessary angling skills and local knowledge to help you have a successful guided angling trip.*	0.4	1.0	4.9	**49.8**	**43.3**	4	4.36	1.4	4.9	**93.1**
Inspir3	*How likely are you to use the tactics, skills, techniques and information your guide has given you when fishing on your own?*	1.0	2.2	5.9	**45.1**	**45.1**	5	4.32	3.3	5.9	**90.2**
ReprPoss1	*My angling guide(s) have showed me new tactics and techniques which could make me a better angler.*	0.4	4.1	8.5	**51.8**	**34.6**	4	4.17	4.5	8.5	**86.4**
BehMod1	*Angling guides are more skilled and competent anglers than the average recreational angler.*	1.0	3.3	15.4	**46.1**	**33.7**	4	4.09	4.3	15.4	**79.9**
ReprPoss2	*My angling guide(s) shared information with me that has changed the way I think about fish and fishing in some way.*	0.6	5.1	15.2	**48.2**	**30.3**	4	4.04	5.7	15.2	**78.5**
BehMod3	*Emulating/copying an angling guide's techniques and tactics on a guided trip will make you a more successful angler.*	0.6	3.3	15.7	**55.9**	**24.0**	4	4.00	3.9	15.7	**79.9**
Inspir2	*I admire my angling guide(s).*	1.0	3.0	23.2	**46.7**	**25.6**	4	3.93	4.1	23.2	**72.4**
Inspir1	*My angling guide(s) motivated me to try and improve myself as an angler.*	0.2	6.3	23.6	**48.0**	**21.5**	4	3.85	6.5	23.6	**69.5**
ReprPoss3	*Seeing the angling success that my guide has had (e.g. photos of fish caught or previous reports) shows me that I can also have that kind of success.*	0.8	5.9	28.0	**47.2**	**17.5**	4	3.76	6.7	28.0	**64.6**
Composite scale		0.7	3.8	15.6	**48.8**	**30.6**	4	4.06	4.5	15.7	**79.8**

Responses towards questions portraying angling-guides as role-models were predominately positive, with 79.8% of the responses to scale questions indicating positive attitudes towards angling-guides as role-models, while only 4.5% indicated negative attitudes (Table 2.2). While responses were similarly positive for all questions, anglers responded most positively to questions from the *Behavioural Model* set, and more negatively to questions from the *Representation of the Possible* and *Inspiration* sets (Table 2.2). Exploratory factor analysis revealed that the role-model perception scale, while sufficiently reliable for measuring a single construct (alpha = 0.92, Omega = 0.94), could be improved beyond a simple composite role-model scale score through dimension reduction.

Table 2.3: Results of a parallel factor analysis of angling-client responses to the nine-question role-model perception scale showing the standardized factor loadings (< 0.2 omitted) based on a correlation matrix, the variances as explained by factors, the correlation between extracted factors, and that between factors and factor scores (n = 492). Factor 1 (IRP = *Inspirational Representation of the Possible Factor*) and Factor 2 (BHM = *Behavioural Model Factor*).

	Factor loadings (λ)	
Item	Factor 1	Factor 2
BehMod1		**0.82**
BehMod2		**0.75**
BehMod3	**0.27**	**0.47**
ReprPoss1	**0.72**	
ReprPoss2	**0.81**	
ReprPoss3	**0.52**	
Inspir1	**0.77**	
Inspir2	**0.76**	
Inspir3	**0.49**	**0.34**
Eigenvalue	3.1	1.76
Variance		
Proportion Variance	0.34	0.2
Cumulative Variance	0.34	0.54
Proportion Explained	0.64	0.36
Cumulative proportion	0.64	1
Correlation I		
Factor 1	1	0.66
Factor 2	0.66	1
Regression scores	0.94	0.91

Factor analysis revealed two latent variables (i.e. Factor 1 and Factor 2) in the nine-question role-model perception scale (Table 2.3), and extracting two factors showed a considerable improvement in model fit (RMSEA = 0.062) and factoring reliability (Tucker-Lewis = 0.94). Factor 1 explained most of the variation (proportion = 0.64; λ = 3.1), loading primarily on the six questions from the *Representation of the possible* and *Inspiration* sets. Factor 2 explained the remaining variation in responses (proportion = 0.36; λ = 1.76), loading primarily on the three questions from the *Behavioural model* set. As such, Factor 1 was dubbed the *Inspirational Representation of the Possible* (IRP) factor, and Factor 2 the *Behavioural Model* (BHM) factor (Table 2.3). There was some overlap in loadings (Mean item complexity = 1.2), with the IRP factor also loading somewhat on question *BehMod3* (λ = 0.27) from the *Behavioural model* set, and the BHM factor also loading somewhat on question *Inspr3* (λ = 0.34) from the *Inspiration* set (Table 2.3). The two factors were positively correlated (r = 0.66; Table 2.3), and each correlated positively with their respective weighted-factor scores (IRP factor: r = 0.94; BHM factor: r = 0.91; Table 2.3).
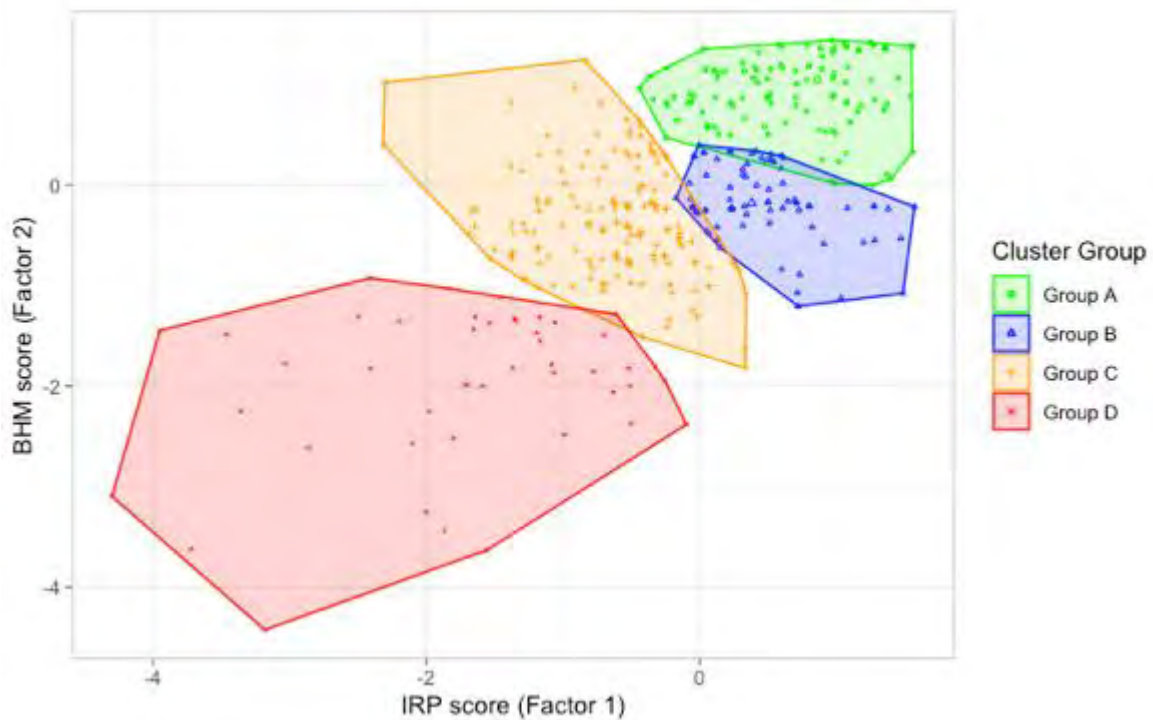
Figure 2.3: Scatter-plot of angling-client responses to the role-model perception scale, reduced to two weighted factor scores (standardized scale), showing four cluster groupings assigned at a height of 10 using Ward's general agglomerative hierarchical clustering procedure (n = 492). (IRP = Inspirational Representation of the Possible Factor; BHM = Behavioural Model Factor).

Hierarchical cluster analysis of the two weighted-factor scores revealed four clusters, namely Group A, B, C and D (Figure 2.3). Group A, defined by a centroid with high scores in both factors, is characterised by respondents who primarily indicated strong agreement with questions found in each factor, and included all the respondents who had only positive responses ("agree" or "strongly agree") to all questions in the role-model perception scale (Figure 2.3). Group B, defined by a centroid with a moderately high score in each factor, is characterised by respondents who principally indicated agreement with questions found in each factor, but at a lower level than those in Group A (Figure 2.3). Group C, defined by a centroid with a moderately high score in Factor 2 similar to Group B (Figure 2.3), but lower Factor 1 score than Group B, is characterised by respondents who predominately indicated agreement with questions from the *Behavioural model* set, but indifference or even disagreement with questions from the *Representation of the possible* and *Inspiration* sets (Figure 2.3). Lastly, Group D, defined by a centroid with the lowest scores for each factor, comprised respondents who mainly indicated indifference or disagreement with most questions from all sets (Figure 2.3), and included the three respondents who showed no positive responses ("agree" or "strongly agree") towards any of the nine questions in the composite role-model perception scale. These three respondents had all only been on one guided-angling trip. Of the four cluster groups (Figure 2.4), Group C (dubbed *moderately aspirant of behavioural roles*) contained most of the 492 respondents (36.2%), followed closely by Group A (dubbed *strongly role-aspirant*; 33.7%). Group B (dubbed *moderately role-aspirant*), which was most similar to Group C, contained 21.1% of those surveyed. Group D (dubbed *non-aspirant*) was the smallest (8.9%), and most dissimilar to Group A (Figure 2.4).
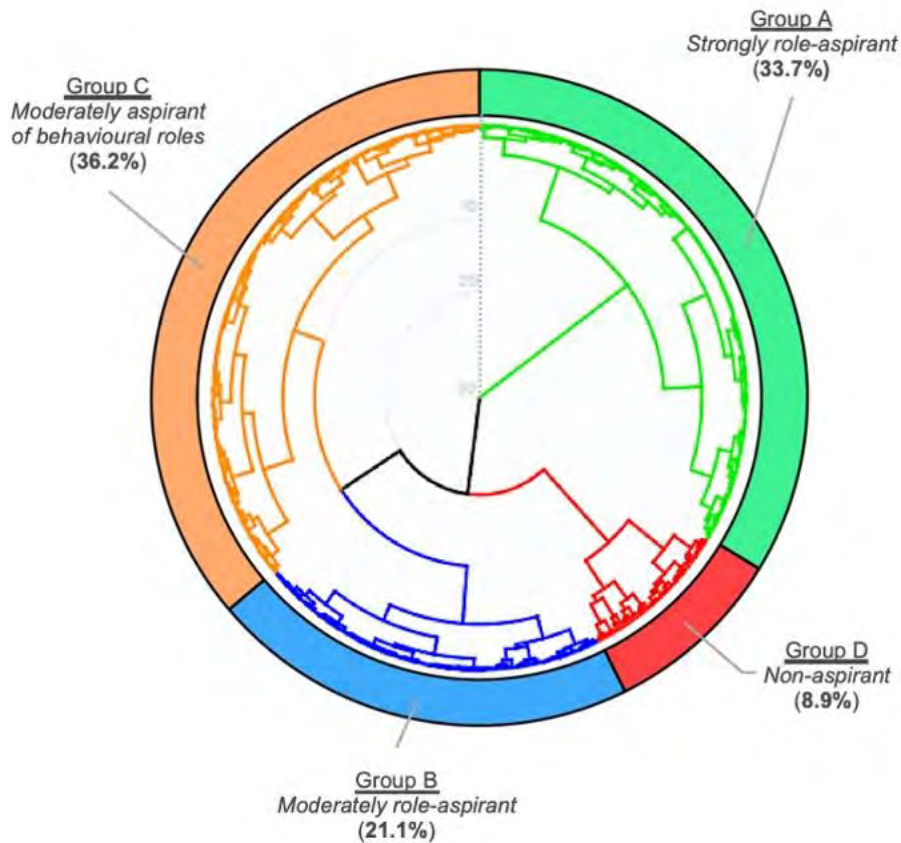
Figure 2.4: Circular dendrogram showing the hierarchical clustering of role-model perception survey respondents into four groups (using Wards D) based on two weighted factors (Factor 1 – *Inspirational Representation of the Possible*; Factor 2 – *Behavioural Model*), superimposed onto a doughnut chart showing relative proportion (%) of respondents assigned to each cluster (n = 492).

Discussion

Although angling-guides are considered to be highly-esteemed members of the recreational angling community (Smith 2011), little is known of how they are perceived by their clients and whether they have sufficient influence to change angler behaviour. The findings of this chapter provide considerable evidence to suggest that the anglers surveyed have largely positive perceptions of angling-guides (Table 2.2), but that those perceptions varied somewhat depending on which role-model function was in question. Some respondents had positive perceptions of angling-guides as *Behavioural models*, but not as *Inspiration* or *Representations of the possible* (Figure 2.4). Despite this, it appeared that majority of anglers (91.1%) were likely to positively perceive angling-guides as role-models in some fashion (Figure 2.4).

In contrast to the original (Merton 1957), early (Kemper 1968; Bandura 1977) and other simplistic (Ibarra & Petriglieri 2008) definitions of role-modelling, the contemporary MTRM

incorporates motivational theories to propose that role-models affect role-aspirants achievements, motivations and goals by three functions: as Behavioural models, Representations of the possible and Inspiration (Morgenroth et al. 2015). One of the key presuppositions of the MTRM framework is that these functions are inter-dependent, have overlapping outcomes and can operate in conjunction with other functions or independently, given that they depend on the context and attributes of both the role-model and role-aspirant. For example, an individual could be inspired by the successful business tycoon and philanthropist Warren Buffet to adopt new entrepreneurial goals (e.g. start a business), but never have the opportunity to learn any of the business acumen required to achieve this goal from him. In contrast, the guided-angling industry only exists based somewhat on the descriptive stereotype that angling-guides are *Behavioural Models*, in that they are believed to be competent, knowledgeable and skilled enough to be worth emulating. Given the simple fact that the angler has paid for angling guidance highlights their intent to learn, and suggests they must have faith that the angling-guide is competent. It is perhaps self-evident that the angler must positively perceive angling-guides as *Behavioural Models*. It would therefore be unusual in the angling space for anglers who have chosen to go on a guided-angling trip to have a negative perception of angling-guides as *Behavioural Models*.

Given that it can be argued that angling-guides are inherently *Behavioural Models*, it seems incongruous that some anglers would have paid for guidance but disagree with the notion that guides are competent, skilled and worth emulating (Table 2; Figure 2.3 & 2.4). Granted there are likely instances where anglers make use of angling-guides, not for their skill or knowledge, but to overcome some other impediment to their preconceived goal, such as access to a fishing-boat, or to gain entry to a restricted angling concession. In these scenarios, the competence of an angling-guide may be irrelevant. While this may explain why a small proportion of respondents had negative attitudes towards angling-guides serving their most rudimentary function, it is more likely that previous dissatisfaction with angling-guide competence on previous trips, or some other interpersonal factor has altered the angler's attitude towards angling-guides as *Behavioural Models* over time. The vast majority of respondents had positive perceptions of angling-guides as *Behavioural Models*, which suggests that, according to the traditional definitions (Merton 1957; Kemper 1968; Bandura 1977), role-modelling is likely taking place on guided-angling trips.

The perception of a role-model as the embodiment of a pre-conceived goal underpins the social learning mechanism of skill acquisition and pre-conceived goal achievement associated with the traditional idea of role-modelling which was incorporated into the *Behavioural Model* function in the MTRM (Morgenroth et al. 2015). This function only depends on the role-model being perceived as having success and competence in the given space. In contrast, the *Representation of the possible* and *Inspiration* functions are predicated on more nuanced mechanisms from motivational theory, and are associated with the uncovering and adoption of new goals (attainability), and the motivation to pursue both new and pre-conceived goals and goal-related behaviours (desirability). Unlike the *Behavioural Model* function, these two functions depend on a host of role-aspirant, role-model and shared attributes. This suggests that an angler's attitude towards their angling-guide as an *Inspirational Representation of the possible* depends on their own level of success, self-esteem (Wohlford et al. 2004), theory of ability (i.e. self-efficacy; Bandura 1997) and values (Gauntlet 2002). Furthermore, the anglers' attitudes may also be affected by their perceptions of an angling-guide's non-goal related competence (e.g. intellect; Vallerand & Reid 1984; Brambilla et al. 2012), sociability (Calvert et al. 2001; Sweetman et al. 2013) and ethics (Brambilla et al. 2011, Brambilla et al. 2012). Additionally, shared group membership (e.g. gender, ethnicity, community of practice) may also play a role in how potential role-models are perceived (Turner et al. 1994). Therefore, unlike the perception of angling-guides as *Behavioural Models,* the perceptions of angling-guides as *Inspirational Representations of the possible* is far more likely to vary across the recreational angling community given the diversity of interpersonal relationships (Table 2.3; Figure 2.3).

The manner and extent to which an angler perceives their angling-guide as a role-model varied considerably between individual anglers (Table 2.2, Figure 2.4). Notwithstanding the group containing the few individuals (8.9%) who were clearly non-aspirant (Figure 2.3; Figure 2.4), this work identified three different perceptions of angling-guides as role-models commonly held by anglers who positively perceived angling-guides serving one or more role-model functions. The group with the most commonly held perception (36.2%) comprised anglers who likely see angling-guides as competent, skilled and worth emulating, but are not inspired by them to adopt new goals. Anglers in this group were deemed to be "*Moderately aspirational of behavioural roles*" (Figure 2.3 & 2.4; Group C – 36.2%). Most similar to this group, the anglers who were rated "*Moderate role-aspirants*" (Figure 2.3 & 2.4; Group B – 21.1%) likely see angling-guides as competent and skilled, but also inspiring enough to perhaps motivate

them to adopt new goals. Lastly, the group regarded as "*Strong role-aspirants*" (Figure 2.3 &
2.4; Group A – 33.7%) contained anglers who strongly agreed that angling-guides were
competent, skilled, worth emulating, admirable and inspiring enough to encourage them to
adopt and pursue new goals. This suggests that even amongst anglers with positive perceptions
of angling-guides as role-models, the extent and nature of the role-model's influence may vary
depending on the personal attributes of both the angling-guide and the angling-client.

Given the diverse nature of the individuals, interpersonal relationships, cultures and fisheries
associated with the guided-angling industry (Table 2.1), it is troublesome to efficiently address
the simple question: Are angling-guides role models? There is considerable evidence presented
herein which shows that a majority of anglers have positive perceptions of angling-guides
serving one or more role-model functions, which in turn suggests that they are susceptible to
the role-model influence of angling-guides, even if only at the most rudimentary *behavioural
model* level. While angling-guides could interact with and perhaps influence hundreds of
clients from around the world every year (Figure 2.2), it is likely that their role-model influence
may extend beyond typical guide-client interactions given their social standing as opinion
leaders in the recreational angling community (Smith 2011). For example, several prominent
angling-guides in South Africa are active on social medias such as Instagram® and YouTube®,
and their knowledge, attitudes and behaviours presented in these mediums will be accessible
well beyond their client base, and could prompt vicarious learning by recreational anglers who
have never been on guided-angling trips. This potential for far-reaching influence highlights
the responsibility that angling-guides have to set positive examples in their communities to
promote pro-environmental attitudes and behaviours, given that they can have considerable
positive impact.

This work has implications for modern recreational fisheries management, but is certainly
exploratory in nature, and not without its shortcomings. Firstly, the Motivational Theory of
Role Modelling (Morgenroth et al. 2015), which underpins much of the understanding of the
role-modelling process in this study, is not empirically tested. While it provides the most
comprehensive and contemporary understanding of what constitutes a role-model, by their own
admission, the MTRM is only a theoretical framework. Therefore the role-model perception
scale (Table 2.2) developed in this study is only an approximation of their proposition, and
while results suggest that it is internally consistent and reliable, its actual validity in predicting
the true receptiveness of the respondents to role-model influence was not explored.

Furthermore, the MTRM is predicated on literature focussed on achievement settings, and does not account for other settings, such as the adoption of altruistic behaviours. This study assumed that recreational angling could fit into this achievement space, even if only partly, however there are certainly aspects of recreational angling which may not be expressly based on typical ideas of achievement, and therefore may be overlooked by the role-model perception scale. Pro-environmental angling-guides are contributing to the common good by seeking to minimize their impact on the environment, especially considering that fish populations are a shared resource. Therefore, motivation to behave altruistically may also be a consequence of role-modelling which is not expressly considered by the MTRM. Furthermore, this study can only account for the attitudes of anglers who have in-fact been on at least one guided-angling trip, and cannot make any assumptions about the majority of the recreational angling community, who likely have not.

Additionally, there are inherent non-sampling biases associated with the online sampling methodology given that the appeal to participate in the survey was most likely seen by those with internet access and those who frequented social media platforms. Furthermore, snowball sampling is subject to sampling bias, whereby the increased likelihood of sampling within a given social group likely increased similarity between respondents, and ignores isolates who may have different attitudes. Furthermore, the fact that the survey was only distributed in English ignores the majority of recreational anglers who do not speak English. This creates a strong bias towards western nations, and as such this data is primarily representative of the USA and South Africa. Lastly, the overwhelming positive responses may suggest that responses were subject to bias through mindlessness, and future efforts must ensure that instruments have mechanisms to detect and exclude this. We must therefore reiterate that the results are to be interpreted within the bounds of these potential biases and the assumptions made by this study, but that they provide a good representation of how angling-guides are perceived in the English speaking world.

Angling-guides may be a powerful tool for the promotion of the pro-environmental behaviours required to reduce the impact of recreational angling on global fish populations. In the same vein however, those with poor ethic, knowledge and behaviours may already be promoting and perpetuating the adoption of irresponsible angling behaviours, highlighting the critical need for both pro-active and remedial intervention. If targeted with an effective social-intervention (as per Steg & Vlek, 2009), angling-guides may become effective "agents of change" in the global

social movement of self-reform by promoting a responsible angling ethos. Simply making angling-guides aware of their influence and encouraging them to accept their responsibility to educate the public and promote pro-environmental behaviour may have some impact, but they may choose to not embrace this responsibility depending on their perception of the "costs" (e.g. effort) and their individual level of environmental consciousness. The first two steps towards an effective intervention are (1) identification of the behaviours which require change, and (2) examination of the main factors underlying these behaviours (Geller 2002; Steg & Vlek 2009). It is therefore critical to obtain a baseline understanding of the angling-guides behaviours in context to improve intervention design and measure its effectiveness. Therefore, it is pertinent to first explore angling-guides' current practices, their knowledge of best practices, their attitudes towards practices and their attitudes towards environmental responsibility before an intervention can be implemented.

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Appendices

Appendix 2.1: Names of the Facebook® groups (as they appear online) where recreational anglers were recruited into the study response pool by banner-recruitment.

Group name	Group name
"All Fishing Australia"	*"LBSF (Land Base Shark fishing)"*
"Amazon River Monsters (ARM)"	*"Monster Fishing Costa Rica"*
"Artlure Fishing South Africa"	*"Offshore Fishing"*
"Australian Beach/Surf Fishing"	*"Patagonia Fly fishing"*
"BAHAMAS ON FLY"	*"Pike fishing Scotland C&R"*
"Bass Fishing Fanatics"	*"Qatar Fishing Maniacs"*
"Bass Fishing South Africa"	*"Rainbow Trout Nation"*
"Boating Bahamas"	*"Reel Bent Fishing"*
"Drone Fishing Community"	*"Reel Fishing Australia Wide"*
"EC Rock & Surf Fishing"	*"River Fishing Scotland"*
"Fishing Addicts"	*"Salt Fishing South Africa"*
"Fishing America !!!!!!!!!!!"	*"Salt water fishing south africa"*
"FISHING AROUND SCOTLAND"	*"Salt Water Fishing Worldwide"*
"Fishing Australia"	*"Saltwater Fly Fishing Group"*
"Fishing Australia"	*"Scotfish"*
"Fishing Central Queensland"	*"Sea Angling Adventures"*
"Fishing Fanatics"	*"Sea Fishing Scotland"*
"Fishing GT & Big Fish around the world!"	*"Sea, Boat and Lure Fishing UK – www.ftduk.net."*
"Fishing Holidays/ Fishing Areas"	*"SeaFishingUK"*
"Fishing in Scotland"	*"SEALINE – South African Angling and Boating Community"*
"Fishing in Tasmania"	*"Shark Fishing Worldwide"*
"Fishing in Thailand"	*"Shore fishing UK"*
"Fishing Life"	*"Shore jigging"*
"Fishing Lovers"	*"Shore Jigging – Heavy Lure Fishing International"*
"Fishing Reports Victoria"	*"Small Boats Sea Fishing Uk"*
"Fishing trips, & tips"	*"Striped Bass"*
"Fishing Victoria – Freshwater & Saltwater"	*"Striped Bass & Blue fish fishing 🎣"*
"Fishing Videos"	*"SURFCASTERS INC"*
"Fishing World"	*"Team Sea Angling"*
"Fly and Spinning Anglers"	*"The Fishing"*
"Fly Fishing Group"	*"Topwater & Jigging Fishing Trips"*
"Friends who like Fishing Holidays in Thailand"	*"Trout Chaser"s"*
"Go Fish Costa Rica"	*"Trout Talk"*
"GT – A Fly Fishers Guide to Trevally"	*"Uk Catch Reports (sea)"*
"GT, Popping&Jigging"	*"Ultimate Fishing Zone"*
"Hooked On Fishing Group Page"	*"Victorian Trout & Redfin Fishing"*
"I love fishing"	*"Worldwide Trout Anglers"*
"Jigging & Popping around the Globe"	*"Yellow Talk"*
"Kayak fishing Scotland"	

Appendix 2.2: Pre-questionnaire brief and research intention summary.

This research project is being undertaken by an international research committee made up of both researchers and prominent members of the angling industry from the United States of America and South Africa. This research falls under a doctoral research project underway at the Southern African Fisheries Ecology Research Lab (SAFER Lab) at the Department of Ichthyology and Fisheries Science at Rhodes University in Grahamstown, South Africa.

This research intends to assess the role angling-guides play in the recreational angling industry world. It will also help establish a baseline to assess the feasibility of tools being developed for recreational fisheries management and conservation.

This survey takes less than 5 minutes to complete.

Your privacy is important and all data are kept completely confidential. To help protect your confidentiality, the surveys will not contain information that will personally identify you. The results of this study will be used for scholarly purposes only.

If you have any questions about the research study, please contact Matthew Farthing (matthew.farthing.rsa@gmail.com) or the Rhodes University Ethics Committee (Please contact Mr Siyanda Manqele – email: s.manqele@ru.ac.za). This research has been reviewed according to Rhodes University ethics procedures for research involving human subjects National Health Research Ethics Council (Registration Number REC-241114-045).

You may refuse to answer any question and may withdraw from the survey at any time.

Choosing the "agree" box below indicates that:

• you have read the above information

• you voluntarily agree to participate

• you are at least 18 years of age

Chapter 3

Global review of angling-guide knowledge, behaviour and attitude

"A conservationist is one who is humbly aware that with each stroke [of the axe] he is writing his signature on the face of the land." – Aldo Leopold

Introduction

Recreational angling is a popular past-time worldwide, with approximately 11.5% of the world taking part (Cooke 2004; Arlinghaus et al. 2014). Motivations for participation differ significantly between individuals (e.g. Beardmore et al. 2013). Some pursue fish for their food value (Cooke et al. 2018), while others target fish for sport, chasing various goals such as number of fish, large trophy fish, or even to pursue very specific record-breaking catches (Beardmore et al. 2011; Ardahan & Turgut 2013; Beardmore et al. 2013; French et al. 2019). Others take part for relaxation, to connect with nature or simply for the sense of place (Parkkila et al. 2010; Ardahan & Turgut 2013; Hughes 2014; Saayman et al. 2017). These motivations drive many to travel locally and internationally for angling, where many will utilize angling-guides to improve chances of success by accessing skilled instruction, local knowledge or to gain access to a boat or angling concession. Anglers of all skill levels may utilise angling-guides. Some may employ angling-guides because they require instruction and assistance with the most rudimentary of angling tasks, such as casting or tying knots. More advanced anglers may use angling-guides to gain access to their knowledge of the area and current perspective on target species behaviour. Irrespective of skill level, it appears that these anglers rely on their angling-guide's teaching, instruction, knowledge and/or equipment to improve their success. Correspondingly, angling-guides are likely to endeavour to provide as much angling success and enjoyment as possible.

Consensus that angling enjoyment depends almost wholly on fish population health has led many conscientious anglers to adopt pro-environmental C&R behaviours (Cooke & Schramm 2007; Pelletier et al. 2007). In a review of C&R best-practices, Brownscombe et al. (2017) highlighted the possible stages of a C&R event, showing the best-practice choices and tactics required at each stage. Given that the relationship between "angling-success" and

environmental integrity can be at odds, the C&R best-practice guidelines navigate a fine line between the possible, the practical and the necessary. Short of foregoing participation entirely, the choice or tactic that is least deleterious to fish health in many cases can have an immanent sacrifice for potential angling success or enjoyment, such as reduced catch rates, increased physical effort or some other perceived cost. While some choices are simple and require little sacrifice or effort (e.g. de-barbing hooks), others may demand more and are more difficult to adopt (e.g. refrain from angling during spawning season). This best-practice *sustainability vs satisfaction* conundrum is even more pronounced for angling-guides, who earn their living from recreational fisheries resources. On one hand, angling-guides want to ensure that their clients have success and enjoyment, as potential gratuities, word-of-mouth and repeat business typically depend on client satisfaction. On the other hand, poor angling-practice for these short-term gains may have direct impacts on fishery health, and thereby the long-term sustainability of the angling-guide's business. As such, angling-guides are faced with the same quandary of where to draw the line between what is practical, what is possible and what is necessary to ensure both ecologically and economically sustainable recreational angling.

Angling-guides have the difficult choice of how to balance client success with the sustainable use of fisheries resources. For example, circle hooks are generally thought to be the least damaging to fish health, but require a considerable change in the anglers' hook set technique (Cooke and Suski 2004; Cooke et al. 2012). This may initially result in lower strike-to-landing ratios than j-hooks, especially given a circle hook's relatively low tolerance for varying fish size and mouth-morphology (Cooke and Suski 2004; Cooke et al. 2012). In contrast, treble hooks on lures will almost always yield better strike-to-landing ratios than j-hooks, but cause considerably more physical damage to the fish, and add considerable air-exposure as a result of the difficulty of unhooking (Brownscombe et al. 2017). A further, more nuanced illustration of the issue, would be an angling-guide choosing to fish in a spot with a high density of sharks which regularly consume gamefish during retrieval or after release (Raby et al. 2013). These habitats may represent excellent angling opportunities, but mortality by predation may result in unacceptably high mortality even without any retention of fish. These aforementioned scenarios represent situations where the angling-guide's choices and tactics (all perfectly legal) have a direct impact on the survival rate of fishes subjected to C&R. This highlights that truly sustainable recreational angling relies on the implementation of a suite of *unenforceable behaviours* that go beyond simple compliance with regulations.

The adoption of *unenforceable behaviours* is particularly necessary to improve the sustainability of recreational angling, especially where compliance is low and enforcement capacity is lacking (e.g. in South Africa – Bova et al. 2017; Kramer et al. 2017), or in remote areas where guided-angling operations can operate with little oversight. Given that angling-guides are likely perceived as role-models in the recreational angling community (see Chapter 2), and that they may provide the only oversight during C&R events, an understanding of their environmental ethic is necessary. An angling-guide's poor-practice will not only have a direct impact on the fishery during trips, but may be perpetuating poor-practices and misconceptions of C&R best practices in the recreational angling community (see Chapter 2). By setting a norm for poor-practices and low moral regard for fish health, angling-guides may encourage or reinforce the poor behavioural intentions among their clientele.

Behavioural intentions are influenced by three factors: attitude towards the behaviour (how positive do I feel about the behaviour), subjective norms (what do other people expect me to do) and perceived behavioural control (how easy is it for me to do this behaviour) (Ajzen 2001). When attitudes and subjective norms are favourable towards the behaviour in question, and perceived behavioural control is high, the intention to perform said behaviour should also be high (Ajzen 1991). Given contextual limitations, behavioural intentions do not automatically result in behaviours being performed (Ajzen 1991; Nilsson et al. 2020), but they are a strong predictor (Ajzen & Fishbein 2005; Salzborn et al. 2012). The three determinants may make varying, independent contributions to overall behavioural intention depending on the context. In some cases, attitudes may be the only contributor, whereas in other cases only two of the three determinants may be responsible (Ajzen & Fishbein 2005; Salzborn et al. 2012). It is likely that most C&R best-practices (Brownscombe et al. 2017) are likely to have a high perceived behavioural control given their ease and familiarity (e.g. terminal tackle choice & retrieval tactics), even amongst novice anglers. As such, attitudes and subjective perceptions of the social norm may be more important determinants of C&R best-practice behavioural intentions. Attitudes can be seen as guiding behaviour, and appear to enter the attitude-behaviour relationship at the crucial decision making point (Abelson 1981). An individual's attitude (positive, negative or uncertain) towards an object or concept is presumed to be a function of their personal belief about whether or not the object possesses certain attributes (or not), and their personal evaluation of each of those attributes (Fishbein 1963; Fishbein 1967). There is evidence to suggest that attitudes towards broad objects (e.g. national parks) and concepts (e.g. climate change) can be used to predict a wide variety of behaviours in a broad

domain, but they do so with low fidelity (Ajzen 2001; Salzborn et al. 2012). In contrast, attitudes towards specific objects (e.g. commercial products) or specific concepts (e.g. alcohol consumption, seatbelt use or smoking cigarettes) can be used to predict those specific behaviours with higher fidelity (Salzborn et al. 2012). This has been called the bandwidth-fidelity dilemma (Salgado 2017), highlighting attitudes must be measured specifically to have any predictive value. As such, the measurement of attitudes towards specific C&R best-practices may provide insight into the likelihood of those behaviours being exhibited.

The role of recreational angling in the global fish crises is of growing concern (Cooke & Cowx 2004), and recent consensus that the effectiveness of C&R depends largely on the angler's choices and tactics (Brownscombe et al. 2017) highlights the need to better understand angling behaviours. An angling-guide's environmental behaviour during guided-angling trips not only has important implications for the health of the fishes caught-and-released during the trip, but may also influence how anglers behave after returning home. Angling-guides are likely perceived as role-models by their clientele (see Chapter 2). Given this, they may be able to affect positive changes in C&R behaviours in the recreational angling community, or may be perpetuating the adoption of poor C&R practices and anti-environmental moral norms, depending on the particular guide's knowledge, attitudes and behaviour. We know nothing of the extent of the adoption and use of C&R best practices on guided-angling trips, which represents a pressing gap in our knowledge. Addressing this dearth of knowledge will improve our understanding of the potential impacts of the guided-angling industry on global recreational fisheries resources, and their potential role in redressing those impacts. As such, collecting information on the knowledge, attitudes and actual behaviour of angling-guides is of tremendous utility. While direct observation of behaviour would be the best indication of whether or not that behaviour is displayed (Nilsson et al. 2020), it is costly and time-consuming to observe guided-angling trips. Assessing their knowledge of, and attitudes towards C&R practices may be a cost-effective exploration of angling-guide C&R behaviour with access to the global arena that would otherwise be beyond the scope of this study. As such, the aim of this research is to perform an exploratory assessment of the knowledge, attitudes and environmental behaviour (with emphasis on C&R) of recreational angling-guides globally. This is broken down into six objectives:

1. Assess the *demographics* of the angling-guiding community and fisheries.

2. Assess angling-guides' current catch-and-release *practices*.

3. Assess angling-guides' *knowledge* of current catch-and-release best practices.

4. Assess angling-guides' *attitudes* towards angling related *environmental behaviours*.

5. Assess angling-guides' *attitudes* towards *environmental responsibility*.

6. Determine the relationship between knowledge, attitudes and other demographic factors of angling-guides.

Methods and Materials

Data collection

Data were collected using an online survey using Google Forms®, distributed directly to anglers by email or WhatsApp®, and using the social media platform Facebook® (Rhodes University Ethics Clearance Registration Number REC-241114-045). For the purpose of this study, the target population was any English literate individual (18 years or older) from any country who worked as an angling-guide or had done so in the past. It is troublesome to estimate the relative proportion of angling-guides in the global population, given their low incidence, obscurity and lack of a clear sampling frame due to lack of formal registration or angling-guide associations. While almost certainly leading to an overestimate for the global population of angling-guides, we chose to adopt the ratio of anglers to angling-guides from the recreational saltwater fishery in Texas (Tseng et al. 2006; Lietz & Grubbs 2008). Assuming the approximate estimates of 1 100 000 saltwater licensed saltwater anglers in Texas (Allen & Southwick 2006), of which as many as 19.4% report using one of the 1000 registered angling-guides in Texas (Texas Parks & Wildlife Dept. 2011), we can deduce that angling-guides may represent as much as 0.1% of the total recreational angling population, assuming that 19.4% of recreational anglers are financially able to pay for guiding services. Assuming a global population of 826 800 000 recreational anglers (10.6% global participation; Arlinghaus et al. 2015), and 4.8% global English literacy (Central Intelligence Agency), there may be as many as 39 686 English speaking angling-guides, although in reality it is likely less. Irrespective, based on these approximations, to maintain a 95% level of confidence and 5% margin of error, a minimum of 385 survey responses would be required (Daniel 1999).

Given the low incidence of angling-guides in the global population, it was deemed too costly to employ a random sampling approach (Sweetland 1972; Marpsat & Razafindratsima 2010; Shaghaghi et al. 2011). As such, non-probability sampling methods were chosen, given their

low cost, low demand for human resources, simplicity and suitability for recruiting participants from obscure communities (Faugier & Sargeant 1997; Browne 2005; Vehovar et al. 2016). Potentially eligible respondents were petitioned for their participation (directly and on Facebook® groups) and after participation, were encouraged to share the survey with others in their social circles, rather than asking them to divulge the contact information for those individuals. Following this, several regional and subject-matter experts were asked to distribute the survey within their respective networks, despite not all being angling-guides themselves. This group comprised members of sport fishing associations, members of recreational angling NGOs and several recreational-fisheries experts who had close affiliations with existing networks within the guided-angling industry (See Appendix 3.1). Additionally, volunteer (aka self-selection) sampling was conducted by banner-recruitment using appeals for participation made on 144 popular angling-centric Facebook groups identified by researchers (see Appendix 3.2), with a follow-up appeal made on the same groups two weeks after first contact. As a result, sampling incorporates elements of snowball sampling (Vogt 1999), purposive (judgmental) and volunteer sampling (Vehovar et al. 2016), and a degree of scrounging (Groger et al. 1999) to reach as much of the target population as possible. It is, therefore, impossible to distinguish by what means each respondent first came to know about the survey, and therefore survey response rates are impossible to calculate. This approach favours broad, diverse representation for qualitative, exploratory purposes at the expense of the generalizability of results for quantitative inferences.

Survey design

The survey was designed to be as short as possible to reduce respondent fatigue (Lavrakas 2008). A pilot test with a small group (n = 8), found that the survey took approximately 10 to 15 minutes to complete. Based on feedback from the pilot test, open-ended questions were avoided where possible to reduce response burden and frustration when using mobile devices to respond. The survey began with a brief summary of the research intent, and assurances of anonymity (see Appendix 3.3). The survey was then broken into five major sections which match the first five objectives:

1. *Demographics and fishery*

Angling-guides were asked several demographic and fishery-specific questions to obtain the following information:

- o Age
- o Gender
- o Highest level of education
- o Residential country
- o Where they had worked as an angling-guide.
- o Employment style (employed or self-employed; full-time or seasonally).
- o Guiding experience (years worked as a guide)
- o How many days per year they guide anglers (on average)
- o Proportion of total income from working as an angling-guide
- o Proportion of guiding income from "tips" or gratuities from clients
- o Had they received any formal training
- o Describe the training should they have any
- o Five most common target species in the order of most targeted to least
- o Style of participation (i.e. fly fishing, conventional artificial lures or organic bait)

2. *Current angling practices*

To assess current angling practices, ten questions were developed to be as broadly applicable to any of the various angling facets and contexts as possible (see Appendix 3.4). Questions were categorised into the different stages of a C&R event as described by Brownscombe et al. (2017), and comprised possible tactics and choices before and during a C&R event during a guided-angling trip (see Appendix 3.4). Questions were focussed on choices and tactics associated with hooking, retrieval, unhooking, documentation, handling, recovery, release and harvest. Not all possible stages of a C&R event proposed by Brownscombe et al. (2017) were represented due to their dependency on contextual factors too specific for interpretation in a broad range of fisheries.

3. *Knowledge of best practice*

To assess the respondents' Knowledge of Best Practice (KBP), seven questions were designed to determine whether they knew the correct C&R best practice for different scenarios which are likely to occur in almost any C&R event during a guided-angling trip (see Appendix 3.5). Responses to questions were scored as either correct (1) or incorrect (0) based on available literature (see Appendix 3.5) and consensus on best-practices (Brownscombe et al. 2017). For example, the correct answer to the question: *"What hook style/type do you think inflicts the LEAST POSSIBLE DAMAGE and INJURY to the fish?"* is *"Circle hook"* based on a considerable body of literature (e.g. Siewert & Cave 1990; Cooke et al. 2001; Prince et al. 2002; Cooke & Suski 2004; Bergmann et al. 2014). The total KBP score was then calculated by summing these scores (1 or 0) for all seven questions. Additionally, a dichotomous "knowledge of best practice" variable was created by classifying respondents as

"knowledgeable of best practices" if they answered four or more of the questions correctly, or "poor knowledge of best practices" if they did not.

4. Attitudes towards environmental behaviour

To assess the respondents' Attitudes towards Environmental Behaviour (AEB), nine questions were formulated based on possible behaviours an angler or angling-guide might exhibit during a trip (Appendix 3.6). Responses were measured on a 5-point Likert scale of agreement, and were awarded a corresponding numerical score between 1 and 5, depending on whether the behaviour portrayed was positive or negative. For scoring responses to positive behaviours, 5 was awarded for the response showing the most pro-environmental attitude towards the given behaviour (e.g. "strongly agree" with debarbing hooks). Conversely, responses to negative behaviours (i.e. littering) were reverse-scored, with "strongly disagree" showing the most pro-environmental attitude, and therefore being scored as 5. The total AEB score was calculated by summing the scores for each question, and a higher AEB score indicated a more pro-environmental attitude.

5. Attitudes towards environmental responsibility

To assess the respondents' Attitudes towards Environmental Responsibility (AER), five questions were developed based on the environmental responsibilities an angling-guide should ideally maintain (see Appendix 3.6). Responses were measured on a five-point Likert-scale of agreement, and were scored correspondingly on a 1-5 scale, with a higher score denoting a more pro-environmental attitude towards responsibility. The total AER score was calculated by summing the scores for each question, and a higher AER score indicated a more positive attitude towards environmental responsibility, which is also a more pro-environmental attitude.

Data analysis

All data analyses were performed using the "stats" package in R Studio (version 4.0.2 – R Core Team 2020). All total scores were treated as continuous variables, while other binary independent variables were treated as ordinal. Measures of association between variables were chosen based on their level of measurement as proposed by Khamis (2008). Correlation coefficients I were interpreted using the general guidelines outlined by Newton & Rudestam (1999). The relationship between respondent's age and the three total scores (KBP, AEB and AER) was assessed using a Pearson Product-Moment Correlation (Pearson 1948). To assess the effect of training on knowledge and attitudes, the relationship between the two dichotomous

training variables (i.e. some formal training or none & accredited training or none) and the three total scores was assessed using a Point Biserial Correlation (Tate 1954). Similarly, the relationship between the dichotomous knowledge of best practices variable (i.e. knowledgeable or not) and the two attitude scores was assessed using a Point Biserial Correlation. Countries of residence were classified into dichotomous developmental status variable (developed or developing). For this purpose, countries were classified into development groups (UN 2019), and developing, least developed, small island developing nations and economies in transition were all grouped into "developing" for the analysis given their small sample sizes.

Results

Demographics and guiding industry information

A total of 342 complete survey responses were received from 47 countries (Figure 3.1a; Table 3.1; see Appendix 3.7), principally South Africa (30.7%), the United States of America (24.3%), Australia (7.0%), Canada (5.3%) and the United Kingdom (4.4%). Respondents listed a total of 79 distinct countries as guiding destinations (Table 3.1), with the United States of America (25.2%), South Africa (23.4%), Australia (7.6%), Canada (6.1%), Norway (5.3%), Angola (4.1%) and the Seychelles (4.1%) being most popular (Figure 3.1b). Respondents were most likely from a developed country (54.1%; Table 3.1), and likely only worked as an angling-guide locally in their country of residence (68.1%), although some respondents guided in as many as eight different countries.

Respondents were predominately high school educated (32.7%) males (98.0%) with a mean age of 41.7 yrs. (SD = 12.4 yrs.; Range = 18-65 yrs.) (Table 3.1). Just over half of the respondents were self-employed (52.9%) angling-guides, working seasonally or part-time (49.1%) for an average of 110 days per year (SD = 82.8 days), earning a mean of 49.1% (SD = 37.5%) of their total income from guiding anglers, and a mean of 18.1% (SD = 22.1%) of their guiding income from gratuities or "tips" (Table 3.2). Most respondents specialised in fly-fishing (70.2%), followed closely by conventional lure angling (65.5%), while only 34.2% indicated that they specialize in all facets of angling (Table 3.2). Most respondents had no formal guide training (63.8%), and only 9.4% had formal accreditation in the form of a certificate, diploma, course or certification dedicated to angling-guiding (Table 3.2). Salmonids were the most frequently listed target species, followed by Carangidae and Cyprinidae (Table 3.3).
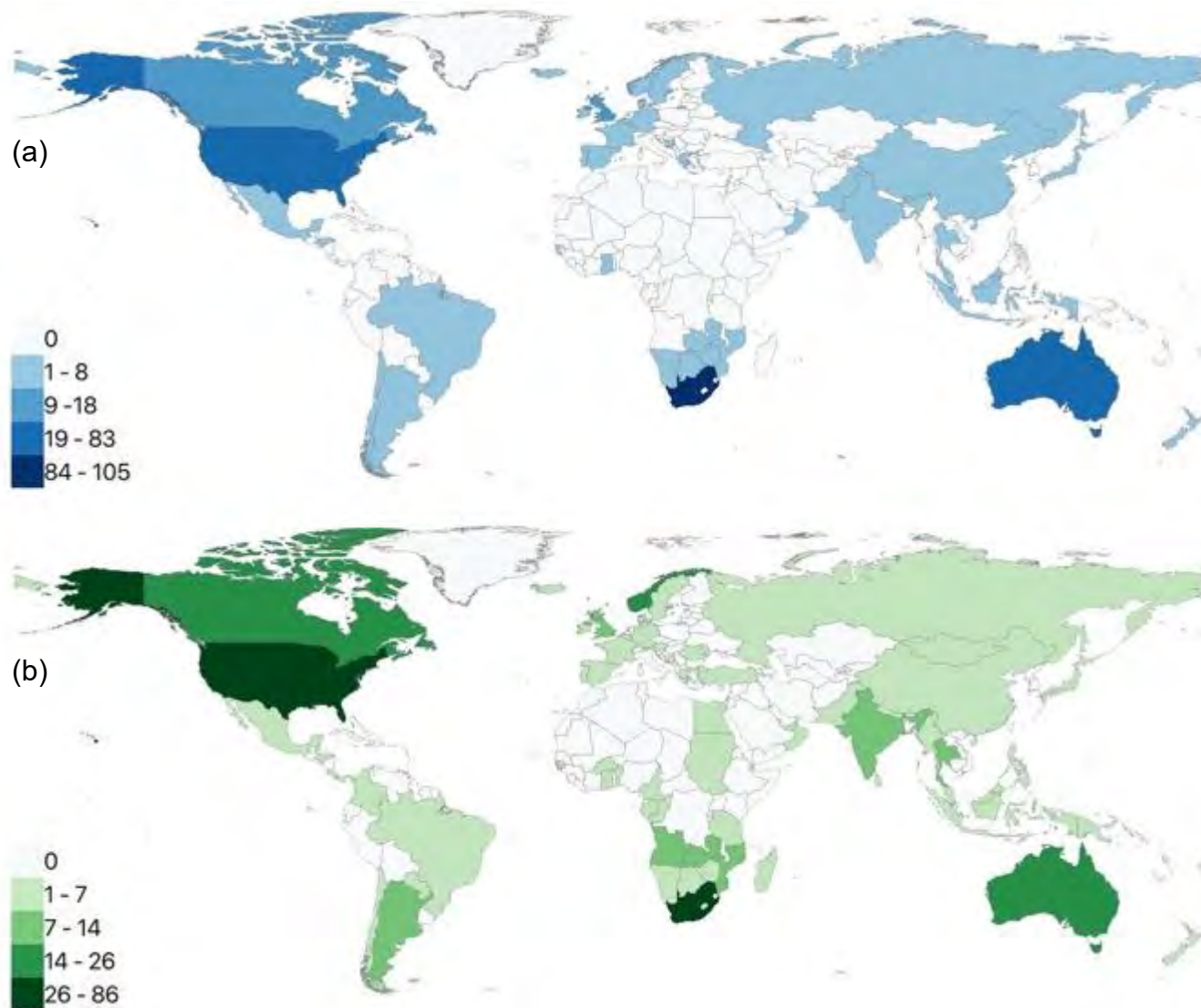
Figure 3.1: Global distribution of angling-guide survey respondents (n) categorised by their (**a**) resident country and (**b**) guiding locations

Table 3.1: Summary of demographic information for the 342 angling-guides in the global study response pool.

Categorical variable	Summary
Respondents (n)	
Residential countries	47
Guiding countries	79
Residential country developmental status (n)	
Developed	185 (54.10%)
Developing	140 (40.90%)
Least Developed	13 (3.80%)
Small island developing state	2 (0.60%)
Economies in transition	2 (0.60%)
Gender (n)	
Male	335 (98.00%)
Female	6 (1.80%)
Other	1 (0.30%)
Age (yrs.)	
Mean age	41.3 (18 – 65)
Education (n)	
No education or Junior School / Primary School	2 (0.60%)
High School / Secondary School / Senior High	112 (32.70%)
College degree (Associate degree)	90 (26.30%)
University degree (Bachelor's degree)	98 (28.70%)
Masters, Doctoral or Higher Degree (e.g. MSc, PhD)	40 (11.70%)

Table 3.2: Summary of employment, experience, income, training and style of participation of 342 angling-guides recruited into the global study response pool.

Categorical variable	Summary
Employment (n)	
Full-time angling guide.	116 (33.90%)
Part-time/seasonal angling guide.	168 (49.10%)
Previously worked as an angling guide.	58 (17.00%)
Employment style (n)	
Self-employed angling guide	180 (52.90%)
Employed and self-employed as an angling guide	65 (19.10%)
Employed as an angling guide	95 (27.90%)
Income from guiding (%)	
Mean percentage of total income from guiding (%)	49 (0 – 100)
Mean percentage of guiding income from "tips" (%)	18.3 (0 – 100)
Guiding	
Mean guiding experience (yrs.)	11.1 (0.4 – 45)
Mean days spent guiding per year	110 (2 – 365)
Training (n)	
No guiding training	217 (63.80%)
Guide training (formal)	123 (36.20%)
Guide training (accredited)	30 (8.82%)
Style of participation (n)	
Fly fishing	240 (70.18%)
Conventional lure angling	224 (65.5%)
Organic bait	174 (50.88%)
All facets	117 (34.21%)

Table 3.3: Summary of the five most targeted fishes listed by the angling-guide respondents during the global angling-guide survey, classified by family.

Family	n	Family	n	Family	n
Salmonidae	306	*Clariidae*	12	*Sisoridae*	3
Carangidae	139	*Percidae*	10	*Characidae*	2
Cyprinidae	104	*Channidae*	9	*Clupeidae*	2
Scombridae	95	*Haemulidae*	9	*Cynodontidae*	2
Sciaenidae	64	*Siluridae*	9	*Merlucciidae*	2
Centrarchidae	55	*Sphyraenidae*	9	*Mugilidae*	2
Istiophoridae	46	*Chanidae*	7	*Osteoglossidae*	2
Carcharhinidae	40	*Arapaimidae*	6	*Anguillidae*	1
Esocidae	37	*Odontaspididae*	6	*Atherinopsidae*	1
Gadidae	31	*Anarhichadidae*	5	*Belonidae*	1
Lutjanidae	31	*Dasyatidae*	5	*Ictaluridae*	1
Sparidae	31	*Pimelodidae*	5	*Lamnidae*	1
Alestiidae	24	*Polynemidae*	5	*Lepisosteidae*	1
Centropomidae	21	*Acipenseridae*	4	*Lophiidae*	1
Megalopidae	20	*Distichodontidae*	4	*Mormyridae*	1
Cichlidae	19	*Labridae*	4	*Poeciliidae*	1
Coryphaenidae	19	*Lotidae*	4	*Potamotrygonidae*	1
Pomatomidae	19	*Scaridae*	4	*Schilbeidae*	1
Albulidae	17	*Arripidae*	3	*Serrasalmidae*	1
Pleuronectidae	17	*Dichistiidae*	3	*Sillaginidae*	1
Moronidae	16	*Pangasiidae*	3	*Squalidae*	1
Serranidae	15	*Platycephalidae*	3	*Triakidae*	1
Balistidae	13	*Sebastidae*	3	*Triglidae*	1

Current practices

Few angling-guides indicated that they would provide/recommend "j-hooks" (34.3%), while most indicated they would encourage their clients to "minimize fight time by playing/fighting the fish hard to land it as soon as possible" (84.7%) (Appendix 3.4). Once the fish was landed, 46.0% of angling-guides suggested that they "leave the fish in the water while unhooking" (Appendix 3.4). Should the fish be hooked in the throat, 41.4% of guides stated that they would "always cut the line and leave the hook in place" (Appendix 3.4). When photographing a client with their catch, the majority of angling-guides demonstrated that they "photographed the client with the fish out of the water, supported by its head and tail" (64.8%), and just over half would insist on returning the fish to the water after no more than 30 seconds of air exposure (54.8%) (Appendix 3.4). When trying to determine the weight of the client's catch, 38.8% of angling-guides stipulated that they "measure the length of the fish and use length-weight conversion tables", while 31.1% of guides specified that they "never try to determine the weight of a clients' catch" (Appendix 3.4). When releasing a fish, just over half of the angling-guides indicated that they actually committed to releasing the fish "when it kicks its tail"

(50.9%) (Appendix 3.4). During guided-angling trips, 50.9% of angling-guides reported that they "always" released their catch, while 35.7% "never" harvested their catch (Appendix 3.4).

Knowledge of best practice (KBP)

Respondent's knowledge of best practice varied across the seven topics chosen (Figure 3.2). Most respondents correctly answered the questions about handling tactics (KBP 1: 76.3% correct) and landing choices (KBP 2: 74.0% correct), while more than half of respondents incorrectly answered the questions about unhooking tactics (KBP 6: 57.9% incorrect) and release knowledge (KBP 7: 66.7% incorrect; Figure 3.2). The majority (69.0%) of respondents answered four or more of the seven questions correctly, and were classified as "knowledgeable of best practices".
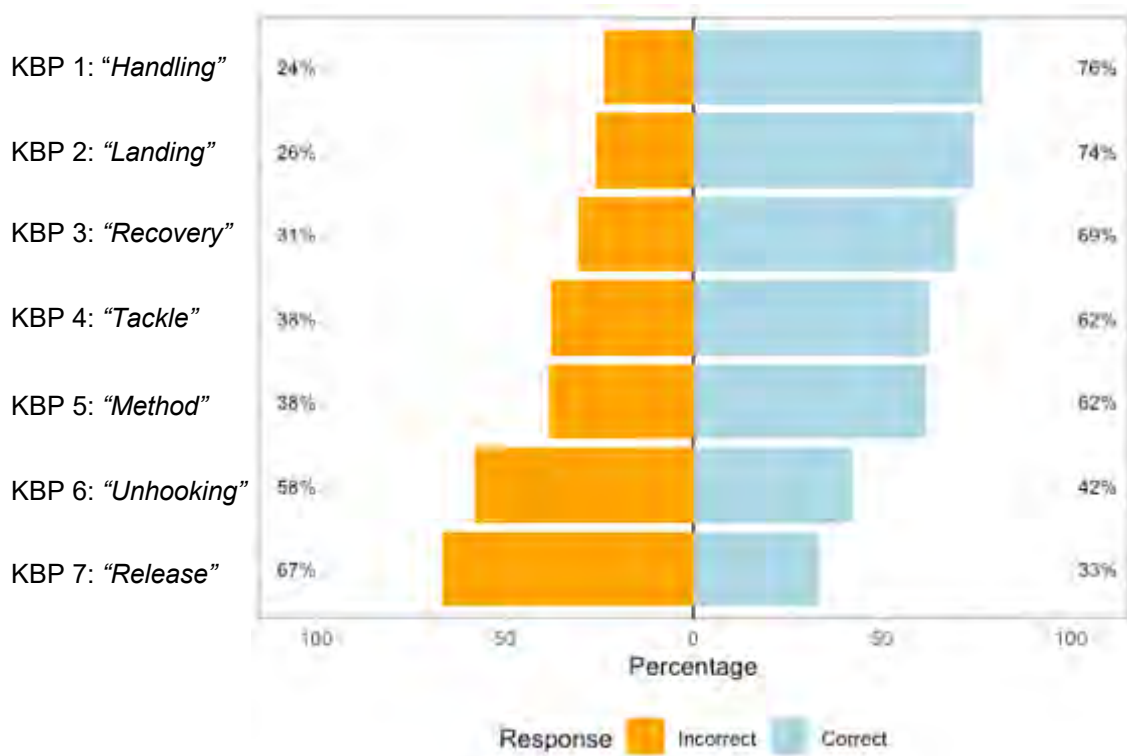
Figure 3.2: Proportion of angling-guide survey responses (%) to each of the "knowledge of best practise" (KBP) questions scored as correct (blue) or incorrect (orange).

Attitudes towards environmental behaviour (AEB)

Respondent's "attitudes towards environmental behaviours" varied across the nine environmental behaviours chosen (Figure 3.3). Respondents scored highest in response to behaviours like "littering" (AEB 1: 96.2% pro-environmental attitudes) and "poor landing practice" (AEB 2: 93.3% pro-environmental attitudes) (Figure 3.3). Respondents scored lower on best-practices which could reduce client catch-rate, such as "debarbing hooks" (AEB 6;

58

69.6% pro-environmental attitudes) or "not using treble hooks" (AEB 7; 69.3% pro-environmental attitudes) (Figure 3.3). Respondents scored lowest in response to the practice of "holding the fish above dry ground" (AEB 9: 50.9% pro-environmental attitudes) (Figure 3.3).
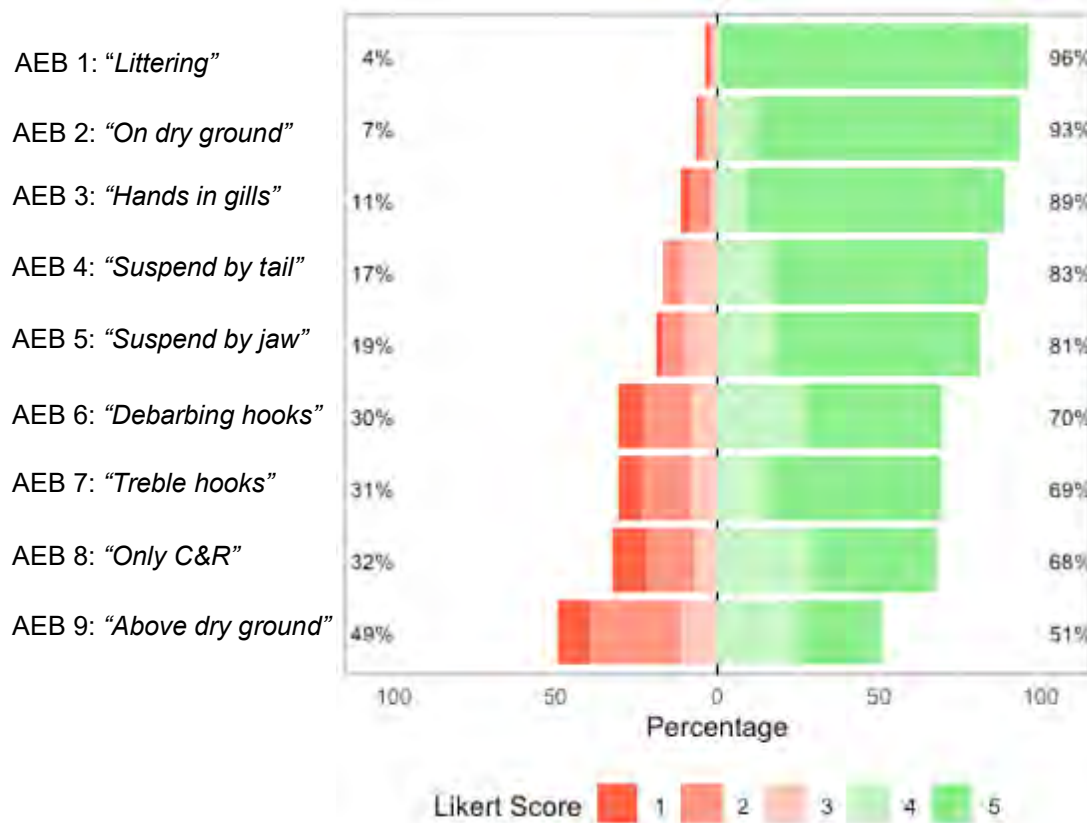
Figure 3.3: Proportion of angling-guides' *Attitudes towards Environmental Behaviour* (AEB) scores for responses to questions about potential C&R behaviours. Higher scores indicate more pro-environmental attitudes, with only scores of 4 or 5 considered to be responses indicative of a pro-environmental attitude aligned with the best-practices for a particular behaviour.

Attitudes towards environmental responsibility (AER)

The distribution of respondent's "attitudes towards environmental responsibility" was similar across all five of the statements chosen, with a majority of respondents expressing pro-environmental attitudes (87.1 – 89.5%) (Figure 3.4). Although only slightly different from other questions, question AER 5: "Guides should be willing to sacrifice client success and enjoyment for sustainable practices" had the lowest proportion of pro-environmental response of any of the five questions (Figure 3.4).
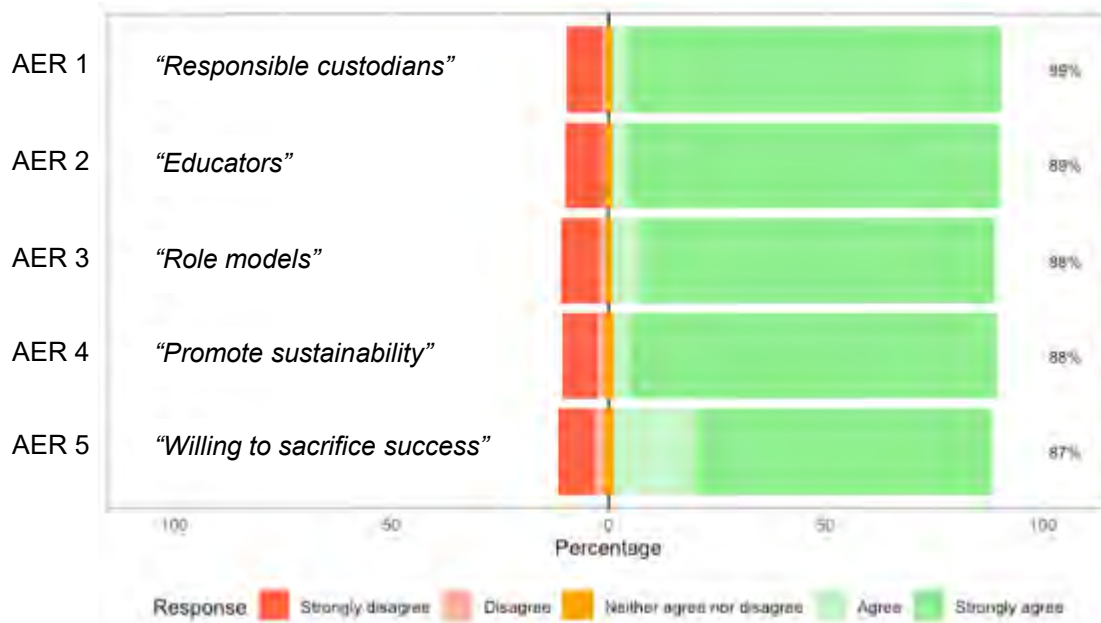
Figure 3.4: Attitudes of angling-guides (n = 342) to five statements pertaining to their environmental responsibilities as an angling-guide (5 point Likert scale). (AER: *Attitudes Towards Environmental Responsibility*)

Training and knowledge

While both mean attitude scores (AEB & AER) were similar for those with and without training (formal and accredited), the mean KBP score was higher for those with training, (formal: p = 0.086; accredited: p = 0.085; both: p-value = 0.081), than those without, although not significantly so. Similarly, those respondents classed as "knowledgeable of best practice" (KBP score ≥ 4) were more likely to have received some kind of training (37.7%) than those who were not knowledgeable (32.1%).

Respondents classified as knowledgeable of best practice (KBP score ≥ 4) had a significantly higher mean AEB score (mean = 4.24; p = 0.003; t = 3.002) than those who were not knowledgeable (mean = 4.05), and although not significant, also had a higher AER score (mean = 4.58; p = 0.087; t = 1.716) than those who were not knowledgeable (mean = 4.36; Table 3.4). The proportion of respondents who had received formal guide training was similar between developed (37.3%) and developing countries (34.4%; Table 3.4).

Table 3.4: Angling-guide survey response distribution and scaled mean scores (± SD) for knowledge of best practice (KBP), attitudes towards environmental behaviour (AEB) and attitudes towards environmental responsibility (AER) summarised according to their training, knowledgeability and residential country development status. Significant (p < 0.05) results are emboldened.

Formal guide training:	No	Yes	p-value
All (n)	219 (64.04%)	123 (35.96%)	-
Scaled mean KBP score	4.09 (±1.41)	4.37 (±1.58)	0.085
Scaled mean AEB score	4.19 (±0.53)	4.18 (±0.60)	0.900
Scaled mean AER score	4.54 (±1.09)	4.48 (±1.20)	0.655
Accredited guide training:	No	Yes	p-value
All (n)	312 (91.23%)	30 (8.77%)	-
Scaled mean KBP score	4.15 (±1.49)	4.63 (±)1.33	0.086
Scaled mean AEB score	4.18 (±0.61)	4.26 (±0.73)	0.413
Scaled mean AER score	4.52 (±1.12)	4.49 (±1.24)	0.888
Knowledgeable of best practice (KBP ≥ 4):	No	Yes	p-value
All (n)	106 (30.99%)	236 (69.01%)	-
Accredited guide training (n)	7 (23.33%)	23 (76.67%)	-
Formal guide training (n)	34 (27.64%)	89 (72.36%)	-
Scaled mean AEB score	4.05 (±0.58)	**4.24 (±0.53)**	**0.003**
Scaled mean AER score	4.36 (±1.28)	4.58 (±1.05)	0.087
Residential country development status:	Developing	Developed	p-value
Accredited guide training (n)	12 (7.64%)	18 (9.73%)	-
Formal guide training (n)	54 (34.40%%)	69 (37.30%)	-

Discussion

The understanding that angling-guides may be emulated by their angling-clients means their knowledge, attitudes and behaviour may influence the ecological outcomes through potential role-modelling. Little is known of angling-guide knowledge of best-practice and attitudes towards environmental behaviours, and as such this baseline assessment is critical for shaping future interventions. Angling-guides from 47 countries were recruited to take part in the survey and while they were mostly knowledgeable of C&R best-practices, they showed poor knowledge of some key aspects of the C&R process. Most angling-guides had not received any form of training, but those with training appeared to have slightly better knowledge scores than those without. Angling-guides generally had pro-environmental attitudes towards C&R behaviour, suggesting that they probably have pro-environmental behavioural intentions. That said, attitudes towards certain behaviours were more pro-environmental than others, which suggests that behaviour is likely to vary considerably between angling-guides, likely as a result of their individual knowledge and their perceptions of the "costs". Knowledgeable angling-guides had more pro-environmental attitudes, which suggests that training focussed on best-

practices may improve angling-guide C&R behaviour. Encouragingly, almost all angling-guides had pro-environmental attitudes towards their potential responsibilities as influential resource users. However, the bandwidth-fidelity dilemma (Salgado 2017) suggests that these broad attitudes may have little bearing on the actual behaviours in question, especially when faced with a significant trade-off between client satisfaction and ecological integrity.

Angling-guides must have a firm understanding of C&R best-practices in order to effectively put those practices to use. Most respondents (69.0%) were considered knowledgeable, answering most of the C&R best practice questions correctly. However, most erroneous responses were given in response to the questions KBP 6 and KBP 7 (Figure 3.2; Appendix 3.5). Here, 57.9% of respondents were incorrect in their assessment of how to proceed when a fish is hooked in the oesophagus (KBP 6), and would therefore likely behave at odds with the body of evidence that suggests the best practice is to leave the hook in place and cut the line (Mason & Hunt 1967; Tsuboi et al. 2006; Warner 1979; Fobert et al. 2009; Cooke & Danylchuk 2020). Similarly, most respondents (66.7%) did not know that "hooking injury and bleeding" plays the biggest role in determining post-release survival (KBP 7; Figure 2; Appendix 3.5; Muoneke & Childress 1994; Cooke and Suski 2005). This suggests that most angling-guides may incorrectly assess a fish's survivability during the C&R process, and are therefore poorly-informed when faced with the decision to retain or release a particular fish. Additionally, angling-guides may overlook the need to switch tactics or gear when hooking injuries become prevalent, given that they may underappreciate the severity of the injuries. These misunderstandings highlight that a firm grasp of best-practices is essential to improve C&R behaviour, and improving angling-guide knowledge, perhaps through training, may have considerable implications for sustainable recreational fisheries.

Training is seldom a legal or community-level pre-requisite to operate as an angling-guide, especially in the parts of the developing world (e.g. southern Africa), where recreational fisheries are poorly regulated (Bova et al. 2017; Potts et al. 2020). Very few (36.0%) of the respondents had received some form of training, and even less (8.8%) had received accredited training specifically for angling-guides (see Table 3.2). Despite this, most respondents (69.0%) were classified as knowledgeable of best practices (Table 3.4). While angling-guides with some kind of formal training had higher mean knowledge of best-practice scores (mean score = 4.37; $p = 0.085$; Table 3.4) than those without (mean scaled score = 4.09), as did those with accredited training (mean scaled score = 4.63; $p = 0.086$; Table 3.4), they were not significantly

better. Firstly, this highlights that best-practice knowledge is not restricted to those with training, and that it is possible to acquire best-practice knowledge from a variety of other sources, perhaps including other angling-guides, social media (e.g. Facebook ®), public-outreach (e.g. www.keepfishwet.org), grassroots angling organisations (e.g. RASSPL competitive angling club) or reference material (e.g. The Responsible Angler, WWF). Secondly, it highlights that while angling-guides may have received formal training, this does not guarantee that they are highly trained. High-quality, accredited training (e.g. angling-guide training at Forshagaakademin in Sweden) based on sound science should expose angling-guides to the basic knowledge of best-practices and C&R science. One reason, perhaps, for why trained angling-guides in this study were not significantly more knowledgeable of best-practices is poor quality training. High quality training will likely improve understanding of fundamental C&R science, and thereby improve angling-guides' *knowledge of the problem* and *internal attribution* of the cause, both of which are psycho-social pre-determinants of the attitudes that contribute to pro-environmental behavioural intentions (Bamberg & Moser 2007). While training only appeared to improve knowledge slightly in this study, high quality training remains important for improving knowledge, and may also enhance attitudes towards C&R practices.

In an effort to better understand angling-guide behavioural intentions, we assessed attitudes towards environmental behaviour (AEB). Respondents' AEB scores were generally high, indicative of a positive attitude towards responsible behaviours, but variation across the behaviours in question highlights that angling-guides have varying attitudes towards different practices (Figure 3.3). For example, an overwhelming majority of angling-guides expressed pro-environmental attitudes towards obviously poor practices, such as littering (96.2%), placing the fish on dry ground (93.3%) and placing hands and fingers in the gills (88.6%). In contrast, only half of angling-guides (50.9%) had pro-environmental attitudes towards holding the fish above dry ground during photographs before release (Figure 3.3). While this may seem trivial, a more nuanced best-practice would be to hold the fish above the water, or perhaps a bucket (e.g. Figure 3.5) as injury to the fish by dropping is common (Figure 3.6), especially amongst inexperienced anglers who might be more likely to employ angling-guides. It is likely that these poor attitudes towards positive practices are the result of poor understanding. Respondents classified as knowledgeable of best-practice (KBP score ≥ 4) had significantly higher AEB scores (mean scaled score = 4.24; $p = 0.003$; Table 3.4) than those less knowledgeable (mean scaled score = 4.05). This suggests that respondents who knew more

Figure 3.5: Photographs of how buckets/containers of different sizes can be used during the unhooking and photography parts of the shore-based catch-and-release process. (*photo credit: Edward Butler*).

Figure 3.6: Sequence of photographs of an angler holding and dropping a fish during photography in a catch-and-release event. (*photo credits: Edward Butler and Kirsten Ball).*

about C&R best practices had more pro-environmental attitudes, and therefore may be more likely to have pro-environmental behavioural intentions, and therefore may be more environmentally responsible.

In a utopian world, every angling-guide would feel a sense of custodial responsibility towards their fisheries resources. Inherent in that sense, would be a resource-use ethic that drives practice choices which carefully balance the satisfaction of the guide's clientele with the sustainability of their fishery resource. Additionally, every effort would be made to exhibit and promote pro-environmental behaviour as a positive role-model, because angling-guides would not only value the integrity of the resources on which they rely, but also acknowledge their ability to influence the norm. Encouragingly, almost all respondents (87.1 - 89.5%) had positive attitudes towards environmental responsibility (AER). This suggests that most respondents acknowledged the social and/or ecological value of angling-guides being "*responsible custodians of fisheries resources*", "*role-models to anglers*", "*educators of sustainable practices*", "*promoters of sustainability*" and "*willing to sacrifice client success for sustainability*". This suggests that even angling-guides with poor knowledge of, and negative attitudes towards best-practices still had high AER scores. Despite the general positivity towards the abstract concept, the actual nature of being *environmentally responsible* may be very different for different individuals, based on their understanding and attitudes. As such, a poorly informed angling-guide may consider themselves to be environmentally responsible based on their awareness of environmental issues and knowledge, when their behaviours could in fact be environmentally deleterious. Furthermore, the fidelity-bandwidth dilemma (Cronbach & Gleser 1957) suggests that attitudes towards a broad concept like environmental responsibility may have little bearing on actual environmentally responsible behaviour (Salgado 2017). Angling-guides may well appreciate the need to behave responsibly, but may choose not to, as pro-environmental attitudes and behavioural intentions do not always result in pro-environmental practices (Kollmuss & Agyeman 2002).

Catch-and-release best-practice is being increasingly adopted by pro-active members of the recreational angling community (Cowx 2002; Butler et al. 2017; Mannheim et al. 2018). Some best-practices are broadly applicable to any fishery, aiming to reduce factors that decrease the survivability of fishes subjected to C&R. Encouragingly, most respondents (84.7%) stated that they instruct their clients on the best-practice of "*playing the fish hard*" to retrieve the fish quickly and minimize fight time, which in turn limits the risk of predation, exhaustion and

excessive physiological stress response (Cooke & Suski 2005). Likewise, 38.8% of angling-guides reported that they choose the best-practice of length-to-weight conversion (Cooke & Suski 2005; Brownscombe et al. 2017), or better yet, simply foregoing knowing the weight at all (31.1%), instead of using a scale to determine the weight of their clients' catch (30.1%). Positively, most respondents (85.2%) stated that they only allowed their clients 60 seconds or less of air exposure for photographs, with over half (54.8%) only allowing their clients 30 seconds or less, which greatly reduces the air exposure and potential for injury due to poor handling. Similarly, most angling-guides suggested that they perform some form of reflex impairment test (i.e. RAMP as per Davis 2010) before releasing their client's catch (87.4%), such as waiting for a "*tail kick*" (50.9%), the "*fish to stay upright*" (23.3%) or observation of "*steady breathing*" (13.2%). This suggests that there is some form of recovery assessment taking place, as opposed to simply releasing the fish immediately (12.7%). Thus, there is evidence to suggest that best-practices are used by a considerable proportion of angling-guides, and are therefore likely to be adopted by their clients who see them as role-models. However, there is still evidence that the remaining proportion of angling-guides employ poor practices, and are therefore likely to also promote the adoption of these practices by the recreational angling public.

While there is strong evidence to suggest that many angling-guides are using C&R best-practices, there was also considerable evidence to suggest that poor practices are used. For example, choosing to *unhook the fish while in water* is broadly considered the best tactic, but less than half of the respondents (46.0%) stated this as their chosen method. Unhooking time contributes greatly to air exposure (Cooke & Suski 2005, Butler et al. 2017, Brownscombe et al. 2017), especially when unhooking is difficult (e.g. when using treble hooks or encountering sharp-toothed species). Similarly, choosing to *cut the line immediately when a fish is hooked in the oesophagus* is generally deemed the best tactic (Fobert et al. 2009; Cooke & Danylchuk 2020), but again less than half (41.4%) of respondents suggested this was their choice. While understandably paradoxical, leaving the hook in place generally increases fish survival (Cooke and Danylchuk 2020). When presented with a case of oesophageal hooking, anglers typically spend too much time trying to remove deep hooks, exacerbating hooking injury and air exposure in the process (Brownscombe et al. 2017; Cooke & Danylchuk 2020). This pervasive misconception, along with others (e.g. carbonated soft-drinks stop bleeding in gill area - Trahan et al. 2020) decreases the survival of released fishes. Considering that half of the respondents stated that they "*always*" released (50.9%), and many "*never*" harvested (35.7%) their client's

catch, it is likely that these pervasive, poor practices are inadvertently contributing to the enigmatic post-release mortality that is becoming increasingly well documented in recreational C&R angling (Muoneke & Childress 1994; Cooke et al. 2001; Lewin et al. 2006; Danylchuk et al. 2007; O'Toole et al. 2010; Weltersbach & Strehlow 2013).

The burgeoning consensus that recreational angling is in-fact a major contributor to the global fish crisis (Cooke et al. 2004; FAO 2003) should be of particular concern to angling-guides, who rely on the resource to earn their living (Table 3.2). Just over half of respondents surveyed were self-employed (52.9%) and earned approximately half of their total income (49.1%) from guiding seasonally or part-time (49.1%) for an average of 110 days per year. While guiding anglers was not the sole source of income for all respondents, it likely contributes significantly to their financial security. This is an important consideration for interventions aimed at improving C&R behaviours, given that there are additional financial motivations which may enter the decision-making process at the nexus of intention and actual behaviour on guided-angling trips. As a result of being mostly self-employed and financially dependent on a service-orientated industry which relies on a resource in crisis, angling-guides have the burden of balancing personal, ecological and market-related demands on their behaviour.

There are many factors which may affect an angling-guides ability and motivation to convert pro-environmental intentions into actual pro-environmental behaviour. On one hand, angling-guides might be motivated to choose behaviours which do not risk losing more immediate financial rewards, such as potential gratuities or repeat business. On the other hand, they may forego immediate rewards for behaviours that ensure the future-integrity of the resources on which they rely. For example, angling-guides may allow their clients to expose a fish to excessive amounts of air-exposure while they admire and photograph their catch, to avoid imposing limits on what may be perceived as the key aspects of the client's C&R enjoyment. Alternatively, they may be motivated to impose air-exposure limits to ensure fish health, either out of high moral regard for ecological integrity, or self-serving concerns over the future utility of the resource. These contrasting biocentric or anthropocentric values (Thompson & Barton 1994) suggest that angling-guides may have trouble aligning their pro-environmental behavioural intentions with their actual behaviours. This highlights that efforts to promote pro-environmental behaviour in angling-guides must be holistic, and include efforts to not only improve behavioural intentions, but assist angling-guides with overcoming perceived barriers to carrying out those intentions during guided-angling trips.

While this study makes a considerable contribution to our understanding of angling-guide knowledge, attitudes and behaviour, it is not without its shortcomings. Firstly, the snowball sampling methodology employed has a strong bias towards cohesiveness (Griffiths et al. 1993), and thereby has an inherent selection bias through "within-group sampling". Similarly, this sampling method tends to overlook "isolates", meaning that less connected groups are likely to be poorly represented (Van Meter 1990). Additionally, the use of regional experts with pre-existing network membership to assist with survey distribution introduces a form of gatekeeper bias (Groger et al. 1999), whereby those with privileged access introduce a form of respondent selection bias. Furthermore, the survey precluded non-English speakers, and likely overlooked those without access to internet and social media, given that this survey was principally distributed online and only in English. Finally, the potential of social-desirability response bias (Edwards 1953; Edwards 1957) in the survey cannot be disregarded, as it is impossible to determine whether some respondents with good knowledge of best-practices dishonestly chose the socially-desirable best-practices in response to questions regarding their own behaviours. As such this study assumes that the assurance of anonymity was sufficient for respondents to respond honestly. Given the exploratory nature of the sampling, no rigorous quantitative assumptions can be made. Despite these shortcomings, this preliminary exploration provides important insight into the knowledge, attitudes and behaviour of an understudied, but influential group who rely on resources that are of growing ecological concern. The wide diversity of regions and fisheries sampled suggests that the response pool is likely a good representation of the angling-guide community. As such, this information on angling-guides provides an important steppingstone for more rigorous research to understand their potential role in the endeavour to achieve sustainability goals.

In conclusion, most angling-guides surveyed were considered knowledgeable of best-practices, but there were several key areas where many guides were incorrect. A firm understanding of best-practices is essential to make correct behavioural decisions, and improving this knowledge is perhaps a pre-requisite for improving attitudes and behavioural intentions. Angling-guides with training appeared to be slightly more knowledgeable, which suggests that high-quality training could improve knowledge considerably. Given that knowledgeable angling-guides likely have a better *knowledge of the problem* and *internal attribution of the cause,* the fact that those who were considered knowledgeable had more pro-environmental attitudes towards practice again highlights the importance of knowledge and understanding in shaping the attitudes associated with pro-environmental behavioural intentions. The fact that even those

with poor knowledge and attitudes towards practice could have positive attitudes towards environmental responsibility highlights that knowledge and understanding is critical, as misinformed angling-guides could incorrectly assume that their behaviours were environmentally responsible. It is apparent that while many angling-guides have demonstrably good knowledge, attitudes and practices, there is room for improvement to meet real sustainability requirements. Given that training appeared to improve knowledge, and knowledge of best-practices appeared to improve attitudes, it is recommended that angling-guides undergo at least some form of training, ideally accredited training, to improve their behavioural intentions and actual behaviour.

Angling-guides are being increasingly recognised as important role-players in the recreational angling industry. While this study focussed on knowledge, attitudes and stated practices, there is likely a considerable dissonance between these and actual behaviour, depending on contextual factors and competing personal, financial and market driven motivations. Consequently, it is imperative to obtain information about actual behaviour before effective, fishery specific interventions can be developed to assist angling-guides to better align their knowledge, attitudes and ethics with their actual practices.

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Appendices

Appendix 3.1: List of individuals and collaborators who assisted with the distribution of the survey to various guided-angling networks.

Person	Role/Association/Affiliation	Region
Prof. WM Potts	Rhodes University, guided-angling industry	Southern Africa
Dr. Adrian Pinder	Bournemouth University, The Mahseer Trust	South and South-East Asia
Dr. Keno Ferter	Institute of Marine Research in Norway, Bergen	Norway and Sweden
Dr. Jun-ichi Tsuboi	National Research Institute of Aquaculture, Fisheries Research Agency	Japan
Dr. Shannon Bower	Infinity Socio-Ecological Solutions, "Keep Fish Wet"	Scandinavia, East-Africa, South-East Asia
Mr. Jason Schratwieser	International Game Fishing Association (IGFA)	USA and World wide
Dr. Jake Brownscombe	Bonefish and Tarpon Trust, FishOceansCAN, "Keep Fish Wet"	United States of America
Prof. Andy Danylchuk	University of Massachusetts, Bonefish and Tarpon Trust, "Keep Fish Wet"	United States of America
Dr. David Fairclough	Department of Primary Industries and Regional Development, AU	Australia
Mr. Edward Truter	Recreational angling industry, African Waters®	Africa
Mr. Barry Wareham	Recreational angling industry	Southern Africa
Mr. Robert Scott	Guided-angling industry, African Waters	Africa

Appendix 3.2: Names of angling-centric Facebook® groups (as they appear online) where banner recruitment took place for angling-guide

Group name	Group name	Group name
"🎣Pike Fishing Scotland🎣"	"Fly Fishing Group."	"Sea Fishing Scotland."
"Adelaide All Fishing."	"Fly Fishing Group"	"SeaFishingUK."
"Adventure Fishing Monsters."	"Fly Fishing Western Australia."	"SEYCHELLES SPORTS FISHING CLUB."
"All about Wahoo."	"Flyfishing and Flytying."	"Shark Fishing Australia."
"All Fishing Australia."	"Flyfishing guides, Services & Equipment South Africa."	"Shark Fishing Worldwide."
"All season pike and predator anglers UK (A.S.P.A.P Anglers)."	"Friends who like Fishing Holidays in Thailand."	"Shore fishing UK."
"australian bass fishing addicts."	"Go Fish Costa Rica."	"Shore Jigging - Heavy Lure Fishing International."
"Australian Beach/Surf Fishing"	"GT - A Fly Fishers Guide to Trevally."	"Siberian taimen and kundja fishing."
"Bahamas Fly Fishing Group."	"GT & Big Fish around the world!"	"Smallmouth Nation."
"BAHAMAS SPORTFISHING."	"GT, Popping&Jigging,."	"South East Qld Offshore Fishing."
"Bass Fishing Fanatics"	"Gulf Coast Fishing Club."	"Spey Geeks."
"Bass On the Fly."	"Gulf of Mexico Offshore Fishing."	"Spey Nation."
"Bass, Crappie, Bluegill and Catfish fishing."	"I Love To Fish."	"Striped Bass."
"Basscasters Club."	"Jacksonville Offshore Fishing."	"SURFCASTERS INC."
"Beach & boat fishing"	"Jersey shore saltwater fishing reports."	"Surfcasting Unlimited LLC."
"Beach and Shore Sea Fishing UK"	"Jigging & Popping around the Globe"	"Swordfish Group."
"BFA - Bream Fishing Australia."	"Land and Bay Fishing SEQ."	"Sydney Jewfish And Squid Fishing."
"Cape Cod Anglers."	"Land Base Shark Fishing World Wide."	"Tailor Fishing Australia."
"Carp Fishing In Thailand"	"Marlin Talk."	"Tampa Bay Fishing Club."
"Chesil Big Fish Hunters"	"Monster Fishing Costa Rica."	"TARPON BRAZIL."
"Euro nymphing."	"Mozambique Deep Sea Fishing."	"Team Sea Angling"
"Everything Bream and Bass."	"Mulloway Fishing WA."	"Texas Gulf Coast Fishing-Bay & Offshore."
"Fishing & Squid Fishing Australia."	"Murray Cod Fishing."	"Texas Offshore Fishing."
"Fishing Addicts."	"Musky Fly Fishing."	"thailand fishing lure in Taiwan."

Appendix 3.2: Names of angling-centric Facebook® groups (as they appear online) where banner recruitment took place for angling-guide

Group name	Group name	Group name
"Fishing America !!!!!!!!!!!!"	*"NE Offshore Pelagic Reports."*	*"The Fishing."*
"FISHING AROUND SCOTLAND"	*"Pescaria Oceânica Esportiva - Brasil."*	*"The Fly Fishing Community."*
"Fishing Australia."	*"Pike fishing Scotland C&R."*	*"This Is Fly.. The Global Journal of Saltwater Fly Fishing."*
"Fishing Central Queensland."	*"Pop & Jig Brasil."*	*"Tiger Talk."*
"Fishing Fanatics."	*"Predator and carp fishing thailand."*	*"Top Fishing Videos."*
"Fishing Freakz."	*"Qatar Fishing Maniacs."*	*"Tope Fishing Uk."*
"Fishing Friends Western Australia."	*"Queensland Offshore Fishing."*	*"Topwater & Jigging Fishing Trips"*
"Fishing GT & Big Fish around the world!"	*"Redfish Fishing: Everything Redfish."*	*"Trout Chaser's."*
"fishing here and there."	*"Reel Fishing Australia Wide."*	*"Trout Talk."*
"Fishing Holidays/ Fishing Areas."	*"Reel Run Fishing."*	*"Trout Trollers Australia."*
"Fishing in Scotland."	*"River Catfishing."*	*"True Fishing!"*
"Fishing in Tasmania"	*"River Fishing Scotland."*	*"Tuna and Offshore Fishing S.A."*
"Fishing is a lifestyle holidays".	*"Rock Fishing Australia."*	*"UK Bass Fishing."*
"Fishing Life."	*"Russian Far East (hunting and fishing)."*	*"Uk Catch Reports (sea)"*
"Fishing Reports Victoria."	*"SAGE Fly fishing Club."*	*"UK Shore Catch Reports."*
"Fishing Thailand."	*"Salt Fishing South Africa."*	*"Ultimate Bottom Fishing."*
"FISHING The CAPE."	*"Salt Fly."*	*"Ultimate Fishing Zone."*
"Fishing trips, & tips."	*"Salt Water Fishing Worldwide."*	*"VIC Tuna, Kings and Snapper."*
"Fishing Unlimited !"	*"Saltwater Fly Fishing Downunder."*	*"W.A LANDBASED FISHING CLUB."*
"Fishing Victoria - Freshwater & Saltwater."	*"Saltwater Fly Fishing Group."*	*"Wahoo Fanatics."*
"Fishing Videos"	*"Saltwater Shore & Offshore Fishing South Africa."*	*"Wild Freshwater Fishing in Thailand."*
"Fishing World."	*"Sand Flats Fishing Central Coast Australia AU."*	*"Worldwide Trout Anglers"*
"Fly and Spinning Anglers."	*"SARASOTA FISHING."*	*"Yellow Talk"*
"Fly Fishing - SaltWater."	*"sea bass lure fishing."*	*"Yellowfin Tuna Atics."*

Appendix 3.3: Pre-questionnaire brief and research intention summary.

This research project is being undertaken by an international research committee made up of both researchers and prominent members of the angling industry from the United States of America and South Africa. This research falls under a doctoral research project underway at the Southern African Fisheries Ecology Research Lab (SAFER Lab) at the Department of Ichthyology and Fisheries Science at Rhodes University in Grahamstown, South Africa.

This research intends to assess the knowledge, attitude and environmental behaviour of recreational angling-guides across many angling facets from around the world. It will also help establish a baseline to assess the feasibility of tools being developed for recreational fisheries management and conservation.

You have been chosen to participate in this research because you are either a part-time or full-time professional angling-guide, or have worked as one in the past. Your participation in this research study is voluntary. You may choose not to participate. If you decide to participate in this research survey, you may withdraw at any time. You may refuse to answer any questions.

The procedure involves asking questions about yourself, including your age, education, income and various behaviours and beliefs surrounding the recreational angling guiding industry and angling practices within your particular fishery.

This survey takes approximately 10 minutes to complete.

Your privacy is important and all data are kept completely confidential. To help protect your confidentiality, the surveys will not contain information that will personally identify you. The results of this study will be used for scholarly purposes only. This research is not affiliated with any law enforcement agency or media/market related agency and this information will not be used in any way that could cause harm to you.

If you have any questions about the research study, please contact Matthew Farthing (matthew.farthing.rsa@gmail.com) or the Rhodes University Ethics Committee (Please contact Mr Siyanda Manqele - email: s.manqele@ru.ac.za). This research has been reviewed according to Rhodes University ethics procedures for research involving human subjects National Health Research Ethics Council (Registration Number REC-241114-045).

You may refuse to answer any question and may withdraw from the survey at any time.

Choosing the "agree" box below indicates that:

• you have read the above information

• you voluntarily agree to participate

• you are at least 18 years of age

Appendix 3.4: Distribution of responses to questions pertaining to angling-guides' Current Angling Practices (CAP) with their **most common responses emboldened**.

Practice	Questions and responses	Response
Hooking (CAP 1)	*What hook style/type do you provide/recommend to your clients in your particular fishery when fishing for the SPECIES YOU TARGET MOST OFTEN?*	
	J-hook	**38.32%**
	Circle hook	22.46%
	Lead jighead	17.37%
	Treble hooks	9.58%
	Octopus hook	7.78%
	Extra Wide Gap hooks	2.69%
	Double hooks	1.80%
Retrieval (CAP 2)	*When your client is fighting a fish, which of the following tactics would you suggest they use when fighting a fish you plan on releasing?*	
	Minimize fight time by playing/fighting the fish hard to land the fish as soon as possible.	**84.71%**
	Maximize fight time by playing/fighting the fish gently to exhaust the fish before landing.	15.29%
Unhooking (CAP 3)	*When unhooking your client's fish after landing it, which of the following best describes where you place the fish during the process?*	
	I leave the fish in the water while unhooking.	**46%**
	I leave the fish in the landing net while unhooking.	26%
	I place the fish on the boat deck while unhooking.	9.14%
	I place the fish on a brag mat/measuring mat while unhooking.	5.43%
	I place the fish in a bucket while unhooking.	5.14%
	I hold the fish in the air while unhooking.	5.14%
	I place the fish on the beach/bank/grass while unhooking.	3.14%
Unhooking (CAP 4)	*When your client's fish is hooked in the throat as shown in the picture below, which of the following best describes what you choose to do before releasing it?*	
	I will always cut the line and leave the hook place.	**41.42%**
	I will try to remove the hook for a while, after which if I am not successful, I will leave it in place.	32.54%
	I will make every effort to remove the hook.	26.04%
Documentation (CAP 5)	*When photographing a client with a fish you plan on releasing, which of the following statements best describes how you instruct your client to handle the fish?*	
	I photograph the client with the fish out of the water, supported by its head and its tail.	**64.78%**
	I photograph the client with the fish still in the water.	28.96%
	I photograph the client with the fish suspended by a lip gripping device.	2.09%
	I let my client decide how they handle their catch.	2.69%
	I photograph the client with the fish out of the water, supported by its tail only.	0.30%
	I photograph the client with the fish, supported by its head/mouth only.	1.19%

Appendix 3.4 (cont.): Distribution of responses to questions pertaining to Current Angling Practices (CAP) (**most common response emboldened**).

Practice	Questions and responses	Proportion
Documentation (CAP 6)	*When attempting to determine the weight of a clients catch before release, which of the following best describes how you do so?*	
	I measure the length of the fish and use length-weight conversion Tables.	**38.76%**
	I never try to determine the weight of a clients fish.	31.07%
	I weigh the fish in the net using a hand scale.	12.43%
	I weigh the fish using a lip gripping scale	7.69%
	I weigh the fish using a sling scale.	7.10%
	I weigh the fish using a hook scale.	2.96%
Handling (CAP 7)	*After a client has landed a fish, how much time will you allow the angler to keep the fish exposed to air for photographs before you will insist that the client returns the fish to the water?*	
	30s (0.5 min)	**54.76%**
	60s (1 min)	30.36%
	90s (1.5 min)	8.04%
	120s (2 min)	5.06%
	180s (3 min)	1.49%
	240s (4 min)	0.30%
Recovery (CAP 8)	*When releasing a fish after the fight, which of the following statements best describes when you actually release the fish?*	
	I release the fish when it kicks its tail.	**50.88%**
	I release the fish when it can stay upright (maintain equilibrium).	23.24%
	I release the fish when I can see it is breathing steadily	13.24%
	I release the fish immediately when I am done unhooking/photographing/etc.	12.65%
Release (CAP 9)	*During a guided trip, how often (if ever) do you and your angling-clients catch-and-release a fish?*	
	Always	**50.88%**
	Often	35.67%
	Sometimes/Occasionally	10.82%
	Rarely	2.05%
	Never	0.58%
Harvest (CAP 10)	*During a guided trip, how often (if ever) do you and your angling-clients catch-and-keep (kill/harvest) a fish?*	
	Never	**35.67%**
	Rarely	32.75%
	Sometimes/Occasionally	17.84%
	Often	10.82%
	Always	2.92%

Appendix 3.5: Knowledge of Best-Practice (KBP) questions, correct answer choices (**emboldened**) and associated evidence for correct choice.

Category	Questions and response options:	Evidence
Handling (tactic) *[KBP 1]*	*"When handling a fish, which of the following do you believe is the LEAST DAMAGING to fish health?"* **Bare wet hands** ~ Bare dry hands ~ Gloved hands ~ Wet microfibre cloth ~ I don't know	Steeger et al. (1994); Barthel et al. (2003); Colotelo and Cooke (2011)
Landing (choice) *[KBP 2]*	"When landing a fish with a net, which net type is likely the LEAST DAMAGING to the fish's skin, scales and slime layer?" **Silicone rubber net** ~ Micromesh nylon net ~ Knotless nylon net ~ Knotted nylon net ~ Cotton net ~ I don't know	Barthel et al. (2003); Colotelo and Cooke (2011); Brownscombe et al. (2017)
Recovery (knowledge) *[KBP 3]*	"Does relative water temperature affect the ability of the fish to recover from an exhausting fight?" **Yes, fish recover faster in cooler water** ~Yes, fish recover faster in warmer water ~ No, water temperature does not affect recovery rate ~ I don't know.	Cooke and Suski (2005); Bartholomew and Bohnsack (2005); Pelletier et al. (2007)
Hooking (choice) *[KBP 4]*	"What hook style/type do you think inflicts the LEAST POSSIBLE DAMAGE and INJURY to the fish?" **Circle hook** ~ J-hook ~ Octopus hook ~ Lead jig-head ~ Extra wide gap hook ~ Double hook ~ Treble hook ~ I don't know.	Siewert and Cave (1990); Cooke et al. (2001); Prince et al. (2002); Cooke and Suski (2004); Bergmann et al. (2014).
Retrieval (tactic) *[KBP 5]*	"Which method of angling is MORE LIKELY to result in the fish receiving a SEVERE HOOKING INJURY?" **Passive angling (drifting a bait or lure, bobber fishing, drifting a fly, live-bait on the bottom)** ~ Active angling (jigging a lure, casting a plug, stripping a fly, trolling lures or live-bait); I don't know	Schisler and Bergersen (1996); Grixti et al. (2007); Alós (2009); Lennox et al. (2015a,b); Brownscombe et al. (2017);
Unhooking (tactic) *[KBP 6]*	"If a fish is hooked in the throat as in the picture below, which of the following do you believe is the best tactic to ensure the fish survives after release?" **Always cut the line and leave the hook place** ~ Make every effort to remove the hook, regardless of how long it takes ~ Try to remove the hook, after which if not successful, leave it in place ~ I don't know	Mason and Hunt (1967); Tsuboi et al. (2006); Warner (1979); Fobert et al. (2009); Cooke and Danylchuk (2020)
Release (knowledge) *[KBP 7]*	"Which of the following factors plays the BIGGEST ROLE in determining whether or not the fish will survive after release?" **Hooking injury and bleeding** ~ Damage to the skin and removal of slime ~ Time out of the water (air exposure) ~ Exhaustion from the fight ~ I don't know	Muoneke and Childress (1994); Cooke and Suski (2005)

Appendix 3.6: Survey questions for measuring Attitudes towards Environmental Behaviours (AEB) and Attitudes towards Environmental Responsibility (AER) of recreational angling-guides.

	Questions (responses on a 5-point scale of agreement)
(AEB 1)	*Always releasing a fish, no matter the size, species or legality of whether it must be released or not.*
(AEB 2)	*Debarbing your client's hooks even though it may result in lower chances of the client landing the fish.*
(AEB 3)	*Placing your hand or fingers in the gill area whilst handling a fish before release.*
(AEB 4)	*Placing a fish on dry ground for unhooking, measurements or a photograph before release.*
(AEB 5)	*Holding the fish above dry ground (i.e. sand, grass, rock, reef etc) for a photograph before releasing it.*
(AEB 6)	*Switching your client's hooks to treble hooks to increase their hook-up ratio and chances of successfully hooking up.*
(AEB 7)	*Suspending a fish by its tail while handling for a photograph before release.*
(AEB 8)	*Suspending a fish by its jaw using a Boga Grip/Lip Grip device for a photograph before release.*
(AEB 9)	*The leaving of unwanted fishing line and other unwanted terminal tackle around the fishing area (beach, water's edge, pier, pond, river bank etc).*
(AER 1)	*Angling-guides should act as responsible custodians of fisheries resources.*
(AER 2)	*Angling-guides should educate their angling-clients on responsible and sustainable angling practices.*
(AER 3)	*Angling-guides should be willing to sacrifice some angling success and enjoyment for their clients if it promotes sustainability and protects the fishery.*
(AER 4)	*Angling-guides should play an active role in protecting the fishery and environment.*
(AER 5)	*Angling-guides are role models for aspiring anglers and clients*

Appendix 3.7: Number of angling-guides (n) who listed countries as their residence and a country in which they have/do guide anglers.

Country	Residence	Destination	Country	Residence	Destination	Country	Residence	Destination
Angola	-	14	Gabon	-	5	Norway	8	18
Antigua and Barbuda	-	1	Germany	3	1	Oman	1	6
Argentina	4	10	Ghana	1	1	Pakistan	1	1
Australia	24	26	Greece	1	1	Panama	-	1
Austria	-	1	Guinea-Bissau	-	3	Papua New Guinea	-	1
Bahamas, The	1	3	Honduras	1	2	Paraguay	-	1
Bahrain	-	1	Iceland	3	4	Philippines	-	1
Belgium	1	1	India	5	9	Portugal	1	1
Belize	-	1	Indonesia	1	3	Qatar	1	1
Benin	-	1	Ireland	4	7	Romania	-	1
Bhutan	3	6	Japan	3	3	Russia	1	3
Bosnia and Herzegovina	1	1	Kiribati	2	2	Seychelles	1	14
Botswana	1	5	Lesotho	-	3	Singapore	1	-
Brazil	3	4	Macau	-	1	South Africa	105	80
Burkina Faso	-	1	Madagascar	-	1	Spain	2	5
Cameroon	-	2	Malaysia	3	4	Sri Lanka	-	1
Canada	18	21	Maldives	-	2	Sudan	-	3
Chile	1	2	Mauritius	1	5	Sweden	7	3
China	1	-	Mexico	2	3	Tanzania	-	5
Colombia	-	1	Moldova	-	1	Thailand	4	8
Congo, The Rep.	-	-	Mongolia	-	1	Turkey	-	1
Costa Rica	-	2	Mozambique	3	11	United Arab Emirates	-	5
Denmark	2	2	Myanmar	-	1	United Kingdom	15	10
Djibouti	-	1	Namibia	2	6	United States of America	83	86
Egypt	-	1	Nepal	-	2	Vanuatu	1	3
Fiji	-	1	Curacao	1	-	Zambia	4	10
France	5	3	New Zealand	3	1	Zimbabwe	2	5

Chapter 4

The knowledge-attitude-practice gaps in observed catch-and-release behaviours of recreational angling-guides

"Harmony with land is like harmony with a friend; you cannot cherish his right hand and chop off his left." – Aldo Leopold

Introduction

Recreational fisheries are a major contributor to the world fish crisis, and their effects on the resource are of growing ecological concern (Cooke & Cowx 2004). The shifting paradigm of the survivability of fishes that are subjected to catch-and-release (C&R) means there is new emphasis on improving angler-behaviour to achieve sustainability goals (Hunt et al. 2011; Hunt et al. 2013; Arlinghaus et al. 2013; Mannheim et al. 2018). Evidence of the potential for angling-guides to promote pro-environmental behaviours to their angling-clients through role modelling (see Chapter 2) may make them a meaningful target for behavioural interventions with far-reaching benefits. Considering that it is also likely that their often poor attitudes and practices may be emulated by angling-clients (see Chapters 2 & 3), it is pertinent to develop effective interventions to remediate poor behavioural norms and pervasive misconceptions of angling best-practices. While measures of knowledge, attitudes and reported behaviours from surveys may give basic insight into the behavioural intentions of angling-guides, direct observation of the actual behaviour in context is essential to inform effective behavioural intervention strategies (Steg & Vlek 2009; Nilsson et al. 2020).

There is burgeoning consensus that the future of sustainable recreational fisheries relies on encouraging anglers to adopt many unenforceable, and sometimes costly best-practice behaviours (Cooke et al. 2013). Given this, a nuanced understanding of the behaviours in question, and their underlying drivers are essential to promote them effectively (Steg & Vlek 2009). Most often, outreach campaigns aimed at promoting pro-environmental angler behaviour are based on the knowledge-attitude-behaviour (KAB) approach, while fewer have attempted to change attitudes and behaviour by other means (Mannheim et al. 2018). The simpler KAB approaches, based on the Theory of Planned Behaviour (Ajzen 1991) (see

Chapter 1), presume that the principal obstacle to pro-environmental behaviour is insufficient knowledge and poor understanding (Burgess et al. 1998). The approach further assumes that education will foster the positive attitudes towards the potential solution (e.g. C&R best-practices), thereby encouraging pro-environmental intentions and ultimately behaviour. As such, to date most efforts in the recreational angling space have been to inform anglers on what they should do (e.g. best-practice techniques) through diffusion of best-practice information to the angling public (Cooke & Suski 2005; Page & Radomski 2006; Brownscombe et al. 2015; Brownscombe et al. 2017; Sims & Danylchuk 2017). While this approach does have merit (e.g. wide-reach, cost-effectiveness) and is essential given that knowledge is a critical pre-requisite, good knowledge and positive attitudes alone have not been shown to effectively predict environmental behaviours such as recycling (Vinning & Ebrea 1992), green purchasing choices (Gutfeld 1991; Young et al. 2010), environmental consumerism (Gupta & Ogden 2006) and sustainable tourism or vacationing choices (Juvan & Dolnicar 2014). While deficient knowledge and lack of ecological awareness can certainly contribute to behaviour that is detrimental to the environment (Kollmuss & Agyeman 2002), there is in fact a complex suite of internal and external drivers which affect the probability of pro-environmental attitudes and behavioural behaviours being executed (Gifford 2014).

This potential disconnect between intention and behaviour is at the core of concerns regarding the ineffectiveness of information-based campaigns to foster actual behaviour change (McKenzie-Mohr 2000, McKenzie-Mohr 2011). There is considerable empirical evidence to show that the link between measured behavioural intentions (also inferred by measured knowledge and attitudes) and actual behaviour is quite weak (e.g. Bickmann 1972; Bergin-Seers & Mair 2009; McDonald et al. 2012; McKercher & Tse 2012). When these measured behavioural constructs (i.e. knowledge and attitudes) are at odds with actual behaviour, this disconnect is commonly referred to as a knowledge-attitude-practice (KAP) gap (Westhoff 1988). The potential gap between environmental knowledge, pro-environmental attitudes and actual environmental behaviour is well documented, but poorly understood (Kollmuss & Agyeman 2002). These gaps represent a fundamental hurdle for those seeking to promote pro-environmental angling-behaviour, because they illustrate that other, more complex drivers are at play during the decision-making process (e.g. Wallmo & Gertner 2008).

Knowledge-attitude-practice gaps have been identified in a wide variety of behavioural scenarios, including contraceptive use and family planning (Westhoff 1988; Singh et al. 2016),

hypertension and health (Joshi et al. 2018), ethical consumerism (Bousltridge & Carrigan 2000; Carington et al. 2010; Peattie 2010, Park & Lin 2018), recycling behaviours. (Chung & Leung 2007; Jekria & Daud 2016; Bendack & Attili 2017), sustainable tourism (Becken, 2004; Bergin-Seers & Mair 2009) and air travel behaviours (McDonald et al. 2015). In a study of the vacationing behaviours of environmental activists, Juvan & Dolnicar (2014) noted that all subjects were "…*highly aware of the negative environmental consequences of tourism in general, but all displayed an attitude–behaviour gap which made them feel uncomfortable.*" (Juvan & Dolnicar 2014). This discomfort, known as cognitive dissonance (Festinger 1957), refers to the psychological discomfort or frustration an individual experiences when they exhibit contradictory or incongruous attitudes, values, beliefs or perceptions about themselves, their surroundings or their behaviour, or when their behaviour is at odds with their self-perceived values, attitudes or beliefs. In a recreational fisheries context one could, for example, have concerns for fisheries decline, but harvest undersize fish, or perhaps have concerns for fish welfare, but lift a fish by the opercula (gill-plate). One avenue to remedy this discomfort, and re-achieve psychological consonance, is for the individual to adjust their behaviour, which is why arousing cognitive dissonance has demonstrated some utility in behaviour change (e.g. water-conservation – Dickerson et al. 1992).

While the instigation of mental discomfort may encourage behaviour change, psychological dissonance can also be reduced internally through *rationalization* or *justification*, thereby re-achieving psychological consonance. This was evident in the aforementioned study by Juvan & Dolnicar (2014), where the authors noted that "*Participants did not report changing their behaviour; instead, they offered a wide range of explanations justifying their tourist activities.*" Individuals may justify or rationalize their dissonant behaviours based on competing costs, benefits, and values placed on opposing behaviours. In a recreational fisheries context, an angler may be acutely aware of the fish population crisis, but still harvest their catch, rationalizing this behaviour based on the high value they place on the food value of fish. Alternatively, rationales for (or drivers of) dissonant behaviours may be explained by Attribution Theory (Heider 1985), which suggests that individuals who do not attribute the cause of the problem to their own actions are unlikely to consider changes in their own behaviour to be part of the solution to that problem. Similarly, the value-belief-norm theory of environmentalism (Stern 2000) suggests that individuals may not be aware of their impacts, and even if they are, they may assign little to no responsibility for the solution to themselves. As such, there are likely many contextually-specific internal and external barriers between an

angling-guide's pro-environmental intentions and their actual behaviour which could create a KAP gap.

Evidence suggests that angling-guides generally report having pro-environmental behavioural intentions (see Chapter 3), based on their mostly good knowledge and pro-environmental attitudes. Angling-guides face multiple barriers to their intended pro-environmental behaviour, many of which are the same faced by any angler while fishing. However, angling-guides have the additional burden of client-satisfaction to consider when making behavioural decisions. Many pro-environmental C&R behaviours have an inherent "cost", such as increased physical effort caused by required haste, or risk of poor photographs while trying to limit air exposure. The latter and other behaviours may be influenced by the pressure of ensuring client-satisfaction which is linked to considerable financial incentives, such as potential gratuities and repeat patronage. As such, the angling-guide's perception of the "costs of" (or barriers to) pro-environmental C&R behaviours may increase considerably when on guided-angling trips. The low-cost high-cost model of pro-environmental behaviour (Diekmann & Preisendoerfer 1992) illustrates that the impact of a pro-environmental attitude on the likelihood of that behaviour being exhibited stands to decrease as the associated perceived "costs" increase. As such, it is likely that angling-guides will struggle to align their intentions with their actual behaviour, resulting in a KAP gap.

Determining whether there is a gap between angling-guide intention and behaviour is a pre-requisite to inform effective intervention strategies. Based on measured intentions and reported behaviours alone, we may erroneously underestimate the extent of poor-practices on guided-angling trips and thereby underestimate the potential negative impact of role-modelling by angling-guides. Additionally, without knowledge of potential KAP gaps, future interventions may inadvertently overlook challenging barriers to certain pro-environmental C&R behaviours, such as *lack of external possibilities or incentives* (Kollmuss & Agyeman 2002), because of demands placed on the angling-guide by the angling-client market. As such, the aim of this chapter is to better understand the relationship between an angling-guide's actual observed behaviours during the catch process on guided-angling trips, and their reported behaviour, knowledge of best-practices, attitudes towards those behaviours and perceived descriptive social norm. To do this the following objectives will be addressed:

(1) Assess whether there is a gap between an angling-guide's *reported behaviours* and their observed behaviours.

(2) Assess whether there is a gap between angling-guide's *knowledge of catch-and-release* practices and their observed catch-and-release behaviour.

(3) Assess the gap between an angling-guide's observed behaviours and their *attitudes* towards those same behaviours.

(4) Assess whether there is a gap between an angling-guide's *perceived descriptive norm* and their observed behaviour.

Methods and Materials

During November 2019, 30 days were spent observing catch events during guided-angling trips at a remote recreational shore-angling destination on the mouth of the Longa River in northern Angola (Figure 4.1).
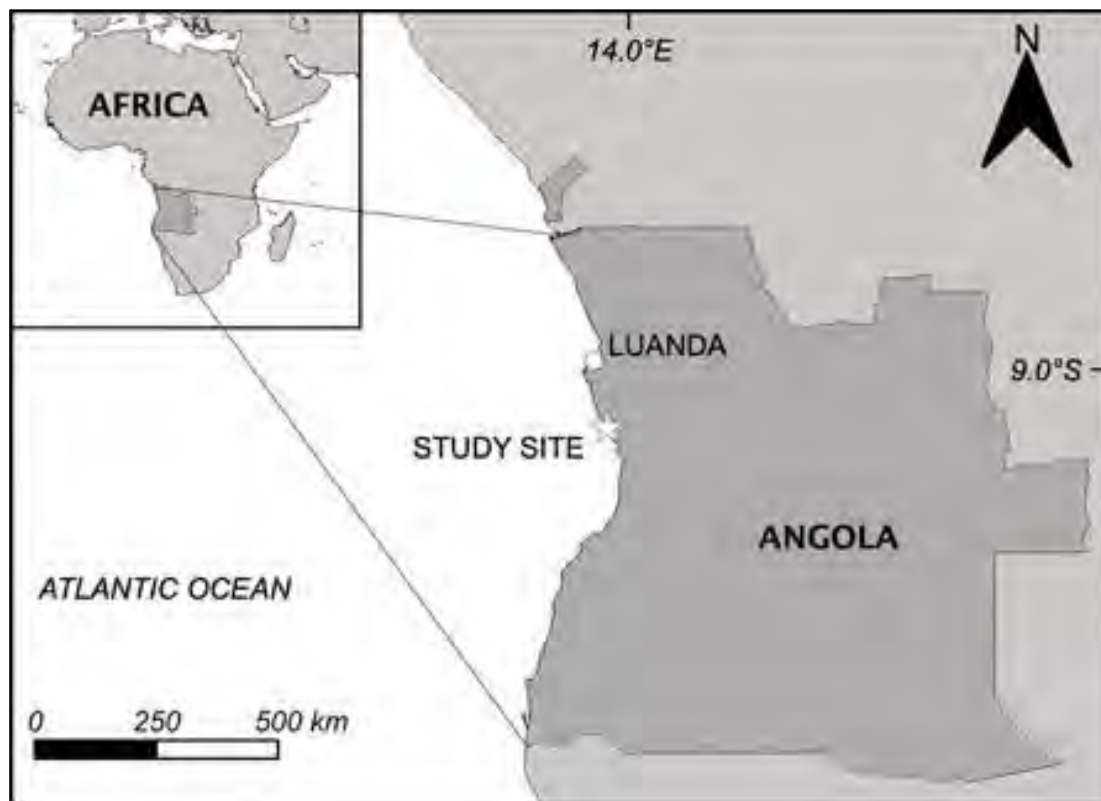
Figure 4.1: Map showing the location of the Longa River mouth (study site) in northern Angola.

The fishery is characterised by a low-energy surf-zone with a sandy beach (Figure 4.2) in the immediate vicinity of a large estuary mouth. Conventional rock-and-surf, shore-based casting tackle (9-15ft rods & 15-30lb braided line) is used to target several species (predominately *Polydactylus quadrifilis*, *Caranx hippos*, *Pseudotolithus senegalensis*, *Lutjanus dentatus*; Figure 4.3) using organic baits (usually live) and artificial lures. Angling took place during both the day and at night, and was active when using artificial lures, or passive when fishing

Figure 4.2: Typical structure of the sandy beach of the recreational shore-based fishery at the mouth of the Longa River, northern Angola.

organic baits such as live mullet (Genera: *Mugil, Liza*) or tilapia (Genera: *Oreochromis, Tilapia*) species. Most fish captured were released, although some fish (in particular white corvina (*Pseudotolithus senegalensis*) were harvested for consumption by angling-clients at the fishing camp. The camp outfitter only allows five angling-guides (the focus of this research), who regularly bring groups of clients to fish the area. The camp outfitter and angling-guides advertise the destination for its good opportunities to catch a variety of trophy fish, as large fish in excess of 100cm TL (10 – 40kg) are regularly caught by clients. Each angling-guide is ultimately responsible for their respective group of clients, their angling success and their general experience during the trip. The guided-angling trips are usually 5 – 8 days long, and angling-guides rarely overlap or share the fishing area on guided-angling trips, though all the angling-guides regularly fish together (without clients present) in their spare time.

Angling-guide behavioural assessment

During the 30-day observation period, the behaviour of angling-guides and their interaction with their clients during C&R was observed directly by a researcher present on the beach, and also recorded using GoPro video-cameras (Figure 4.4). Video recordings were supplemented
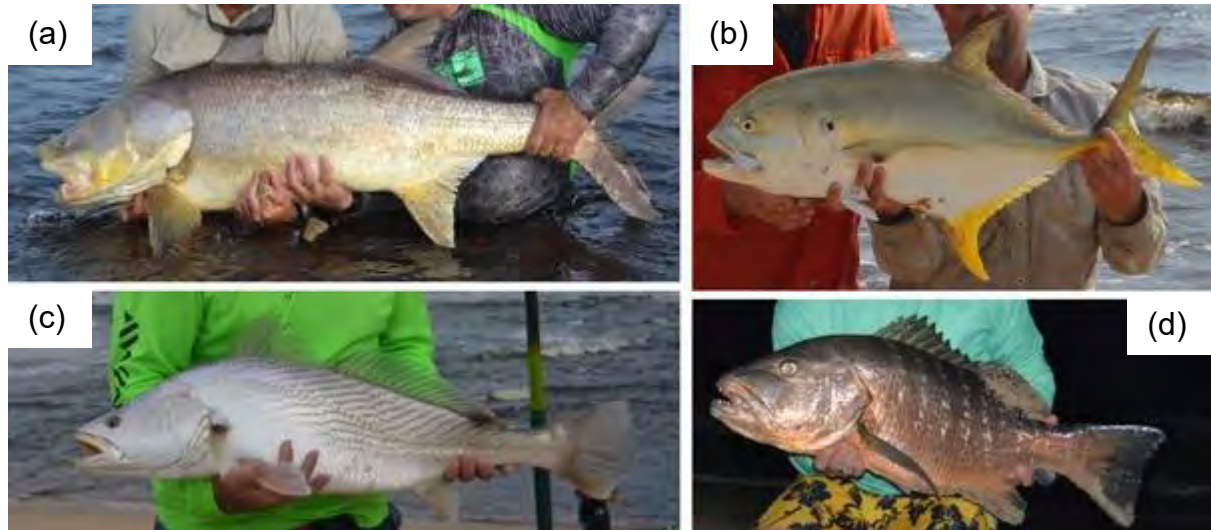
Figure 4.3: Photographs of the four major target species in the recreational shored-based fishery at the Longa River mouth, namely giant African threadfin (A; *Polydactylus quadrifilis*), jack crevalle (B; *Caranx hippos*), white corvina (C; *Pseudotolithus senegalensis*) and African brown snapper (D; *Lutjanus dentatus*

Figure 4.4: Photographs of how the video recording system was deployed to observe catch-and-release events in the recreational shore-based fishery at the mouth of the Longa River, northern Angola.

with notes from the direct observations when required, such as when activities were likely to be unclear or obscured on video. All research subjects, in this case five angling-guides (and 29 angling-clients), were aware and agreed for all angling events to be filmed. Subjects were informed that the intention of the filming was to better understand the catch process during guided-angling trips and in the specific fishery context. They were also informed that the footage was exclusively for scholarly purposes, and were assured of their anonymity. Footage of catch events was analysed after the observation period using the event-logging software BORIS (Friard & Gamba 2016), and supplemented with notes from direct observation to create the observed *behaviours of interest* data set.

For each catch event, several independent variables were recorded, including: angling-guide (the subject), number of clients, time of day, catch species, catch size, tackle used, lure/bait type, hooking-location, fight-time, air-exposure (for photos only and total) and whether the fish was harvested or released. Five *behaviours of interest* were identified by a panel of researchers with good understanding of the fishery to assess angling-guide behaviour:

1. *Selection of hooks on lures (i.e. plugs and spoons)*

All the angling-guides in the study make recommendations to their clients on equipment and tackle to purchase before the trip, and also give instructions before the angling begins on the lure type, hook type and hook size to use for the given angling activity. Most angling-clients regularly seek advice from their angling-guide regarding their tackle during the trip, and guides are constantly recommending, and sometimes even insisting on hook choices. Lures used in this fishery are often supplied by the manufacturer with treble hooks, with a hook type or size deemed unsuitable by the angling-guide, or perhaps even without hooks. Hook selection is therefore almost certainly subject to change based on angling-guide choices. Given that hooking injury is a major contributor to angled fish mortality (Muoneke & Childress 1994; Cooke et al. 2002; Cooke & Suski 2004; Ruderhausen et al. 2012), this behaviour is critically linked to the survival of released fishes.

2. *Placement of fish for unhooking*

Unless the catch is unhooked and released while the angler is wading in the water without returning to shore, the angling-guide is required to decide where to place and how to restrain the fish for the process of unhooking during every catch event in this fishery (Figure 5a, b).
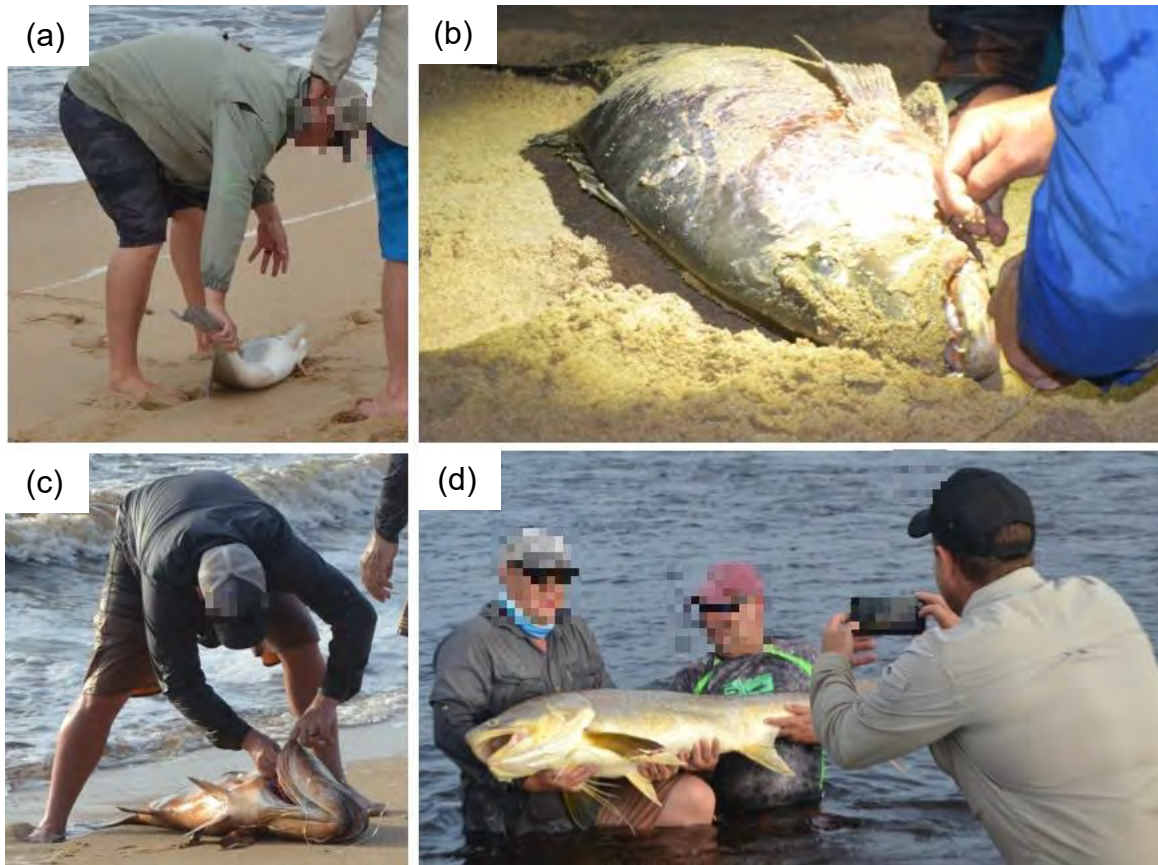
Figure 4.5: Photographs exemplifying some of the observed *behaviours of interest* on which the angling-guide survey focussed. (a) Angling-guide places the client's catch on the sand. (b) Example of how a client's catch can become covered in sand during unhooking. (c) Angling-guide enters through the opercula for unhooking during an oesophageal hooking incident. (d) Angling-guide photographs the client's catch.

Given the sandy beach context, the options are generally: "*in the water*", "*on wet sand*", "*on dry sand*", "*on a mat*" or "*in a container*". Given the abrasive nature of coarse beach sand and the sensitivity of the fish's epithelial mucus (which is critical for healthy function; Barthel et al. 2003; Esteban 2012; Benhamed et al. 2014; Foster et al. 2020), this decision may have a considerable impact on the survival of released fishes.

3. *Actions taken after oesophageal-hooking*

Hooking in the oesophagus is a common occurrence in marine-shore-based fisheries (Butler et al. 2016), and typically occurs when using organic baits and when the rod is left unattended (Brownscombe et al. 2017), which is common practise in this fishery. Oesophageal hooking also occurs when actively fishing with lures, particularly when lures are small, retrieved slowly or when the target species is aggressive and/or large enough to ingest the lure. When presented with a case of oesophageal hooking, the angling-guide has to decide whether to either "*cut the*

line immediately" or to "*first try remove the hook*" by either entering through the buccal cavity or sometimes through the opercular opening (Figure 4.5c, 4.6a, 4.6b). How to proceed in this scenario is a source of contention among recreational anglers, because of the seemingly absurd best-practice recommendation to leave the hook in place. It is not apparent to many anglers that the air-exposure and physical damage associated with difficulty unhooking (Muoneke & Childress 1994; Brownscombe et al. 2017) often does more harm than leaving the hook in place. As such, actions taken after oesophageal hooking have considerable bearing on the survival of released fishes.

1. *Air exposure (total and for photographs)*

Photographs of catches are an important part of the guided-angling trip, not only for angling-client's memories of a trophy catch, but also for angling-guides who may use the photographs for marketing. The angling-guide is normally responsible for taking the photographs (e.g. Figure 4.5d), so the duration of air-exposure for photography is typically a direct result of the behavioural choices of the angling-guides. Air exposure is a major contributor to the fish's physiological stress response (Arends et al. 1999; Danylchuk et al. 2014; Brownscombe et al. 2015; Butler et al. 2017; Arkert et al. 2018; Arkert et al. 2020; Butler et al. 2020; Pringle et al. 2020), and therefore behaviours which contribute to the duration of air exposure have considerable implications for the survival of released fishes.

2. *Sand removal before photographs*

In this particular fishery, during the landing, handling, unhooking and documentation process, fish often come into direct contact with beach sand. Whether caused by deliberately placing the fish on the sand during the unhooking process (Figure 4.5a, 4.5b), or consequence of dropping the fish during handling and taking photographs (Figure 4.7), angling-guides are often faced with the decision of if and how to remove sand from the fish before photographing the client with their catch. When presented with a fish covered in sand (e.g. Figure 4.7), angling-guides can either choose to "*not remove the sand*", "*remove the sand by hand*" (e.g. Figure 4.8), or to "*remove the sand using water*" by either returning the fish to the surf zone and washing it, or washing the sand off the fish using water from a container. As a result of the impacts of sand-abrasion on fish health, this behavioural choice may have a substantial impact on the survival of released fishes.

Figure 4.6: Photographs of practices observed while angling-guides try to remove a hook from the oesophagus of an African brown snapper (*Lutjanus dentatus*). Note the hand under the operculum and placement of the fish on sand.

These five *behaviours of interest* were chosen because they are contextually relevant, ecologically important and are within the angling-guide's internal locus of control (i.e. assumed to have high perceived behavioural control). The *behaviours of interest* were categorized as either point (i.e. occurrence) or state (i.e. duration), and may have related modifiers to further describe behaviour nuances. Some of the *behaviours of interest* may or may not occur during a given catch event depending on the process.

Figure 4.7: Photographs of angling-guides and their angling-clients dropping fish during the process of photographing the catch.

Angling-guide survey

Eighteen months after the observations of angling-guide behaviours took place, a 20-question survey, focussed on the *behaviours of interest*, was distributed to the five angling-guides who had been observed (Appendix 4.1). The angling-guides observed ranged between 32 and 53 years of age ($\overline{x}$ = 39.4 yrs.; SD = 8.14 yrs.), had between13 and 28 years of guiding-experience ($\overline{x}$ = 17.4 yrs.; SD = 6.03 yrs.) and spent between 41 and 210 days guiding anglers per year ($\overline{x}$ = 129 days; SD = 68.78 days). The survey was distributed directly to each angling-guide using Google Forms ® (Rhodes University Ethics Clearance Registration Number REC-241114-045). The survey (Appendix 4.1) comprised four sections to address the four main objectives of the study, namely *reported behaviour* (objective 1) , *knowledge of best-practices* (objective 2), *attitudes* (objective 3) and *perceived descriptive social norms* (objective 4). Each section comprised five questions, each focussed on one of the five *behaviours of interest* (Table 4.1). Questions were designed to be directly comparable to the angling-guides observed *behaviours of interest* from the observations made 18 months prior, and also between sections. Results from each survey section were compared with the observed *behaviours of interest* to generate the dependent, binomial "gap" variables. The relative frequency of gaps for the different *behaviours of interest* was assessed for independence within each section/objective using Pearson's chi-squared test for independence (Pearson 1990).

Figure 4.8: Photographic sequence of the angling-guide removing the sand off the fish by hand after the angling-client drops the fish on the beach sand.

Table 4.1: Survey questions (focussed on the five *behaviours of interest*) presented to the five angling-guides 18 months after they were observed guiding angling-clients at the recreational shore-based fishery in northern Angola during the 30-day observation period.

Behaviours of interest	Reported behaviour questions (objective 1)
(1) Hook selection on lures	*When fishing with plugs and spoons off a sandy beach, which of the following hook types do you instruct your clients to use?*
(2) Placement of fish for unhooking	*When fishing from a sandy beach for edible species, where do you place your clients fish for unhooking before photographs?*
(3) Oesophageal unhooking	*When fishing with bait and your clients edible fish is deep hooked in the throat, which of the following options best describes how you proceed?*
(4) Air exposure (for photos)	*When fishing from a sandy beach, how much time will you allow the fish to be exposed to air specifically for photographs before you insist on releasing the fish?*
(5) Sand removal before photographs	*When a client's edible fish is covered in sand before the photograph, which of the following best describes how you choose to proceed?*

Behaviours of interest	Knowledge of best-practice questions (objective 2)
(1) Hook selection on lures	*When fishing with lures off a sandy beach, which of the following hook types do you think is best to ensure the fish caught will survive after release?*
(2) Placement of fish for unhooking	*When fishing from a sandy beach, where do you think it is best to place an edible fish for unhooking to ensure it has the best chance of survival after release?*
(3) Oesophageal unhooking	*When fishing with bait and an edible fish is deep hooked in the throat, which of the following options do you think gives the fish the best chance of survival after release?*
(4) Air exposure (total)	*How much time do you think an average fish can spend exposed to air and still survive after release?*
(5) Sand removal before photographs	*When an edible fish is covered in sand before the photograph, which of the following options do you think gives the fish the best chance of survival after release?*

Behaviours of interest	Perceived norms of practice questions (objective 3)
(1) Hook selection on lures	*When fishing with lures off a sandy beach, which of the following hook types do you think other guides in South Africa instruct their clients to use on their plugs and spoons?*
(2) Placement of fish for unhooking	*When fishing from a sandy beach, where do you think other guides in South Africa place their client's fish for unhooking before photographs?*
(3) Oesophageal unhooking	*When fishing with bait and the client's fish is deep hooked in the throat, which of the following options best describes how other guides in South Africa proceed?*
(4) Air exposure (for photos)	*When fishing from a sandy beach, how much time do you think other guides in South Africa allow an edible fish to be exposed to air specifically for photographs before they insist on releasing the fish?*
(5) Sand removal before photographs	*When an edible fish is covered in sand before the photograph, what do you think other angling-guides in South Africa do?*

Behaviours of interest	Attitudes towards practice questions (objective 4)
(1) Hook selection on lures	*An angling guide instructs their clients to use treble hooks on their plugs and spoons.*
(2) Placement of fish for unhooking	*An angling guide places their client's fish on the sand above the high tide mark while unhooking.*
(3) Oesophageal unhooking	*An angling guide immediately cuts the line when their clients catch is hooked deep in the throat.*
(4) Air exposure (for photos)	*An angling guide only allows their clients 30 seconds for photographs, after which they release the fish whether they have good photos or not.*
(5) Sand removal before photographs	*An angling guide removes the sand off the fish by hand before photographs.*

1. Reported behaviour (objective 1: reported vs observed behaviour)

This section assessed what the angling-guides report their behavioural choices to be in a given situation. The questions were formulated to be situationally specific, to ensure that their reported behaviours were framed in the same context that the observations were made. If an angling-guide was observed displaying a point behaviour (i.e. occurrence) that did not match their reported behaviour, or a state behaviour (i.e. duration) which exceeded their reported behaviour, the binomial reported-observed gap variable was scored as "1", denoting that there was gap in that given *behaviour of interest* during that catch event (reported ≠ observed). Alternatively, if an angling-guide's point behaviour matched their reported behaviour, or the state behaviour was below their reported behaviour, then the binomial reported-observed gap variable was scored as "0", denoting that there was no gap, and that reported and actual behaviours were harmonious (reported = observed). Thereafter, the relative frequency (%) of reported-observed gaps for a given *behaviour of interest* was calculated as a proportion of the catch events where that *behaviour of interest* was displayed.

2. Knowledge of best-practices (objective 2: knowledge vs observed behaviour)

This section questioned what behavioural choices the angling-guides believe to be the best-practice in a given situation. Whether or not their response was in-fact correct was irrelevant for the scope of this study, because while an individual's understanding of a behaviour is a pre-determinant of their intention to perform that behaviour (Ajzen 1991), the accuracy of their understanding is not. Similar to the previous section, the binomial knowledge-observed gap variable was scored as "1" if the angling-guide's observed state behaviour exceeded (e.g. total air-exposure) or point behaviour did not match (e.g. hook type choice) their responses to the questions assessing their knowledge. As such, the presence of a knowledge-observed gap was scored as "1" (knowledge ≠ observed), but alignment and harmony between knowledge and observed behaviour was scored as "0" (knowledge = observed). Unlike other sections, which will refer to air-exposure (for photos*) as the specific *behaviour of interest*, the section on knowledge of best-practice will refer to air exposure (total*), because the question did not refer to air exposure during photographs, but air exposure overall (see Table 4.1). The relative frequency (%) of knowledge-observed gaps for a given *behaviour of interest* was calculated as a proportion of the catch events where that *behaviour of interest* was displayed.

3. Attitudes (objective 3: attitudes vs observed behaviour)

This section assessed the angling-guide's attitudes towards either the best or worst practice for each *behaviour of interest*, depending on which was practical for questioning. For air exposure (for photos), it would be difficult to present the worst practice for questioning, so the best practice of limiting the photo time to 30s was used to assess attitudes for this *behaviour of interest*. In contrast, placing the fish on dry sand is the worst practice in this context, and is therefore simpler to present as a question. Responses were measured on a five-point Likert scale of agreement, but were later refined into *agreement* ("*strongly agree*" and "*agree*"), *indifference* ("*neither agree nor disagree*") and *disagreement* ("*strongly disagree*" or "*disagree*"). For a given catch event, the binomial <u>attitude-observed gap</u> variable was scored as"0" if attitudes aligned with observed behaviour (attitude = observed), indicating no gap between attitudes and observed behaviour. Conversely, the <u>attitude-observed gap</u> variable was scored as "1" if the observed behaviour contradicted the attitude measured (attitude $\neq$ observed), denoting the presence of a gap. Contradictory attitudes could be either *agreement* or *disagreement*, depending on whether the particular survey question portrayed the best or worst practice for the *behaviour of interest. Indifferent* attitudes were excluded. As for all previous gaps, the relative frequency (%) of <u>attitude-observed gaps</u> for a given *behaviour of interest* was calculated as a proportion of the catch events where that *behaviour of interest* was displayed by an angling-guide.

4. <u>Perceived norms (objective 4: perceived norms vs observed behaviour)</u>

This section questioned the angling-guides' perception of the descriptive social norms of the *behaviours of interest*. Here, "*other **angling-guides** in southern Africa*" was considered to be the community of peers by which the norm is set, because the behaviours in question are specific to catch events on guided-angling trips, and not recreational angling in general. Similar to the previous section, the binomial <u>norm-observed gap</u> variable was scored as "1" if the angling-guide's observed state behaviour exceeded (e.g. air exposure) or point behaviour did not match (e.g. oesophageal-unhooking practice) their responses to the questions assessing their perceived norm for that *behaviour of interest*. As such, the presence of a <u>norm-observed gap</u> was scored as "1" (perceived norm $\neq$ observed), but alignment and harmony between the angling-guide's perceived norm and their observed behaviour was scored as "0" (perceived norm = observed). As before, the relative frequency (%) of <u>norm-observed gaps</u> for a given *behaviour of interest* was calculated as a proportion of the catch events where that *behaviour of interest* was displayed by an angling-guide.

Results

Observations of catch events and behaviours of interest

During the 30-day observation period, 66 complete catch events were observed, recorded and later assessed (Table 4.2; Appendix 4.2). Catches were dominated by white corvina (*Pseudotolithus senegalensis*; 47.0%) and African brown snapper (*Lutjanus dentatus*; 21.2%). Most of the fish caught were between 50 and 99 cm (TL), and most were released (77.3%; Table 4.2). Most catches took place during daylight hours (78.8%), primarily using live-bait (45.5%) and "spoons" (31.4%) with "medium strength" ($20 \leq 30$lb braided line) tackle (50.0%) (Table 4.2). The average fight-time ($\overline{x}$ = 301.5 sec; SD = 347.2 sec.), air exposure for photographs ($\overline{x}$ = 76.8 sec; SD = 60.8 sec.) and total air exposure (102.5; SD = 74.4 sec.) all increased with size of catch (Table 4.2). On average, air exposure for photographs accounted for 49.5% (range: 11.1 – 90.0%) of total air exposure. The five *behaviours of interest* were not observed in every catch event. Hook selection on lures (i.e. plugs and spoons) was observed in 23 catch events, while placement of fish for unhooking was observed in 61. All 66 catches were subjected to some amount of air exposure for unhooking, while 45 of those catches were subjected to additional air exposure for photographs. Oesophageal hooking was observed in five of the catch events, and sand removal before photographs was observed during 16 catch events.

Angling-guide survey

For most behaviours of interest, the angling-guide's reported *behaviours* were well-aligned with their knowledge of best-practices for those same behaviours (Table 4.3). However, their reported placement of fish for unhooking was not well-aligned with their knowledge of best-practice for this behaviour, with 4/5 angling-guides having knowledge of a better practice than their own (Table 4.3). Similarly, reported *behaviours* were generally well-aligned with attitudes towards those same behaviours, except for oesophageal unhooking, which had the most contradictions between angling-guides attitudes and reported behaviours (Table 4.3). In contrast, angling-guides indicated perceived norms which were worse practices than their own reported behaviours, or closely aligned with them, but never perceived the norm as a better practice than their own (Table 4.3). The reported behaviour of most (4/5) angling-guides aligned with their perception of the norm for both hook selection on lures, and placement of fish for unhooking, but 4/5 indicated that the norm for air exposure (for photos) was worse (i.e. higher duration) practice than their own, and 3/5 indicated that the norm for sand removal

before photographs was "*by hand*", which is a worse practice than that reported as their own (i.e. "*in the surf*"; Table 4.3).

Table 4.2: Summary of fishery metrics, target species, angling facets and incidents where *behaviours of interest* where observed in the footage of the 66 catch-events filmed during the 30-day observation period at the shore-based recreational fishery in northern Angola, supplemented with notes from direct observation.

Variable	All	0-49cm	50-99cm	100cm +
Catch events (n)	66	15	42	9
Catch harvested (n)	15 (22.7%)	2	11	2
Catch released (n)	51 (77.3%)	13	31	7
Species caught (n)				
White corvina	31	9	22	-
African brown snapper	14	-	10	4
Jack crevalle	7	2	5	-
Giant African threadfin	6	1	2	3
Other	5	1	4	-
Tackle choice (n)				
Light (< 20lb)	7	-	6	2
Medium (20 ≤ 30lb)	33	13	19	1
Heavy (30lb <)	25	2	17	6
Fight time				
Fight time (mean ± SD) sec.	301.5 ± 347.2	70.5 ± 38.5	286.9 ± 298.2	754.6 ± 434.6
Fight time (range) sec.	30.0 - 1435.1	30 - 150.6	16.9 - 1301.9	151.9 - 1435.1
Facet (n)				
Bait (live)	30	2	23	5
Lure (spoons)	21	8	13	-
Lure (soft body)	8	3	3	2
Bait (dead)	4	2	-	2
Lure (plugs)	2	-	2	-
Lure (hardbody)	1	-	1	-
Time of day (n)				
Day	52	13	35	4
Night	14	2	7	5
Behaviours of interest (incidences and duration)				
(1) Hook selection on lures (i.e. spoons and plugs) (n)	23	8	15	-
(2) Placement of fish for unhooking (n)	61	12	40	9
(3) Air exposure (photo*) (n)	45	5	31	9
(3) Air exposure (photo*) ($\bar{x}$ ± SD) sec.	76.8 ± 60.8	35.3 ± 14.9	71.1 ± 55.2	119.5 ± 74.5
(3) Air exposure (photo*) (range) sec.	11.2 - 267.2	19.9 - 53.8	11.2 - 267.2	38.1 - 256.3
(3) Air exposures (n)	66	15	42	9
(3) Air exposure (total*) ($\bar{x}$ ± SD) sec.	102.5 ± 74.4	49.1 ± 34.7	103.8 ± 63.4	185.7 ± 94.6
(3) Air exposure (total*) (range) sec.	3.7 - 354.4	3.7 - 115.2	6.7 - 307.2	62.7 - 354.4
(4) Oesophageal hooking incidents (n)	5	1	3	1
(5) Sand removal before photographs (n)	16	1	12	3

Table 4.3: Results of the angling-guide survey distributed to each of the five angling-guides who were observed guiding angling-clients at the recreational shore-based fishery in northern Angola during the 30-day observation period. (Attitudes: SD - *strongly disagree*; D - *disagree*; NAND - *neither agree nor disagree;* A - *agree;* SA - *strongly agree*).

Behaviours of interest	Survey sections for gap objectives (1-4)	Individual angling-guide's (1-5) responses to survey questions				
		1	2	3	4	5
(1) Hook selection on lures	(1) Reported behaviour	*J-hook*	*J-hook*	*J-hook*	*J-hook*	*J-hook*
	(2) Knowledge of best practice	*J-hook*	*J-hook*	*J-hook*	*J-hook*	*J-hook*
	(3) Perceived norm of practice	*J-hook*	*J-hook*	*J-hook*	*Treble hook*	*J-hook*
	(4) Attitude towards "using treble hooks"	SD	SD	SD	SD	SD
(2) Placement of fish for unhooking	(1) Reported behaviour	*On wet sand*	*On wet sand*	*On wet sand*	*On wet sand*	*On wet sand*
	(2) Knowledge of best practice	*In the water*	*On wet sand*	*In the water*	*On a sling/mat*	*In the water*
	(3) Perceived norm of practice	*On wet sand*	*On wet sand*	*On wet sand*	*On wet sand*	*On dry sand*
	(4) Attitude towards "placing on dry sand"	SD	SD	SD	SD	SD
(3) Actions taken after oesophageal hooking	(1) Reported behaviour	*First try remove*	*Cut line immed.*	*Cut line immed.*	*First try remove*	*Cut line immed.*
	(2) Knowledge of best practice	*First try remove*	*Cut line immed.*	*First try remove*	*First try remove*	*Cut line immed.*
	(3) Perceived norm of practice	*First try remove*	*First try remove*	*First try remove*	*First try remove*	*First try remove*
	(4) Attitude towards "cut-line immediately"	A	SA	A	NAND	A
(4) Air exposure (total and for photos)	(1) Reported behaviour (Photo time*) sec	60	60	90	60	30
	(2) Knowledge (Total air exposure*) sec	90	90	150	60	60
	(3) Perceived norm (Photo time*) sec	60	90	120	180	60
	(4) Attitude towards "30sec only"	A	A	A	A	A
(5) Sand removal before photographs	(1) Reported behaviour	*In the surf*	*In the surf*	*In the surf*	*In the surf*	*In the surf*
	(2) Knowledge of best practice	*In the surf*	*In the surf*	*In the surf*	*In the surf*	*In the surf*
	(3) Perceived norm of practice	*By hand*	*In the surf*	*By hand*	*In the surf*	*By hand*
	(4) Attitude toward "sand removal by hand"	D	D	D	D	NAND

When selecting hooks for use on lures (i.e. plugs and spoons), all five angling-guides reported recommending "*j-hooks*" to their clients, and all indicated that "*j-hooks*" were best-practice (Table 4.3). Most angling-guides (4/5) also believed that other angling-guides used "j-hooks", and all *strongly disagreed* with the use of "*treble hooks*". Regarding placement of fish for unhooking, all five angling-guides reported that they place the fish "*on wet sand*" for unhooking, but only 1/5 indicated that this was the best-practice (Table 4.3), with the remainder (4/5) suggesting that "*in the water*" or "*on a mat*" was better practice. Most angling-guides (4/5) suggested that "*on wet sand*" was the norm for this *behaviour of interest*, and all angling-guides *strongly disagreed* with placing a fish "*on dry sand*". When faced with oesophageal hooking, most angling-guides (3/5) reported that they "*cut the line immediately*", but most (3/5) believed that it was best practice to "*first try remove the hook*". Conversely, all angling-guides indicated that the norm for this *behaviour of interest* was to "*first try remove the hook*", but most (4/5) were in agreement with "*cutting the line immediately*". Regarding air-exposure (total and for photos), angling-guides reported allowing air-exposures between 30s and 90s for photographs, and indicated that a fish could survive between 60s and 150s of total air-exposure (Table 4.3). The angling-guides' perceptions of the norm for air-exposure for photographs was between 60s and 180s, and all *agreed* with only allowing 30s. When encountering a fish covered in sand before photographs, all angling-guides reported washing the sand off the fish "*in the surf*". All stated that this was the best practice (Table 4.3), and most "*disagreed*" with removing the sand "*by hand*", which was most commonly perceived as the norm.

Frequency of observed gaps

Overall, 59.8% of the angling-guides' observed *behaviours of interest* were at odds with reported behaviours (Figure 4.9a), while 75.6% did not align with their knowledge of the best-practice (Figure 4.9b), and 50.5% did not align with their attitudes (Figure 4.9c). When comparing angling-guides' observed behaviour with their perceptions of the norm, there was a much lower frequency of gaps (19.1%; Figure 4.9d). Consequently, 80.9% of observed *behaviours of interest* were aligned with perceived norm. The frequency of observed gaps varied significantly ($p < 0.00$) between the five *behaviours of interest* in all four of the gap objectives (Figure 4.9).

The frequency of gaps between reported and observed behaviour varied significantly between the five *behaviours of interest* (objective 1; $p < 0.00$; $\chi 2 = 68.926$; $df = 4$; Figure 4.9a). There were no reported-observed gaps for hook selection on lures, while the highest reported-
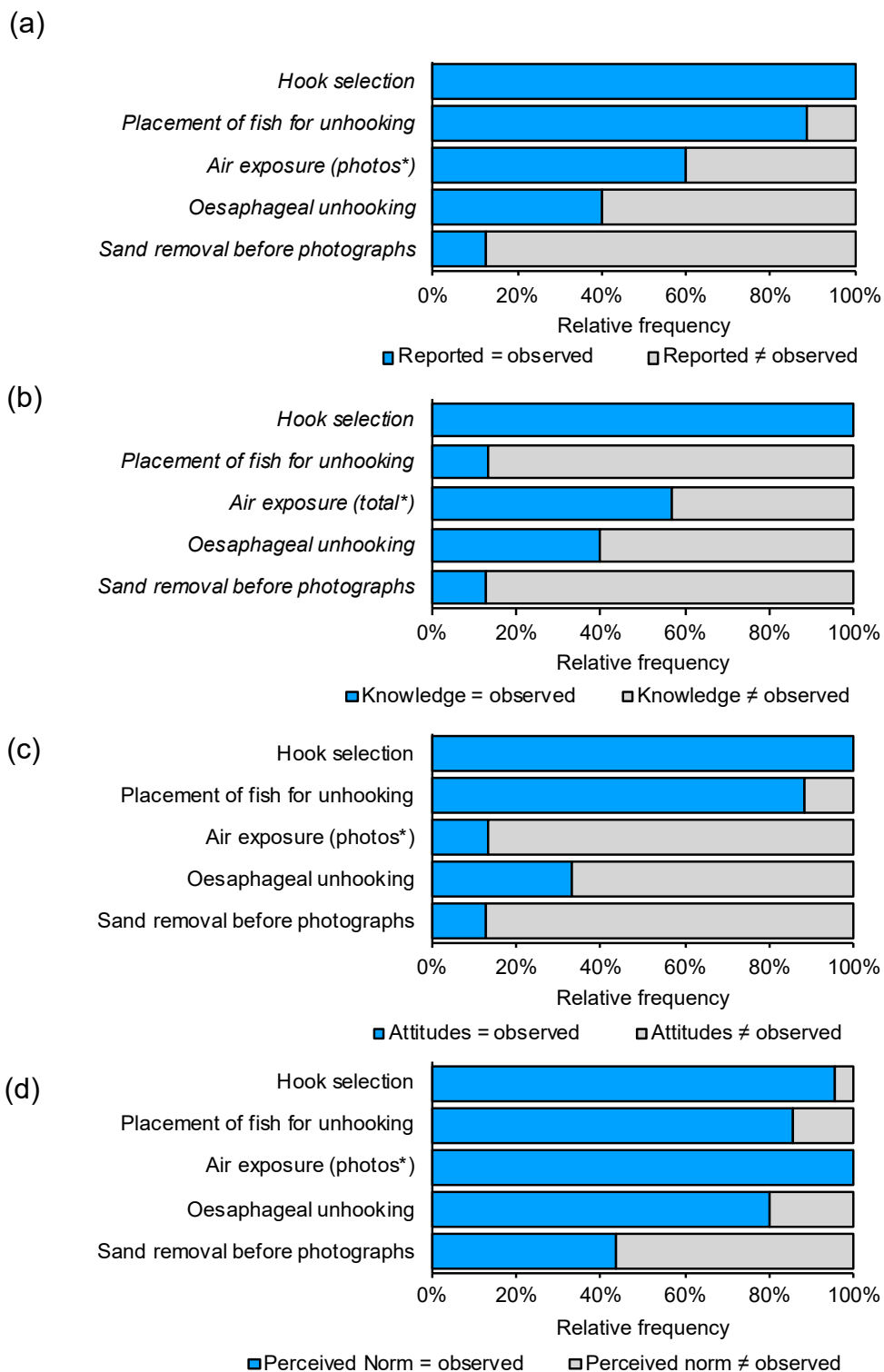
Figure 4.9: The relative proportion of observed angling *behaviours of interest* performed by angling-guides, categorised as either in alignment with (blue), or misaligned/dissonant (grey) of their (a) reported behaviour, (b) knowledge of behavioural best practice, (c) attitudes towards the behaviour and (d) perceived norm.

observed gap frequency (87.5%) was for <u>sand removal before photographs</u> (Figure 4.9a). Similarly, the frequency of gaps between <u>knowledge of best practices</u> and <u>observed behaviour</u> varied significantly between the five *behaviours of interest* (objective 2; p < 0.00; $\chi 2 = 83.506$; df = 4; Figure 4.9b). Following a similar pattern to the reported-observed gaps (Figure 4.9a), there were no knowledge-observed gaps for <u>hook selection on lures</u> (Figure 4.9b), while the highest knowledge-observed gap frequency was observed for <u>sand removal before photographs</u> (Figure 4.9b). The relative frequency of reported-observed and knowledge-observed gaps was similar for all the *behaviours of interest* except <u>placement of fish for unhooking (Figure 4.9a, b)</u>, which had a much higher <u>knowledge-observed gap</u> frequency (86.9%) than that of <u>reported-observed gaps</u> (11.5%).

As with previous gap objectives, the frequency of gaps between <u>attitudes</u> and <u>observed behaviour</u> varied significantly between the *behaviours of interest* (obj. 3; p < 0.00; $\chi 2 = 83.869$; df = 4; Figure 4.9d). In a similar fashion to the <u>reported-observed gaps</u>, the lowest frequency of <u>attitude-observed gaps</u> was observed for <u>hook selection on lures (i.e. plugs and spoons)</u>, while the highest frequency of <u>attitude-observed gaps</u> was for <u>sand removal before photographs</u>. The frequency of <u>attitude-observed gaps</u> (Figure 4.9c) and <u>reported-observed gaps</u> (Figure 4.9a) was similarly low for <u>placement of fish for unhooking</u>, which is the *behaviour of interest* which had one of the highest frequencies of <u>knowledge-observed gaps</u>. Conversely, there was a much higher <u>attitude-observed gap</u> frequency for <u>air-exposure (for photos)</u> than that for <u>reported-observed</u> or <u>knowledge-observed gaps</u> for the same *behaviour of interest*, because all angling-guides "*agreed*" with limiting air exposure for photographs to 30s, but all regularly exceeded this in the <u>observed behaviour</u>.

Like all previous gap objectives, the frequency of gaps between <u>perceived norm</u> and <u>observed behaviour</u> varied significantly between the *behaviours of interest* (obj. 4; p < 0.00; $\chi 2 = 171.587$; df = 4; Figure 4.9c). However, there was a lower frequency of <u>norm-observed gaps</u> in most of the *behaviours of interest,* particularly those which were most dissonant/contradictory in the three other gap objectives. Overall, when comparing the frequency of <u>norm-observed gaps</u> with other gap variables, there was stronger alignment of <u>observed behaviours</u> with <u>perceived norm (Figure 4.9d)</u> than that with <u>reported behaviour (Figure 4.9a)</u>, <u>knowledge of best practices (Figure 4.9b)</u> and <u>attitudes towards the behaviour</u> (Figure 4.9c).

Discussion

Angling-guides are respected members of the recreational angling community, and may have considerable, far-reaching influence on angler's pro-environmental behavioural intentions. Given this, it is not only useful, but also pertinent to intervene at guide level to remediate misconceptions and promote otherwise unenforceable best-practice angling behaviours. Understanding the strength of the link between the pre-determinants of behavioural intention (on which traditional interventions focus), and the actual behaviour of angling-guides is essential to design cost-effective interventions. The relationship between an angling-guide's actual observed behaviour, their reported behaviour, their knowledge of best-practice, their attitudes towards the behaviour and their perceptions of the social norm varied substantially between the five *behaviours of interest,* but was similar between the five angling-guides. Angling-guides generally reported behaving in a manner, which to their knowledge, was the best-practice, and generally displayed attitudes which supported this notion. However, when comparing their observed behaviour with their own knowledge, there was a considerable gap between what the angling-guides did and what they thought was most pro-environmental. Furthermore, when comparing their actual behaviour with their own attitudes, there was appreciable dissonance. Generally, angling-guide's perceptions of the descriptive social norm depicted practices that were similar or "worse" than what they reported their own behaviour to be. Conversely, their observed behaviour aligned more with their perceptions of this norm. This indicates there is indeed a knowledge-attitude-practice gap in the angling-guide's *behaviours of interest*. This KAP gap, and the strong alignment of their behaviour with how they believed others behaved suggests that interventions employing only the simplistic knowledge-attitude-behaviour approach may be of limited use in fostering actual behaviour change in this space. As such, angling-guide interventions need to leverage a wider range of behavioural insights and cognitive biases to overcome the barriers to pro-environmental behaviour on guided-angling trips, incorporating models with stronger emphasis on social-norms to achieve social impact.

The considerable discrepancy between the reported and observed angling-guide behaviour is likely the product of many interwoven factors which may vary depending on the individual. In this case-study, questions regarding state (i.e. duration) behaviours, such as air exposures for photos, are likely troublesome for angling-guides to report accurately, given their specificity for time. As such, the discrepancy between some reported and observed behaviours may simply be the result of an innocent/inadvertent self-report bias (Donaldson & Grant-Vallone 2002)

resulting in an inaccurate response. Alternatively, given the human tendency to overestimate our own ability and performance (Lake Wobegon effect - Cannell 1987; Carney 1991), it is possible that angling-guides may sub-consciously report behaviours that are, to their own knowledge, "better" than the reality (i.e. illusory superiority bias - Hoorens 1993), especially when that behaviour is difficult to recall (i.e. recall bias - Sacket 1979). However, most of the *behaviours of interest* represent very clear choices (e.g. hook selection, sand removal practice) with distinct behavioural actions. These familiar choices (perhaps even habits) should not be difficult to recall accurately. While sub-conscious self-serving biases may be partly responsible for the discrepancy between reported and observed behaviour, other conscious biases, such as social-desirability bias may also have an effect.

Social-desirability bias (Warner 1965) is perhaps the most common reason for respondent's knowingly reporting behaviours that do not align with their own. When behaviours are sensitive (e.g. alcohol consumption, sexual activity), or respondents fear social judgement (e.g. shared resource use behaviours), they may report themselves behaving in a manner they believe others think they should behave (Sj str m & Holst 2002). In this case-study, it is possible that the angling-guides are aware of the growing social pressures to be more environmentally responsible, and may believe that pro-environmental angling behaviours, such as C&R best-practices (Brownscombe et al. 2017), are socially-desirable, especially by fisheries researchers, with whom they likely closely associate this growing social pressure. This was highlighted in this study by the strong alignment between what they reported their behaviour to be and what they believed to be the best-practice for the given *behaviour of interest*. Thus angling-guides may have felt compelled to report what they each believed was most pro-environmental and thereby most socially-desirable, especially when questioned by fisheries researchers. Social desirability bias is likely to affect the reporting of attitudes in the same way, whereby respondents are more likely to agree with socially desirable behaviours than behaviours they deem to be undesirable by others (especially fisheries researchers). Therefore a combination of conscious and sub-conscious self-serving biases likely contribute to the discrepancy between reported and observed behaviours, with knowledge of the best-practice playing a role in the extent of the gap.

It is difficult to understand whether reported behaviour, knowledge and attitudes give an accurate depiction of genuine behavioural intention, given the myriad of potential biases in their measurement. Given the susceptibility of reported behaviours and measured attitudes to

recall and social-desirability response bias, it is difficult to understand the true behavioural intentions of the angling-guides surveyed in this study. On one hand, ignoring the potential for the aforementioned measurement biases, the angling-guides appear to be knowledgeable, have pro-environmental attitudes and generally report behaviours that align with best-practices. As such, the discrepancy between their reported and observed behaviours could be attributed to contextual barriers which may prohibit angling-guides from executing their pro-environmental intentions. Alternatively, assuming that angling-guides' reported behaviours and attitudes were subject to considerable social-desirability response bias in the survey, it is possible that their true behavioural intentions are in fact "worse" than those measured, and at odds with their pro-environmental knowledge, which is not subject to the same bias. While not profoundly different from the former, this scenario illustrates a barrier to pro-environmental behaviour in the form of a conscious, pre-conceived intention to behave in a manner which is knowingly environmentally deleterious. This poor intention is likely based on the high value placed on some other competing benefit, or the high perceived "costs" associated with the alternative pro-environmental behaviour in a specific context. This highlights that intervention efforts must avoid unilateral behavioural assumptions, because individuals may be motivated by very different factors (Heimlich & Ardoin 2008). Irrespective, the knowledge-attitude-practice gap identified in this study exemplifies the complexity associated with pro-environmental behaviour intervention, and highlights that there are likely many contextually-specific barriers to overcome in order to reach sustainability goals.

On guided-angling trips, many pro-environmental best-practice C&R behaviours require more time, effort and sacrifice to employ, and may detract from some individual manifestations of angling-enjoyment. As a result, an angling-guide's pro-environmental attitudes may be at odds with their attitudes towards client satisfaction, business success and potential gratuities. The low-cost high-cost model of pro-environmental behaviour (Diekmann & Preisendoerfer 1992) posits that the perceived "cost" of the pro-environmental behaviour negatively affects the influence of the relevant attitude on the likelihood of the behaviour being exhibited. In this model, the "cost" is broad and subjective, and could be time, effort, inconvenience, discomfort or even actual economic cost. While this model is simplistic and overlooks much behavioural nuance, it helps illustrate why some *behaviours of interest*, such as hook selection on lures, with relatively low "costs" (i.e. inconvenience, effort or sacrifice of success) have lower KAP gap frequency. Conversely, sand removal behaviour had the highest frequency of KAP gaps, and likely has the best-practice with the highest "costs" in the form of increased effort,

inconvenience and potential physical discomfort of having to carry and fill large water containers, or enter the surf-zone to collect water to do so. Similarly, there was a high KAP gap frequency in air-exposure (for photos). This is likely because limiting the time allowed for photographs in an effort to reduce air-exposure may come at the "cost" of reduced angler satisfaction, given the socio-cultural importance of good photographs of memorable catches in the angling-community. As such, angling-guides have the additional burden of balancing the "cost" of the best-practice against the "cost" of reduced angling-client satisfaction. Thus the guide behaviour in this case, may be largely dependent on the client and market demands. Angling-guides may therefore find it easier to align their knowledge, attitudes and behaviour when there is little at stake in the form of personal "cost" (e.g. loss of potential gratuities), or "cost" to their clients (e.g. dissatisfaction). Incorporating these behavioural insights into intervention efforts is critical for overcoming the contextual barriers to pro-environmental behaviour on guided-angling trips.

Angling-guides are likely faced with a considerable psychological trade-off in their environmental behaviour on guided-angling trips. On one hand, angling-guides may be motivated (anthropocentrically or biocentrically) to behave pro-environmentally to ensure the integrity and longevity of the fishery they likely value highly (both economically and eco-centrically). On the other hand, they may be compelled to behave in an ecologically deleterious manner to ensure the satisfaction of the clientele, on which they also depend financially. While the results of this trade-off depend largely on the individual angling-guide's characteristics (e.g. nature of conservation motivations, socio-economic status, morality, pro-environmental consciousness etc.) and the market-related behavioural demands, the evidence of a KAP gap suggests that best-practice knowledge and pro-environmental attitudes do little to moderate the eventual outcome in this case study. However, the strong alignment of observed behaviour with perceived descriptive social norms suggests that social-norms may be strong moderators of behaviours in this space, and therefore their impact and utility in pro-environmental angling-guide interventions must be explored.

Social norms are known to strongly affect how humans behave, driving their desire to conform and avoid the disapproval of others in their community (Elster 1989). While there are several types of norm, the perceived descriptive (what is commonly done) and injunctive (what "ought" to be done) social norms (as per Cialdini et al. 1990) are most relevant for behaviour change (Bova et al. 2017). While this study only endeavoured to collect a basic understanding

of what angling-guides believe other angling-guides do (perceived descriptive norm), their reported behaviour (and its discrepancy from observed behaviour) may reflect social pressure to report socially-desirable behaviours that "ought to be done". On one hand, this social pressure may be from social-desirability response bias described earlier, out of fear of scrutiny by fisheries researchers during the survey. Alternately (perhaps additionally), it may reflect normative pressures to report behaviours that align with the injunctive norm, which describes what is acceptable and what should be done, and is set by those actually present during normal behaviour. In this study, angling-guides generally reported behaviours which they believed were best-practice and socially desirable by researchers and/or peers ("proxy" for injunctive norm), when in reality, their observed behaviours were generally not. In fact, their observed behaviours were well-aligned with how they believed other angling-guides behave (perceived descriptive norm), which was generally a worse practice than what they reported their own behaviour to be. While certainly not a robust assessment, there are perhaps considerable discrepancies between how angling-guides perceive their own behaviour, and how they perceive the behavioural norm.

Misperceptions of various norms have considerable environmental implications, because it is possible that individuals may perceive the social norms of environmental behaviour as "worse" than their own, when in fact it is similar. This is especially problematic because it can potentially encourage the display of, or rationalization for, poor behaviour by allowing individuals to adjust their behaviour to match the "pseudo-norm" they have misperceived (Prentice & Miller 1996; Berkowitz 2005; Bova et al. 2017). This false-consensus may provide means for angling-guides to reduce their psychological dissonance when faced with a significant trade-off between the "costs" (e.g. client dissatisfaction) of a best-practice behaviour which they know is valuable, and the potential benefits (i.e. gratuities) of the alternative, knowingly worse practice (ecologically). As such, an investigation of the social norms on guided-angling trips, and their underlying factors will be especially useful for intervention efforts in this space.

There is an interesting contradiction in what angling-guides might construe to be socially-desirable angling behaviour on guided-angling trips. On one hand, the angling-guides appeared to acknowledge the social-desirability of pro-environmental best-practices by reporting their behaviours to be what they believe is best. On the other hand, the strong alignment of observed behaviour with the perceived descriptive norm suggests that it may be socially-desirable for

angling-guides to behave in the same manner as other angling-guides. However, behaving in the same manner as their peers, by their own assessment, would be a knowingly worse practice than what they deem to be socially-desirable in the first place. Furthermore, angling-guides generally operate outside of the direct scrutiny of other angling-guides (their peers in the perceived descriptive norm in this study), with only their clients present. It is therefore important to understand which "group" accounts for the strongest normative pressure. While the questions in this study were hyper-focussed on specific angling-guide C&R *behaviours of interest*, and that of their angling-guide peers, perhaps the strongest normative pressure on angling-guides is to simply defer to client demand (real or perceived), irrespective of what the specific behaviour is. As such, angling-guides may have an idea of what is typically done by others (perceived descriptive norm) which steers how much they can deviate from the general injunctive norm whilst still fulfilling their obligations for client satisfaction, which is perhaps the most powerful norm in the industry. Deviating from this norm likely has the most economic ramifications, and may render angling-guides unable to compete with others in the market with whom clients are more satisfied.

The KAP gap identified in this study represents a fundamental hurdle for the preservation of environmental integrity, as most ecological problems are rooted in human behaviour (Gardner & Stern 2002). In the context of this study, the *behaviours of interest* have important implications for the survival of fishes that are subjected to C&R. While it must be reiterated that the accuracy of the responses to the knowledge of best-practices was irrelevant to the aim of this study, it must be noted that in all cases where gaps between observed behaviour and knowledge occurred, the individual's responses to the knowledge questions were more aligned with best-practices (Brownscombe et al. 2017) than observed behaviour. As such, the high frequency of gaps between knowledge and observed behaviours not only suggests that there may be contextual barriers to pro-environmental behaviour, but also a high frequency of knowingly poor environmental practices with considerable ecological consequences. Therefore, these gaps not only inform future intervention methodologies, but also motivate the absolute necessity for intervention to remediate current angling-guide behaviour on guided-angling trips.

This study provides important behavioural insight for future efforts to develop pro-environmental interventions aimed at changing angling-guide C&R behaviours while on guided-angling trips. That said, it is only a case-study of a single fishery with five angling-

guides overtly observed for a limited time-period, and results should be seen as exploratory. The potential for social-desirability to affect the behaviour of angling-guides during observation, and their subsequent responses to the survey represents a caveat. While the study methodology went to great lengths to ensure subject concealment, it cannot guarantee that angling-guides did not show "better than normal" behaviours during guided-angling trips knowing they were being observed and filmed. However, this potential bias was likely to only minimize the observed gaps, and as such we must consider that actual angling-guide behaviour may be worse than that observed in this study, and therefore the extent of the gap is potentially larger than that presented herein, and not smaller. Furthermore, knowledge that they had been filmed may have led some angling-guides to adjust their responses for reported behaviours to match what they believed had been filmed. That said, a considerable 18-month period between the observations and the survey was allowed and this likely reduced the angling-guide recollection of any potential contradictions between their reported behaviour responses and their actual behaviour during observation. Given the considerable period between observation and surveying, it is impossible to know whether angling-guides underwent significant improvements in knowledge or changes in attitude in this time. As our research group is the only one working on improving recreational angler behaviour in southern Africa and we deliberately did not conduct any interventions during this period, we feel that we can assume that knowledge and attitudes were similar between the observation period and the surveys.

In conclusion, this exploratory case-study presents evidence to suggest that there is a considerable knowledge-attitude-practice gap in angling-guide behaviour on guided-angling trips. The frequency of gaps varied depending on the *behaviour of interest*, and it appeared as though the discrepancy between knowledge, attitude and behaviour was highest for behaviours with poor practice alternatives that had the greatest collective benefits for client satisfaction. Observed angling-guide behaviour aligned best with their perceptions of how other angling-guides behaved, which was generally a worse practice than what they reported their own to be. As such, it appears that social norms may play a considerable role in moderating angling-guide behaviour, especially when they have good knowledge of what should be done (e.g. best-practice), but choose not to do so. Consequently intervention efforts aimed at changing angling-guide behaviour must consider that there are several considerable contextual barriers to overcome, and the knowledge-attitude-behaviour approach traditionally applied in the angling-space will be of little use when the benefits of the alternative negative behaviours are high.

In future, effort must be made to better understand the source of normative pressures in the guided-angling industry, and to correctly assess what those norms are in order to remediate potential misperceptions. Additionally, the role of the clientele and their manifestations of angling-enjoyment and socially-desirable angling-guide behaviour in shaping the social-norm must also be explored, given that angling-guides depend on client satisfaction for financial security. Without effective intervention, angling-guides are likely to continue to behave poorly if that is what the market demands. Therefore, a pragmatic and holistic intervention approach with a strong emphasis on promoting benefits and overcoming barriers is essential to foster actual behaviour change in this complex space. As such, the Community-Based Social Marketing (CBSM) approach (McKenzie-Mohr 2000), which has emerged from the Theory of Planned Behaviour and incorporates commercial marketing principles to systematically identify and address the barriers and benefits for desired behaviours may hold promise for fostering actual behaviour change in the angling-guide community.

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Appendices

Appendix 4.1: Google Forms ® Survey distributed electronically to the five angling-guides 18 months after they were observed on guided-angling trips.

Rock & Surf Angling Guide Survey

This survey aims to better understand how angling guides view the catch-and-release process during rock-and-surf guided trips while fishing from sandy beaches. There questions follow the catch-and-release process, asking information about your choices, what you think other guides do and what you think is best. There are no personal questions, so your answers are completely anonymous. Your input will help research to better understand and improve catch-and-release practices in South Africa.

* Required

1. How old are you?

_____

2. Do you agree to take part in this survey? *

   Mark only one oval.

   ◯ Yes

   ◯ No

The following set of questions is about your guiding experience, fishing habits, skills and choices.

3. How many years experience do you have guiding anglers?

_____

4. On average, how many days a year do you guide anglers?

_____

5. How important is the influence of fishing on your lifestyle (eg. your social life, reading habits, internet browsing, or work schedule?

   Mark only one oval.

	1	2	3	4	5	6	7	8	9	10	
Not important at all	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely important

6. How often do you choose to go fishing rather than pursue another recreational activity?

   Mark only one oval.

	1	2	3	4	5	6	7	8	9	10	
Never	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Always

7. How would you compare your overall fishing skills compared to the average fisher?

Mark only one oval.

	1	2	3	4	5	6	7	8	9	10	
My skills are much lower	○	○	○	○	○	○	○	○	○	○	My skills are much higher

The following set of questions relate to YOU AND WHAT YOU CHOOSE TO DO when guiding clients using rock-and-surf fishing tackle from a sandy beach.

8. When fishing with plugs and spoons off a sandy beach, which of the following hook types do you instruct your clie
to use?

Mark only one oval.

○ Double hook

○ J-hook

○ Treble hook

○ Circle hook

○ Octopus hook

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9. When fishing with bait and your clients edible fish is deep hooked in the throat, which of the following options best describes how you proceed?

Mark only one oval.

- ◯ Cut the line immediately
- ◯ First try to remove the hook, and then only cut the line
- ◯ Make sure I remove the hook

10. When fishing from a sandy beach for edible species, where do you place your clients fish for unhooking before photographs?

Mark only one oval.

- ◯ On a sling/mat
- ◯ In a bucket
- ◯ On wet sand
- ◯ On dry sand
- ◯ In the water

11. When fishing from a sandy beach, how much time will you allow the fish to be exposed to air specifically for photographs before you insist on releasing the fish?

Mark only one oval.

- ◯ 30 seconds
- ◯ 1 minute
- ◯ 1.5 minutes
- ◯ 2 minutes
- ◯ 2.5 minutes
- ◯ 3 minutes
- ◯ 3.5 minutes
- ◯ 4 minutes
- ◯ 4.5 minutes
- ◯ 5 minutes or more

12. When a client's edible fish is covered in sand before the photograph, which of the following best describes how y
choose to proceed?

Mark only one oval.

◯ Remove the sand by hand

◯ Remove the sand with a towel

◯ Remove the sand with a microfiber cloth

◯ Remove the sand in the surf

◯ Remove the sand with water from a bucket

◯ Don't remove the sand.

The following set of questions focuses on what YOU THINK IS BEST FOR THE FISH'S SURVIVAL when guiding clients or
fishing trips where you fish rock-and-surf tackle for edibles from a sandy beach.

13. When fishing from a sandy beach, where do you think it is best to place an edible fish for unhooking to ensure it h
the best chance of survival after release?

Mark only one oval.

◯ On a sling/mat

◯ In a bucket

◯ On wet sand

◯ On dry sand

◯ In the water

14. When fishing with lures off a sandy beach, which of the following hook types do you think is best to ensure the fis caught will survive after release?

Mark only one oval.

Double hook

J-hook

Treble hook

Circle hook

Octopus hook

15. When fishing with bait and an edible fish is deep hooked in the throat, which of the following options do you think gives the fish the best chance of survival after release?

Mark only one oval.

Cut the line immediately

First try to remove the hook, and then only cut the line

Make sure I remove the hook

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16. How much time do you think an average fish can spend exposed to air and still survive after release?

Mark only one oval.

○ 30 seconds

○ 1 minute

○ 1.5 minutes

○ 2 minutes

○ 2.5 minutes

○ 3 minutes

○ 3.5 minutes

○ 4 minutes

○ 4.5 minutes

○ 5 minutes or more

17. When an edible fish is covered in sand before the photograph, which of the following options do you think gives t fish the best chance of survival after release?

Mark only one oval.

○ Remove the sand by hand

○ Remove the sand with a towel

○ Remove the sand with a microfiber cloth

○ Remove the sand in the surf

○ Remove the sand with water from a bucket

○ Don't remove the sand

The following set of questions relate to YOUR ATTITUDES TOWARDS HOW OTHER GUIDES OPERATE with their clients on fishing trips where they fish rock-and-surf tackle from a sandy beach. For each of the statements below please rate your agreement or disagreement with the practices.

18. An angling guide immediately cuts the line when their clients catch is hooked deep in the throat.

Mark only one oval.

○ Strongly Agree

○ Agree

○ Neither agree nor disagree

○ Disagree

○ Strongly disagree

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19. An angling guide instructs their clients to use treble hooks on their plugs and spoons.

Mark only one oval.

- ⬭ Strongly Agree
- ⬭ Agree
- ⬭ Neither agree nor disagree
- ⬭ Disagree
- ⬭ Strongly disagree

20. An angling guide places their client's fish on the sand above the high tide mark while unhooking.

Mark only one oval.

- ⬭ Strongly disagree
- ⬭ Disagree
- ⬭ Neither agree nor disagree
- ⬭ Agree
- ⬭ Strongly Agree

21. An angling guide only allows their clients 30 seconds for photographs, after which they release the fish whether they have good photos or not.

Mark only one oval.

- ⬭ Strongly Agree
- ⬭ Agree
- ⬭ Neither agree nor disagree
- ⬭ Disagree
- ⬭ Strongly disagree

22. An angling guide removes the sand off the fish by hand before photographs.

Mark only one oval.

- ⬭ Strongly disagree
- ⬭ Disagree
- ⬭ Neither agree nor disagree
- ⬭ Agree
- ⬭ Strongly Agree

The following set of questions focuses on HOW YOU THINK MOST OTHER GUIDES IN SOUTH AFRICA OPERATE with clients on fishing trips where they fish rock-and-surf tackle from a sandy beach.

23. When fishing with bait and the client's fish is deep hooked in the throat, which of the following options best describes how other guides in South Africa proceed?

Mark only one oval.

◯ They cut the line immediately

◯ They first try to remove the hook, and then only cut the line

◯ They make sure to remove the hook

24. When fishing from a sandy beach, where do you think other guides in South Africa place their client's fish for unhooking before photographs?

Mark only one oval.

◯ On a sling/mat

◯ In a bucket

◯ On wet sand

◯ On dry sand

◯ In the water

25. When an edible fish is covered in sand before the photograph, what do you think other angling-guides in South Africa do?

Mark only one oval.

◯ Remove the sand by hand

◯ Remove the sand with a towel

◯ Remove the sand with a microfiber cloth

◯ Remove the sand in the surf

◯ Remove the sand with water from a bucket

◯ Don't remove the sand

26. When fishing with lures off a sandy beach, which of the following hook types do you think other guides in South Africa instruct their clients to use on their plugs and spoons?

Mark only one oval.

Double hook

J-hook

Treble hook

Circle hook

Octopus hook

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27. When fishing from a sandy beach, how much time do you think other guides in South Africa allow an edible fish to be exposed to air specifically for photographs before they insist on releasing the fish?

Mark only one oval.

- ◯ 30 seconds
- ◯ 1 minute
- ◯ 1.5 minutes
- ◯ 2 minutes
- ◯ 2.5 minutes
- ◯ 3 minutes
- ◯ 3.5 minutes
- ◯ 4 minutes
- ◯ 4.5 minutes
- ◯ 5 minutes or more

Appendix 4.2: Catch event observations from the 30 day observation period showing angling metrics and binomial gaps (gap = "1"; no gap = "0") between angling-guide observed behaviour and their reported behaviour, knowledge of best practice, perception of the norm and attitude towards behaviour obtained by survey18 months after observation. <u>Species</u>: *JC – Jack Crevalle; GF – guitar fish; ABS – African brown snapper; R – ray; WC – white corvina; GAT – Giant African threadfin; GRF – garfish.* <u>Tackle</u>: *L – Light (<20lb); M – Medium (20-30lb); H – Heavy (>30lb).* <u>Hook</u>: *J – j-hook; C – circle; T – treble.* <u>Lure/bait</u>: *S – spoon; DB – dead-bait; LB – live-bait; HB – hard-body; SP – soft-plastic; P – plug.*

										Angling metrics				Reported vs observed					Knowledge vs observed					Perceived norm vs observed					Attitude vs observed				
Observation ID	Species	Size (cm)	Clients (n)	Tackle (L/M/H)	Hook (S/C/T)	Day/Night	Lure/bait	Harvest/Release	Guide (1/2/3/4/5)	Air exposure (s)	Photo time (s)	Fight time (s)		Hook selection on lures	Placement of fish for unhooking	Air exposure (photos*)	Oesophageal unhooking	Sand removal before photographs	Hook selection on lures	Placement of fish for unhooking	Air exposure (total*)	Oesophageal unhooking	Sand removal before photographs	Hook selection on lures	Placement of fish for unhooking	Air exposure (photos*)	Oesophageal unhooking	Sand removal before photographs	Hook selection on lures	Placement of fish for unhooking	Air exposure (photos*)	Oesophageal unhooking	Sand removal before photographs
1	JC	50-99	5	M	J	D	S	R	1	86.8	47.2	688.4		0	0	0	-	-	0	1	1	-		1	0	0	-	-	0	0	1	-	-
2	GF	100+	5	H	C	N	DB	R	1	178.4	126.8	302.7		-	0	1	-	1	-	1	1	-	1	-	0	0	-	1	-	0	1	-	1
3	GF	100+	5	H	C	D	DB	R	1	87.6	38.2	152.0		-	0	0	-	-	-	1	1	-		-	0	0	-	-	-	0	1	-	-
4	ABS	50-99	5	M	T	D	HB	R	1	106.0	52.5	116.8		-	0	0	-	1	-	1	1	-	1	-	0	0	-	1	-	0	1	-	1
5	ABS	50-99	5	H	C	D	LB	R	1	139.5	55.7	644.6		-	1	0	-	1	-	1	1	-	1	-	1	0	-	1	-	1	1	-	1
6	R	0-49	8	M	C	N	DB	R	2	22.0	-	59.4		-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
7	GAT	100+	8	L	J	N	SP	R	2	170.6	107.7	1116.8		-	0	1	-	-	-	1	1	-	-	-	0	0	-	-	-	0	1	-	-
8	R	0-49	8	M	J	D	S	R	2	36.8	-	122.0		0	0	-	-	-	0	1	0	-	-	0	0	-	-	-	0	0	-	-	-
9	ABS	50-99	8	H	J	N	LB	R	2	239.6	155.7	320.8		-	0	1	-	1	-	1	1	-	1	-	0	0	-	1	-	0	1	-	1
10	WC	0-49	8	M	J	D	S	R	2	45.0	-	73.2		0	0	-	-	-	0	1	0	-	-	0	0	-	-	-	0	0	-	-	-
11	ABS	50-99	8	M	C	D	LB	R	2	188.2	114.8	737.8		-	0	1	-	1	-	1	1	-	1	-	0	0	-	1	-	0	1	-	1
12	WC	50-99	8	M	J	D	LB	R	2	153.4	111.4	286.9		-	0	1	-	-	-	1	1	-	-	-	0	0	-	-	-	0	1	-	-
13	WC	50-99	8	H	J	D	LB	R	2	101.0	122.8	94.4		-	0	1	-	-	-	1	0	-	-	-	0	0	-	-	-	0	1	-	-
14	WC	50-99	8	M	J	D	LB	R	2	135.6	149.0	240.1		-	0	1	-	-	-	1	0	-	-	-	0	0	-	-	-	0	1	-	-
15	WC	50-99	8	H	J	D	LB	R	4	36.0	-	193.1		-	0	-	-	-	-	0	0	-	-	-	0	-	-	-	-	0	-	-	-
16	WC	50-99	8	H	C	D	LB	H	4	136.9	84.3	246.9		-	0	1	1	0	-	0	1	1	0	-	0	0	0	0	-	0	1	x	0
17	WC	50-99	8	H	C	D	LB	R	4	104.3	65.5	114.5		-	0	1	-	1	-	0	1	-	1	-	0	0	-	1	-	0	1	-	1
18	R	50-99	8	H	C	D	LB	R	4	63.2	-	113.4		-	0	-	-	-	-	0	0	-	-	-	0	-	-	-	-	0	-	-	-
19	JC	50-99	8	M	J	D	S	R	2	61.5	38.0	483.4		0	0	0	-	-	0	1	0	-	-	0	0	0	-	-	0	0	1	-	-

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										Angling metrics			Reported vs observed					Knowledge vs observed					Perceived norm vs observed					Attitude vs observed				
Observation ID	Species	Size (cm)	Clients (n)	Tackle (L/M/H)	Hook (S/C/T)	Day/Night	Lure/bait	Harvest/Release	Guide (1/2/3/4/5)	Air exposure (s)	Photo time (s)	Fight time (s)	Hook selection on lures	Placement of fish for unhooking	Air exposure (photos*)	Oesophageal unhooking	Sand removal before photographs	Hook selection on lures	Placement of fish for unhooking	Air exposure (total*)	Oesophageal unhooking	Sand removal before photographs	Hook selection on lures	Placement of fish for unhooking	Air exposure (photos*)	Oesophageal unhooking	Sand removal before photographs	Hook selection on lures	Placement of fish for unhooking	Air exposure (photos*)	Oesophageal unhooking	Sand removal before photographs
20	GAT	100+	8	L	J	D	LB	R	4	146.8	175.2	274.9	-	0	1	1	-	-	0	1	1	-	-	0	0	0	-	-	0	1	x	-
21	ABS	100+	8	H	J	D	LB	R	2	302.2	64.3	997	-	0	0	-	0	-	1	1	-	0	-	0	0	-	0	-	0	1	-	0
22	WC	0-49	8	H	J	D	LB	R	2	16.3	-	35.4	-	0	-	-	-	-	1	0	-	-	-	0	-	-	-	-	0	-	-	-
23	WC	0-49	8	H	J	D	LB	R	4	20.2	-	30.0	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
24	WC	50-99	8	H	J	D	LB	R	4	43.0	-	336.7	-	0	-	-	-	-	0	0	-	-	-	0	-	-	-	-	0	-	-	-
25	WC	50-99	8	M	J	D	S	R	4	6.7	-	88.5	0	0	-	-	-	0	0	0	-	-	0	0	-	-	-	0	0	-	-	-
26	JC	50-99	8	L	J	D	P	R	2	307.3	267.2	360.8	0	0	1	-	1	0	1	1	-	1	0	0	0	-	1	0	0	1	-	1
27	JC	50-99	8	L	J	D	P	R	2	172	135.1	1302	0	0	1	-	-	0	1	1	-	-	0	0	0	-	-	0	0	1	-	-
28	GRF	50-99	8	M	J	D	S	R	2	53.9	11.2	17.0	0	0	0	-	-	0	1	0	-	-	0	0	0	-	-	0	0	0	-	-
29	WC	50-99	8	M	J	D	S	R	2	144.3	113.8	225.4	0	0	1	-	-	0	1	0	-	-	0	0	0	-	-	0	0	1	-	-
30	GAT	50-99	8	L	J	D	LB	R	2	120.3	14.3	30.2	-	0	0	-	-	-	1	0	-	-	-	0	0	-	-	-	0	0	-	-
31	WC	0-49	8	M	J	D	S	R	2	3.8	-	116.4	0	-	-	-	-	0	-	0	-	-	0	-	-	-	-	0	-	-	-	-
32	GAT	0-49	6	M	J	D	SP	R	2	44.0	-	51.2	-	0	-	-	-	-	1	0	-	-	-	0	-	-	-	-	0	-	-	-
33	WC	0-49	6	M	J	D	SP	R	2	115.3	53.8	31.2	-	0	0	-	-	-	1	0	-	-	-	0	0	-	-	-	0	1	-	-
34	WC	50-99	6	L	J	D	LB	R	2	50.1	-	60.9	-	0	-	-	-	-	1	0	-	-	-	0	-	-	-	-	0	-	-	-
35	WC	50-99	6	M	J	D	SP	R	2	84.0	39.5	128.5	-	0	0	-	1	-	1	0	-	1	-	0	0	-	1	-	0	1	-	1
36	WC	50-99	6	L	J	D	LB	R	2	41.1	12.0	200.6	-	1	0	-	-	-	1	0	-	-	-	1	0	-	-	-	1	0	-	-
37	WC	0-49	6	M	J	D	S	R	2	17.7	-	30.0	0	1	-	-	-	0	1	0	-	-	0	1	-	-	-	0	1	-	-	-
38	WC	50-99	6	M	J	D	S	R	3	166.9	18.5	60.2	0	1	0	0	-	0	1	1	0	-	0	1	0	0	-	0	1	1	1	-

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													Reported vs observed					Knowledge vs observed					Perceived norm vs observed					Attitude vs observed				
Observation ID	Species	Size (cm)	Clients (n)	Tackle (L/M/H)	Hook (S/C/T)	Day/Night	Lure/bait	Harvest/Release	Guide (1/2/3/4/5)	Air exposure (s)	Photo time (s)	Fight time (s)	Hook selection on lures	Placement of fish for unhooking	Air exposure (photos*)	Oesophageal unhooking	Sand removal before photographs	Hook selection on lures	Placement of fish for unhooking	Air exposure (total*)	Oesophageal unhooking	Sand removal before photographs	Hook selection on lures	Placement of fish for unhooking	Air exposure (photos*)	Oesophageal unhooking	Sand removal before photographs	Hook selection on lures	Placement of fish for unhooking	Air exposure (photos*)	Oesophageal unhooking	Sand removal before photographs
39	JC	50-99	6	M	J	D	S	R	3	109.6	32.9	271.8	0	0	0	-	1	0	1	1	-	1	0	0	0	-	0	0	0	1	-	1
40	ABS	50-99	6	H	C	N	LB	R	3	151.8	58.6	248.7	-	0	0	-	-	-	1	1	-	-	-	0	0	-	-	-	0	1	-	-
41	ABS	100+	6	H	C	N	LB	R	3	224	191	997.1	-	0	1	-	-	-	1	1	-	-	-	0	0	-	-	-	0	1	-	-
42	GRF	50-99	6	M	J	D	S	R	3	31.3	-	30.9	0	-	-	-	-	0	-	0	-	-	0	-	-	-	-	0	-	-	-	-
43	ABS	100+	6	H	C	N	LB	R	3	144.7	63.0	788.4	-	1	1	-	1	-	1	1	-	1	-	1	0	-	0	-	1	1	-	1
44	ABS	50-99	6	H	C	N	LB	R	3	110.9	51.6	1078.7	-	0	0	-	-	-	1	1	-	-	-	0	0	-	-	-	0	1	-	-
45	WC	0-49	6	M	J	D	S	R	3	112.1	48.5	85.4	0	0	0	0	1	0	1	1	0	1	0	0	0	0	0	0	0	1	1	1
46	JC	0-49	3	M	J	D	S	R	3	66.4	24.5	150.7	0	0	0	-	-	0	1	0	-	-	0	0	0	-	-	0	0	0	-	-
47	WC	0-49	6	M	J	D	S	R	3	62.8	30	69.2	0	0	0	-	-	0	1	0	-	-	0	0	0	-	-	0	0	0	-	-
48	ABS	50-99	6	H	C	N	LB	R	3	80.5	39.8	491.4	-	0	0	-	-	-	1	0	-	-	-	0	0	-	-	-	0	1	-	-
49	ABS	50-99	3	H	C	N	LB	R	3	127.4	45.4	266.9	-	0	0	-	-	-	1	1	-	-	-	0	0	-	-	-	0	1	-	-
50	JC	0-49	3	M	J	D	S	R	3	89.4	20.0	111.3	0	0	0	-	-	0	1	0	-	-	0	0	0	-	-	0	0	0	-	-
51	ABS	50-99	3	H	C	D	LB	R	3	75.4	32.0	343.7	-	0	0	-	-	-	1	0	-	-	-	0	0	-	-	-	0	1	-	-
52	ABS	50-99	3	H	C	N	LB	R	3	139.9	90.4	1045.2	-	0	1	1	-	-	1	1	1	-	-	0	0	1	-	-	0	1	0	-
53	WC	50-99	3	M	J	D	S	H	3	69.0	26.0	36.7	0	0	0	-	1	0	1	0	-	1	0	0	0	-	0	0	0	1	-	1
54	WC	50-99	3	M	J	D	S	H	3	123	30.5	100.7	0	0	0	-	1	0	1	1	-	1	0	0	0	-	0	0	0	1	-	1
55	CF	0-49	2	M	C	D	DB	H	5	26.6	-	49.0	-	0	-	-	-	-	1	0	-	-	-	1	-	-	-	-	0	-	-	-
56	ABS	100+	2	H	C	N	LB	H	5	354.4	256.4	1435.1	-	0	1	-	-	-	1	1	-	-	-	1	0	-	-	-	0	1	-	-
57	WC	0-49	8	M	J	N	SP	H	2	58.0	-	43.5	-	1	-	-	-	-	1	0	-	-	-	1	-	-	-	-	1	-	-	-

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Observation ID	Species	Size (cm)	Clients (n)	Tackle (L/M/H)	Hook (S/C/T)	Day/Night	Lure/bait	Harvest/Release	Guide (1/2/3/4/5)	Air exposure (s)	Photo time (s)	Fight time (s)	Hook selection on lures	Placement of fish for unhooking	Air exposure (photos*)	Oesophageal unhooking	Sand removal before photographs	Hook selection on lures	Placement of fish for unhooking	Air exposure (total*)	Oesophageal unhooking	Sand removal before photographs	Hook selection on lures	Placement of fish for unhooking	Air exposure (photos*)	Oesophageal unhooking	Sand removal before photographs	Hook selection on lures	Placement of fish for unhooking	Air exposure (photos*)	Oesophageal unhooking	Sand removal before photographs
58	WC	50-99	8	H	J	N	S	H	2	154.7	46.2	93.8	0	0	0	-	1	0	1	1	-	1	0	0	0	-	1	0	0	1	-	1
59	WC	50-99	8	L	J	D	LB	H	4	15.5	-	86.5	-	1	-	-	-	-	1	0	-	-	-	1	-	-	-	-	1	-	-	-
60	WC	50-99	8	M	J	D	S	H	2	119	45	143.7	0	0	0	-	-	0	1	0	-	-	0	0	0	-	-	0	0	1	-	-
61	WC	50-99	8	M	J	D	S	H	2	-	-	98.1	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-
62	WC	50-99	8	H	J	D	LB	H	2	17.6	-	201.9	-	0	-	-	-	-	1	0	-	-	-	0	-	-	-	-	0	-	-	-
63	WC	50-99	8	H	J	D	LB	H	4	27	-	130.1	-	0	-	-	-	-	0	0	-	-	-	0	-	-	-	-	0	-	-	-
64	GAT	100+	6	M	J	D	SP	H	2	62.8	53	727.9	-	0	0	-	-	-	1	0	-	-	-	0	0	-	-	-	0	1	-	-
65	WC	50-99	6	M	J	D	SP	H	2	150.5	98.5	95.3	-	0	1	-	-	-	1	1	-	-	-	0	0	-	-	-	0	1	-	-
66	GAT	50-99	6	M	J	D	SP	H	2	14.3	-	197.4	-	0	-	-	-	-	1	0	-	-	-	0	-	-	-	-	0	-	-	-

Chapter 5

General discussion: fostering pro-environmental recreational angling behaviour on guided-angling trips

"Cease being intimidated by the argument that a right action is impossible because it does not yield maximum profits, or that a wrong action is to be condoned because it pays." – Aldo Leopold

The preceding chapters of this thesis suggest that angling-guides are influential members of a resource-use community which would benefit from behavioural intervention. Chapter 2 suggests that angling-guides are socially-influential as role-models, while Chapter 3 illustrates that while they appear to have pro-environmental attitudes, angling-guide knowledge and potential behaviour could be improved. Lastly, Chapter 4 highlights that angling-guides may follow the perceived social norm, knowingly choosing the benefits of deleterious angling practices over more "costly" best-practice alternatives on guided-angling trips. Together, these conclusions suggest that while improvements in knowledge (of problems and best-practices) are certainly required, even knowledgeable angling-guides may fail to overcome the considerable barriers to the unenforceable pro-environmental behaviours required to achieve sustainability goals in this space.

As role-models, angling-guides can influence angler-behaviour, either for the good of the resource, or to its detriment, depending on the angling-guides' knowledge, ethics and behaviour. The varying mechanisms by which they may have influence as role-models (see Chapter 2) suggests that their utility in interventions aimed at recreational anglers depends particularly on the goal, be it to change their existing behaviours or inspire them to adopt new goals. Most anglers appear to agree that angling-guides are competent and worth emulating to achieve angling success (see Chapter 2). This means that, as *behavioural models*, angling-guides can teach C&R best-practices and teach the information required to perform them. This has been the goal of most outreach efforts in the recreational angling-community to date, which have relied on the knowledge-attitude-behaviour strategy for improving angler practice by disseminating relevant how-to information. However, anglers were more divided on whether they found angling-guides inspiring or motivating, which suggests that angling-guides may be

less effective at encouraging anglers to adopt new goals. While it is possible to improve angling-guide knowledge and competence, it is far more difficult to modify their attributes or personability to ensure that they are motivational or inspirational enough to encourage angler behaviour change beyond simple technical practices. That said, there was still a considerable proportion of respondents who are likely to be receptive to this kind of influence, and therefore it should not be discounted. As such, angling-guides represent an important intervention opportunity in the global effort to improve recreational angler-behaviour, even if only at the most rudimentary level of teaching the correct angling skills and best-practices.

Understanding that angling-guides are potentially valuable in promoting pro-environmental behaviour is only the first step towards effective intervention. Based on their influence, intervening at the angling-guide level may be an efficient use of resources, given their extensive networking potential and reach. Like most interventions targeting ecological behaviours, improving knowledge is perhaps the simplest and most broadly applicable measure, because a lack of *awareness of the problem* and *misattribution of its cause* represent considerable barriers to pro-environmental behaviour (Kollmuss & Agyemann 2002). For example, many recreational anglers are not acutely aware of ecological issues such as fisheries decline. If they are, many do not consider their behaviours to be contributing to the problem, choosing to instead blame other user groups, such as commercial fishers (Danylchuk et al. 2017; Kramer et al. 2017; Deep-sea club anglers in Port Elizabeth, South Africa – AC Winkler 2021 unpublished data). Angling-guides likely suffer from similar misconceptions, and as a result may be misinformed (see Chapter 3) and behave poorly on guided-angling trips (see Chapter 4). Furthermore, angling-guides may be unaware of their social-impact as role-models, and therefore may not appreciate the potential ramifications of their poor practices. Therefore, improving angling-guide knowledge of best-practices, understanding of ecological issues and awareness of their influence is an essential pre-requisite to improving their behaviour, and thereby potentially improving the behaviour of their angling-clients. However, simply disseminating this information on best-practices and ecological issues to the recreational angling-community has failed to give rise to mass-scale reform in angling-behaviour, which suggests that more formal intervention may be required for successful impact at guide-level.

In some regions, angling-guides are legally obligated to complete formal training standards before being allowed to operate (e.g. Sweden, Germany, some American states). Training is an effective means of ensuring sufficient knowledge and competence before being allowed to

exploit resources for commercial gain. However, very few of the angling-guides surveyed in Chapter 3 had received any formal training, and even fewer had received accredited training. Since some form of training appeared to improve knowledge of best-practices, mandatory training of angling-guides may be an effective means of ensuring that they mitigate their impact on the resource during guided-angling trips, and thereby set positive examples to angling-clients. However, it is impossible to enforce this on a global scale, especially in the developing world, where much of the guided-angling industry operates in isolation with little oversight from regulatory authorities. Furthermore, without formal quality and content standards, training materials may be insufficient, and overlook key skills such as catch-and-release best-practices. The lack of training in the guided-angling industry may be the consequence of low demand for training, both by angling-guides and angling-clients, or a lack of formal standards, regulations or training providers. Consequently, while training is obviously important to remedy some poor angling-guide behaviours, considerable steps will be required to effectively promote high quality, comprehensive training within all segments of the angling-guide community, and other behaviour change strategies may be required.

The fundamental realisation that behaviour occurs within communities, and that behaviour is shaped, moderated and driven at community level is important for broad-scale behavioural change interventions. Understanding how to change problematic behaviours from the bottom-up (community-based), rather than top-down (regulatory) allows interventionists to transcend bureaucratic boundaries and economic limitations associated with traditional management. Given the strong community orientation of recreational-anglers based on their communities of practice (groups, syndicates, social and competitive clubs etc.) or styles of participation (SOP), and the social-impact of norms in this space which often utilises a shared resource, the community based social marketing (CBSM) approach for behaviour change may be useful for changing angling-guide behaviour (see Chapter 4). Community based social marketing emerged from the theory of planned behaviour, combining psychological understanding with social and commercial marketing techniques. The CBSM approach aims to address problematic behaviour more pragmatically than traditional knowledge-attitude-behaviour approaches. The CBSM approach acknowledges the power of traditional information-based outreach efforts (e.g. angling-guide best-practice education) in improving the knowledge and awareness of the target population, but addresses its shortfall in eliciting actual behaviour change. Effective social marketing must address the barriers and benefits associated with a specific behaviour and must specifically target segments of the community with an intervention to address their

specific behaviours in their specific context (Andreasen 1995). The CBSM approach has a strong focus on contextual understanding (of the context and target group) to identify the barriers and benefits of the desired behavioural outcome to aid the careful design of behaviour-change strategies based on that insight. Broadly, the principles of CBSM (McKenzie-Mohr & Smith 1999; McKenzie-Mohr 2000) seek to achieve the following:

1. carefully identify and fully understand specific behaviours (CBSM Step 1)

2. uncover barriers to the desired behaviours and understand their benefits (CBSM Step 2)

3. design a program to overcome barriers and enhance the benefits (CBSM Step 3)

4. pilot the program (CBSM Step 4)

5. evaluate its effectiveness in broader implementation (CBSM Step 5)

The CBSM approach stresses strong contextual understanding and a high degree of specificity in targeting certain behaviours, barriers and benefits. This is perhaps the most fundamental reason for why the CBSM approach so often achieves successful behaviour change. However, there is likely a considerable trade-off between the global applicability of an angling-guide intervention using this methodology, and its effectiveness in changing specific angling behaviours. This is because so many best-practices, barriers and benefits are specific to context, facets, angling-method, target species, and socio-cultural factors which may differ regionally or between communities of practice. Consequently, the best-case scenario would be to deploy interventions with the highest resolution possible at the specific community level, such as a specific angling-guide community in a specific fishery using a specific angling-method in a specific region. However, given the urgent need for global change, this may not be a practical level at which to deploy interventions, given the much higher demand for financial and human resources. As a result, it appears that an angling-guide community defined by their style-of-participation is perhaps the lowest resolution at which behaviours, barriers and benefits can be targeted with sufficient specificity, and still be globally applicable. For example, offshore game-fishing angling-guides may target different species around the world using slightly different lures and baits, but many of the best-practices are globally applicable for this SOP. Similarly, freshwater fly-fishing angling-guides may target a diverse suite of species in many localities, but again many of the best-practices, even at the most fundamental and technical level, are probably globally applicable in this SOP. Therefore, while it may not be possible to design a truly meaningful, all-encompassing global angling-guide intervention, defining target communities by their SOP may be a suitable compromise.

Using these CBSM principles, the following paragraphs will describe the process by which an angling-guide intervention could be developed for a specific SOP. To illustrate this process, the observations of marine shore-based angling-guides from the Chapter 4 case study will be used to provide insight, context and detail for the design of an intervention aimed at changing the behaviour of angling-guides from the community defined by a marine shore-based style of participation.

CBSM Step1: *Selecting angling-guide behaviours to change and promote*

Careful selection of the angling-guide behaviours to be changed and promoted is critical. Firstly, problematic behaviours and their pro-environmental behaviour (PEB) alternatives likely vary between different communities of practice and SOPs. For example, the choice of offset j-hook in an SOP characterised by passive angling with organic baits (e.g. marine-shore-based angling) dramatically increases the chances of oesophageal-hooking (Schisler & Bergersen 1996; Diggles & Ernst 1997; Margenau 2007; St lhammar et al. 2014; Brownscombe et al. 2017;), whilst the same hook choice on a lure (e.g. shore-based game-fishing) is probably the best-practice in that context. Secondly, it is imperative to understand the impact of the problematic behaviours on fish health and where potential improvements are practical. For example, small improvements in air-exposure behaviour may significantly improve survivability of fishes subjected to C&R (Butler et al. 2020), whilst large changes in terminal tackle choice (Cooke et al. 2001) or equipment choice (e.g. rod power & line strength) may not (Brownscombe et al. 2014). Given finite resources for intervention at angling-guide level, and their likely low tolerance for large-scale change, interventions must focus on the most problematic behaviours that can be addressed to avoid wasting resources or diluting important messages. Fortunately, there is a considerable body of evidence in C&R science on which to base best-practice recommendations. The C&R framework proposed by Brownscombe et al. 2017 (Figure 5.1) presents the most complete understanding of the catch process and how angler behaviour/choice affects the outcome. This presents interventionists with a systematic framework to identify the behaviours which need to be addressed, and to shape their recommendations for the best-practices to be promoted.

In selecting behaviours to be promoted, the CBSM approach stresses that behaviours must be non-divisible and end-state. Divisible behaviours are those which can be further divided into behaviours which have different potential barriers. For example, the recommendation to handle fish carefully and responsibly can be further sub-divided into many behaviours which each
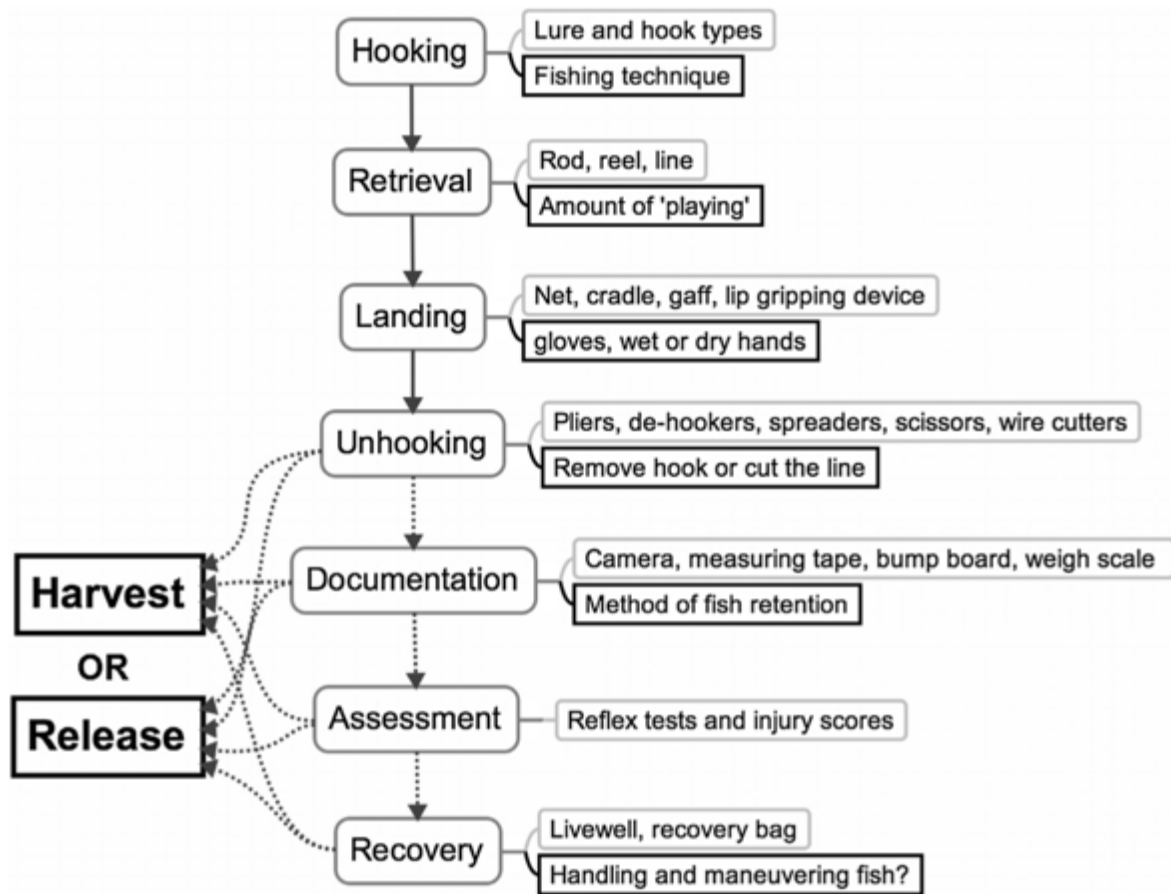
Figure 5.1: From Brownscombe et al. 2017: "Conceptual diagram of potential stages of a recreational angling event (from Hooking to Recovery) including considerations (angler choices) on angling tools (grey boxes), and tactics (black boxes), ultimately resulting in either the harvest or release of the captured fish. Solid connectors represent obligatory steps; dotted lines indicate potential steps dependent on angler choices."

have differing barriers. Therefore, behaviours must be *non-divisible* if they are to be promoted effectively, such as *cut the line immediately if hooked in the oesophagus*. Behaviours which are *end-state* are the final behaviour required to achieve the desired outcome. For example, the *purchasing of circle-hooks* does not guarantee their use, because the angling-guide would still need to use them. As such, the actual *use of circle hooks* would be the *end-state* behaviour to promote. Assembling a panel of experts with good contextual understanding to identify the most ecologically significant behaviours in the relevant context is an effective way to identify important behaviours. Thereafter, systematically assessing the angling-guide behaviour and choices at each stage of the catch process, while concurrently evaluating their implications for fish-health and resource-integrity will allow interventionists to prioritize behaviours for change and promotion.

Marine shore-based angling-guide behaviours to be changed and promoted

During observation of the guided-angling trips in the Chapter 4 case-study, the *behaviours of interest* were identified by a panel of experts as problematic in this SOP, and then subsequently confirmed to be problematic by systematically assessing the catch process observed. While many potential improvements could be made to the behaviour of the angling-guides observed, these five *behaviours of interest* were identified as significant:

- o   *Poor selection of hooks on lures (i.e. treble hooks on plugs and spoons)*

- o   *Poor placement of fish for unhooking (i.e. on sand)*

- o   *Incorrect actions taken after oesophageal hooking (i.e. attempt to remove)*

- o   *Excessive air-exposure (total and for photos)*

- o   *Poor sand removal practice for photographs (i.e. by hand scraping)*

These behaviours were systematically identified as those with the largest impact on fish health and within the control of the angling-guide (i.e. high perceived behavioural control), and therefore could be targeted with a behavioural intervention with finite resources for outreach. Their implications for fish-health are overlapping and often compounding when displayed together, as are many of the poor angling practices in other SOPs. They may not be the most ecologically significant behaviours in other SOPs, but they were identified as the most important in this particular fishery, based on the insights of the author and others with strong understanding of the fishery, the industry and the specific marine shore-based SOP (Prof. WM Potts 2020, pers. comm). Following the same systematic process, the panel of experts established the following best-practice behaviours to promote (Figure 5.2):

1.   *Use only single j-hooks when fishing lures (i.e. plugs and spoons).*

2.   *Set a limit on time allowed for photographs.*

3.   *Use a waterproof camera that can be carried at all times to photograph catches.*

4.   *Avoid contaminating epithelial mucus with sand by placing the fish in a water filled container for unhooking.*

5.   *Never remove sand off the fish by hand – choose instead to wash it off using water.*

6.   *Instruct the client to hold the fish above the water-filled container for photographs.*

7.   *Cut the line immediately when the catch is hooked in oesophagus.*

8. *Always carry sufficiently robust pliers for easy unhooking and cutting line.*

9. *Brief angling-clients on protocols, practices and expectations before angling begins.*

10. *Reprimand clients politely for poor practices which are otherwise beyond your control.*

These best-practice behaviours to promote to angling-guides during guided-angling trips (Figure 5.2) were chosen to address the five problematic *behaviours of interest* which were prevalent in this SOP and fishery. These best-practices are interrelated solutions to the impacts of the problematic behaviours on fish-health and resource-integrity, because they may address more than one aspect of the poor practice's impact. For example, the recommendation for hook choice is not only to limit the physical injury to the client's catch, but also to reduce difficulty unhooking it, which greatly exacerbates air-exposure in this SOP. Similarly, the recommendation to place the clients catch in a water-filled container for unhooking seeks to reduce air-exposure during unhooking and also limit damage/contamination of the epithelial mucus by sand exposure during deliberate placement or dropping fish on sand during photographs. The recommendation to brief angling-clients before angling will improve many aspects of the catch-process, because guided-angling trips typically have several clients, and as such the angling-guide may not be present during every part of the decision making process. In the case-study fishery (see Chapter 4), angling-client confusion regarding protocols (e.g. who takes the photographs, how to hold the catch for photos, when to harvest etc) and expectations (e.g. unhook your own catch when angling-guide is pre-occupied) was noted as exacerbating the poor behaviours. Lastly, the recommendation that angling-guides should politely reprimand their clients for poor behaviour ensures that angling-clients do not repeatedly display poor-practices when left unchallenged.

CBSM Step 2: *Identifying barriers and benefits of pro-environmental angling behaviour*

Having identified the angling-guide's poor behaviours which most need to be addressed, and their best-practice alternatives, it is pertinent to understand their barriers and benefits. The behavioural gaps identified in Chapter 4 highlight that there are likely a myriad of barriers between an angling-guides' pro-environmental intentions and their actual behaviour. The motivation to ensure client satisfaction is a sizeable, overarching barrier to angling-guides pro-environmental behaviour, given their dependence on the associated financial incentives such as repeat patronage and gratuities. This is of little concern when clients have good knowledge of best-practices, good awareness of ecological problems and place a high value on fish-welfare. Angling-clients with these attributes are likely to understand that there is
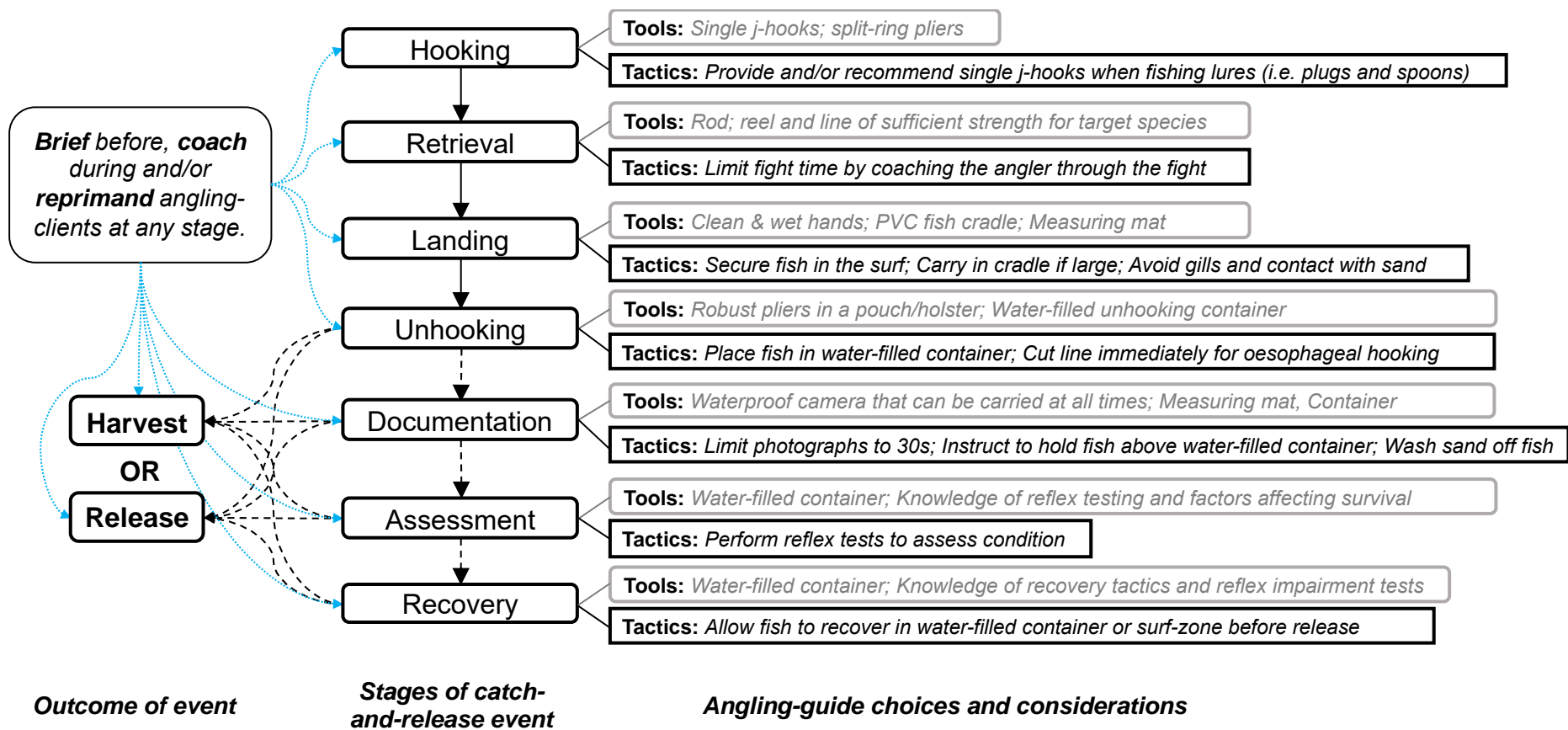
Figure 5.2: Adapted from the catch-and-release (C&R) event framework proposed by Brownscombe et al. (2017): a summary of the ten best-practices (and others) to be promoted to marine shore-based angling-guides, showing their choices and considerations for the tools (in grey) and tactics (in black) required at each stage of the C&R event, highlighting where angling-guides can use "*briefing, coaching and reprimanding*" (in blue) for better managing angling-client behaviour and practices at all stages of the C&R process.

sometimes a trade-off between fish-welfare and angling-enjoyment, and likely derive some pleasure from making the inherent sacrifices for the common good (be it biocentric or anthropocentric). However, given that angling-guides are often employed by less experienced anglers, it is likely that many angling-clients are less knowledgeable or environmentally aware. As a result, they may not be as willing to make sacrifices of angling-enjoyment and may demand behaviours at odds with best-practices. These behaviours may include extended periods of catch admiration (air-exposure), extensive documentation (many photographs, increased handling, weighing and measuring catch), tackle choice which favours high catch-rate (e.g. treble hooks or many hooks), prolonged retrieval times (increased physiological stress response) and strong desire to harvest their catch. These "demands", or perhaps even the angling-guide's assumption of these demands, present an overarching barrier to PEB by angling-guides on guided-angling trips, irrespective of their good knowledge or pro-environmental intentions.

While the pressure to satisfy angling-clients is a major barrier to PEB, angling-guides likely encounter many other barriers to PEB that are unrelated to client-satisfaction. Given that the angling-guide intervention aims to promote pro-environmental angling best-practices, the model of PEB proposed by Kollmuss & Agyeman (2002) may be of use in identifying these barriers (Figure 5.3). Their model of PEB provides a comprehensive framework of the drivers of PEB, and a typology of the potential barriers and may provide a useful framework within which to explore the drivers of the poor behaviours identified in the previous step (CBSM Step 1). Classifying barriers into this typology contributes to later strategy development, as different barriers require different strategic intervention. In the model of PEB, Kollmuss & Agyeman (2002) identified several types of barriers from the array of key factors influencing PEB which were commonly illustrated in several overlapping models attempting to explain PEB. These factors could be internal, and the product of individual personality traits, value systems, attitudes, knowledge, beliefs, and emotional involvement. These factors could also be external, as infrastructural, institutional, political, economic and socio-cultural factors also play a role. Furthermore, these external factors may even shape the aforementioned internal factors, creating an inextricable web of potential behavioural influences.
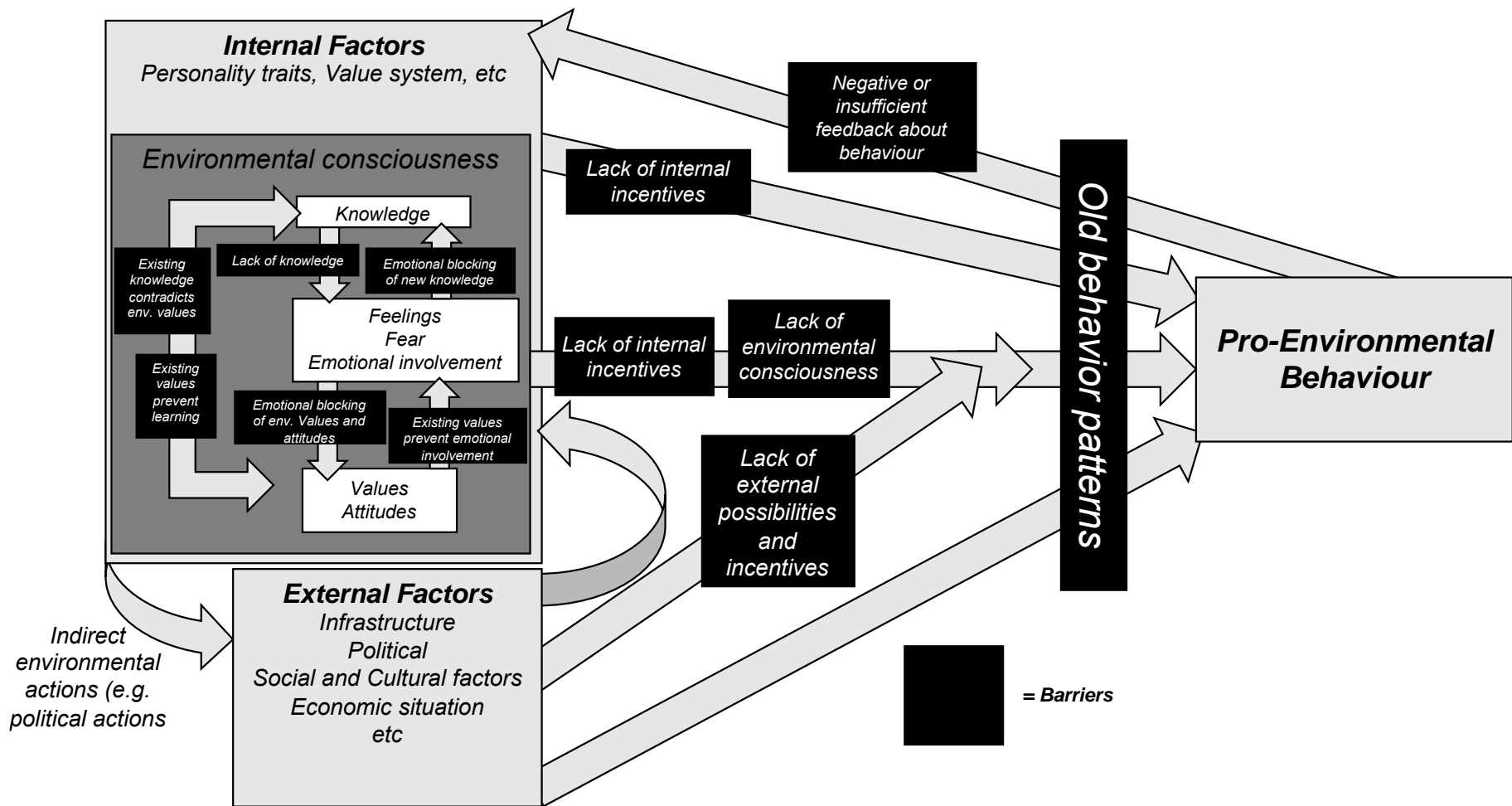
Figure 5.3: The model of Pro-Environmental Behaviour (PEB) proposed by Kollmuss & Agyeman (2002) adapted from the same publication.

The Kollmuss &Agyeman (2002) model of PEB has typified the following principal barriers to PEB:

- o *Lack of external possibilities* (e.g. beyond angling-guides control)
- o *Lack of external incentives* (e.g. insufficient economic or social benefit)
- o *Negative feedback about behaviour* (e.g. from clients or other angling-guides)
- o *Insufficient feedback about behaviour* (e.g. from other community members)
- o *Old behaviour patterns* (e.g. habitual angling practices)
- o *Lack of internal incentives* (e.g. insufficient or competing motivations)
- o *Lack of environmental consciousness* (a complex of poor environmental knowledge, attitudes, values and emotions)
  - ↘ *Lack of knowledge* (of ecological problems, impacts or solutions)
  - ↘ *Emotional blocking of new knowledge* (e.g. rejecting uncomfortable truths)
  - ↘ *Emotional blocking of environmental values and attitudes*
  - ↘ *Existing values prevent emotional involvement* (e.g. low value on fish-welfare)
  - ↘ *Existing values prevent learning*
  - ↘ *Existing knowledge contradicts environmental values*

Using the above list, the potential barriers to the PEBs to be promoted can be systematically assessed to ensure no potential barrier is overlooked. For example, interventionists may assume that angling-guides behave poorly (e.g. excessive air exposure for photographs) due to poor knowledge of the impact or low values placed on fish-welfare (i.e. *lack of environmental consciousness)*, but overlook the potential for a weak internal locus of control *(i.e. lack of external possibilities)* or perceived "costs" such as gratuity loss (i.e. *lack of external incentives*). Using this list, the 10 best-practice behaviours to be promoted were systematically evaluated for their perceived "costs" and the potential barriers associated with them, and thereafter categorised into relevant barrier typologies (Table 5.1).

Having identified the perceived costs and barriers of the best-practice behaviours to be promoted, the next step is to explore their benefits. Benefits are a critical component of marketing social-change, because it appears that individuals respond better to the positive consequences (benefits) of changing their behaviour than they do to negative impacts of not changing it (McKenzie-Mohr 2011). The benefits of the PEBs being promoted provide the motivation and impetus to perform them. However, individual motivations to behave pro-environmentally may vary considerably between individuals, and could include a combination

Table 5.1: Summary of the perceived costs, barriers and benefits of the 10 best-practice behaviours to be promoted to marine-shore-based angling guides with a structured behavioural intervention using Community Based Social Marketing principles.

Angling-guide best-practice behaviour to be promoted	Perceived "costs" of the best-practice	Specific barriers to the best-practice behaviour	Lack of external possibilities	Lack of external incentives	Negative feedback about behaviour	Insufficient feedback about behaviour	Old behaviour patterns	Lack of internal incentives	Lack of environmental consciousness	Lack of knowledge	Emotional blocking of new knowledge	Emotional blocking of env. values and attitudes	Existing values prevent emotional involvement	Existing values prevent learning	Existing knowledge contradicts env. values	Specific benefits of the best-practice to be promoted and communicated	Self-interest	Pro-social	Anthropocentric	Biocentric
1. *Use only single j-hooks when fishing lures (i.e. plugs and spoons).*	Reduced catch-rate, "missed strikes", potential decrease in client satisfaction, additional cost of changing hooks from those supplied by manufacturers, difficult to enforce in large groups	Lack of motivation, poor knowledge of severity of hooking injury, weak internal locus of control regarding ensuring every client only uses correct hooks when in large groups	x	x	x		x	x	x	x						Better for fish, limits risk of injury to client and angling-guide during landing, unhooking and photography.	x	x	x	x
2. *Set a limit on time allowed for photographs.*	Risk of poor photographs, client dissatisfaction	Lack of motivation, poor knowledge, poor awareness, insufficient dissonance due to recall bias, poor preparation, forgetfulness		x	x	x	x	x	x	x						Better for fish, limited risk of dropping fish, limits risk of sand exposure, limits stress response - thereby limiting efforts for recovery.	x	x	x	x
3. *Use a waterproof camera that can be carried at all times to photograph catches.*	Increased cost of purchasing additional camera equipment, more difficult to share photographs with clients	Lack of motivation, poor knowledge, poor awareness, insufficient dissonance due to recall bias, poor preparation, economic costs of better camera equipment,	x	x		x	x	x	x	x						Better for fish, better for photos, avoid damage to cell-phone, avoid increased effort of returning to tackle bag to retrieve non-waterproof devices, easier to use than touch-screen, potentially better photographs.	x	x	x	x

Table 5.1: Summary of the perceived costs, barriers and benefits of the 10 best-practice behaviours to be promoted to marine-shore-based angling guides with a structured behavioural intervention using Community Based Social Marketing principles.

Angling-guide best-practice behaviour to be promoted	Perceived "costs" of the best-practice	Specific barriers to the best-practice behaviour	Model of PEB barrier typology													Specific benefits of the best-practice to be promoted and communicated	Benefit motivations			
			Lack of external possibilities	Lack of external incentives	Negative feedback about behaviour	Insufficient feedback about behaviour	Old behaviour patterns	Lack of internal incentives	Lack of environmental consciousness	Lack of knowledge	Emotional blocking of new knowledge	Emotional blocking of env. values and attitudes	Existing values prevent emotional involvement	Existing values prevent learning	Existing knowledge contradicts env. values		Self-interest	Pro-social	Anthropocentric	Biocentric
4. *Avoid contaminating epithelial mucus with sand by placing the fish in a water filled container for unhooking.*	Increased costs of containers, increased effort of transporting large containers between fishing spots, increased effort of maintain sufficient quantities and quality of water in containers during busy angling days, practical limitations on time required to effectively utilise apparatus	Lack of motivation, institutional barriers, practical limitations of transporting large containers, belief that sand exposure is not deleterious,	x	x		x	x	x	x	x					x	Better for fish-health, increases the time available to complete other important tasks such as readying camera equipment, allows the client to relax and prepare for photographs, decreases sand exposure, limits need to remove sand for photographs, increases the quality of photographs because air exposure is limited, provides safe place for fish to fish if dropped during photographs.	x	x	x	x
5. *Never remove sand off the fish by hand – choose instead to wash it off using water.*	Increased effort of alternatives, risk of poor photos if no alternative is available	Lack of motivation, poor knowledge, poor awareness, belief that practice is not deleterious		x	x	x	x	x	x	x					x	Better for fish-health, better for photos.	x	x	x	x
6. *Instruct the client to hold the fish above the water-filled container for photographs.*	Photographs with containers may not be as desirable, increased effort of transporting and filling container	Lack of motivation, economic cost of containers, practical constraints on use of containers in certain locations	x	x	x	x	x	x	x	x						Better for fish-health, better photos, reduces risk of sand contamination which is bad for fish and for photos.	x	x	x	x

Table 5.1: Summary of the perceived costs, barriers and benefits of the 10 best-practice behaviours to be promoted to marine-shore-based angling guides with a structured behavioural intervention using Community Based Social Marketing principles.

Angling-guide best-practice behaviour to be promoted	Perceived "costs" of the best-practice	Specific barriers to the best-practice behaviour	Lack of external possibilities	Lack of external incentives	Negative feedback about behaviour	Insufficient feedback about behaviour	Old behaviour patterns	Lack of internal incentives	Lack of environmental consciousness	Lack of knowledge	Emotional blocking of new knowledge	Emotional blocking of env. values and attitudes	Existing values prevent emotional involvement	Existing values prevent learning	Existing knowledge contradicts env. values	Specific benefits of the best-practice to be promoted and communicated	Self-interest	Pro-social	Anthropocentric	Biocentric
7. Cut the line immediately when the catch is hooked in oesophagus.	Costs of not retrieving potentially expensive hooks, potentially perceived as worse for fish-health	Poor knowledge of best-practice, poor awareness of impacts		x	x	x	x	x	x	x					x	Better for fish-health, simpler than alternative, reduced physical effort, reduced risk of injury to unhooker when dealing with sharp-toothed species.	x	x	x	x
8. Always carry sufficiently robust pliers for easy unhooking and cutting line.	Cost of purchasing equipment, inconvenience of having pliers on person at all times,	Lack of motivation, economic barriers, habitual behaviour, poor preparation, forgetfulness	x	x	x	x	x	x	x	x						Better for fish-health, reduces effort during unhooking, reduces risk of injury from hooks or sharp-toothed species, shows professionalism, reduces effort to return to tackle bag to retrieve equipment, useful beyond unhooking.	x	x	x	x
9. Brief angling-clients on protocols, practices and expectations before angling begins.	Risks of imposing limits on potential enjoyment, risk of seeming overly authoritarian	Lack of motivation, poor knowledge, socio-cultural norm		x	x	x	x	x	x	x						Better for fish-health, helps maintain order over aspects of the C&R process that are difficult to control, limits confusion, sets a standard for professionalism, makes everyone aware of what the angling-guide expects, makes managing larger groups easier.	x	x	x	x
10. Reprimand clients politely for poor practices which are otherwise beyond your control.	Client dissatisfaction, potential loss of gratuity, loss of repeat patronage, potential for uncomfortable confrontation/altercation	Lack of motivation, socio-cultural norm of "customer comes first"		x	x	x	x	x	x	x						Better for fish-health, ensures clients won't repeat the undesirable behaviour, limits unnecessary impact on the resource on which angling-guides rely, ensures that angling-guides can maintain control of large groups of clients.	x	x	x	x

of pro-social motivations and self-interests (Bamberg & Moser 2007). Therefore, motivations to adopt and perform the best-practices can be a rational choice based on self-interest, or the result of social pressures like moral obligations or social norms (Kollmuss & Agyeman 2002). Furthermore, these motivations to behave pro-environmentally may be anthropocentric, favouring conservation for the future benefit of the self or other humans, or perhaps biocentric, borne of a high moral regard for the intrinsic value of nature and its' integrity. Consequently, interventionists must endeavour to communicate a range of benefits to cater to these varying orientations, depending on the community being addressed. With this in mind, the potential benefits for each of the 10 best-practice behaviours to be promoted to marine shored-based angling-guides were systematically assessed, listed and further categorized into *pro-social, self-interest, anthropocentric and biocentric* benefits to angling-guides to ensure complete coverage (Table 5.1). For example, an angling-guide may not respond to the *biocentric, anthropocentric or pro-social* benefits of improved fish-health when using a water-proof camera instead of a cell-phone to take photos, but illustrating that it requires much less physical effort (e.g. no running back to the tackle bag to collect cell-phone) may be a sufficiently motivating benefit of *self-interest*.

CBSM Step 3: Developing *strategies to address barriers to PEB and promote their benefits*

After having identified the angling-guide behaviours which require change, and obtained sufficient insight on their context, drivers, barriers and benefits, it is possible to structure the intervention. As has been shown, effective behavioural interventions must consider the complex suite of potentially interrelated barriers to the desired behavioural outcome. As such, the nature of the particular behaviour, its context, barriers and benefits should contribute to the design of the intervention. The most effective behavioural interventions use a combination of strategies (Stern 2000), including a combination of informational (e.g. training and informative outreach) and structural (contextual and circumstantial) interventions to overcome barriers (Steg & Vlek 2009). Fortunately, social-psychology has developed many behaviour-change tools which can be readily applied to a variety of problematic behaviours, depending on their drivers, barriers and benefits. The CBSM approach presents an array of these behaviour change tools with key considerations for each as follows (McKenzie-Mohr & Smith 1999):

1. *Commitments* – verbal or written commitments to undertake certain behaviours
   - *Emphasize written over verbal commitments*
   - *Ask for public commitments*

- o *Seek commitments in groups*
- o *Actively involve the person*
- o *Use existing points of contact to obtain commitments*
- o *Help people view themselves as environmentally concerned*
- o *Don't use coercion!*

2. *Prompts* – cues to remind community members to perform behaviours

- o *Make the prompt noticeable*
- o *Make the prompt self-explanatory*
- o *Prompt in as close a proximity as is possible to where the action is to be taken*
- o *Prompt people to engage in positive behaviours*

3. *Norms* – create community support for desired behaviour

- o *Make the norm visible*
- o *Use personal interaction to reinforce norms*

4. *Communication* – distribution of tailored messages and information

- o *Use captivating information*
- o *Know your audience*
- o *Use a credible source*
- o *Frame your message*
- o *Carefully consider threatening messages*
- o *Decide on a one-sided versus two-sided message*
- o *Make your message easy to remember*
- o *Provide personal or community goals*
- o *Emphasize personal contact*
- o *Provide feedback on behaviour*

5. *Incentives* – monetary or non-monetary incentives for desired behaviour

- o *Closely pair the incentive and the behaviour*
- o *Use incentives to reward positive behaviour*
- o *Make the incentive visible*
- o *Be cautious about removing incentives*
- o *Prepare for people's attempts to avoid the incentive*
- o *Carefully consider the size of the incentive*
- o *Use non-monetary incentives*

For example, when angling-guides have positive attitudes towards poor-practices, the psychological understanding of beliefs and values can be applied to educate their misconceptions of the impact of their poor behaviour, and increase the value of the pro-environmental best-practice alternative. When an angling-guide's motivation to engage in a particular best-practice behaviour is low, this motivation could be enhanced by eliciting public

commitments (e.g. Katzev & Wang 1994) or with incentives (e.g. Gardner & Stern 1996). When angling-guides do not feel that they "ought" to utilize best-practices, then social norms models can be exploited to adjust the injunctive and descriptive social norms for that community (e.g. college drinking behaviour - Cialdini et al. 1990; angling compliance - Bova et al. 2017). While not every context allows the use of every tool, the more of these tools an intervention uses, the more likely it is to affect behaviour change.

Interventions to promote best-practices to marine shore-based angling-guides

Having identified the problematic behaviours to be changed, the best-practices to promote, the benefits to communicate and the tools available to do so, it is time to structure the CBSM program. However, it is difficult to assign responsibility for interventions in this space (Danylchuk et al. 2018), and therefore it is difficult to design programs and strategies without understanding who will execute them. Additionally, the capacity and resources (financial and human) of the those who seek to intervene will dictate which tools can be used and to what extent they can be deployed. Furthermore, the organisation which undertakes the intervention effort must be seen as trustworthy and credible if it is to affect behaviour change at the community level. Given that anglers are typically subjected to top-down bureaucratic regulations on their resource use behaviour (Danylchuk et al. 2018), the governing state and its agencies are perhaps not the best messenger, and may be met with considerable resistance. In Danylchuk et al. (2018), the authors attribute part of the success of the "KeepFishWet" social branding and outreach campaign in affecting angler behaviour change to its grassroots nature. Given that this intervention is to be implemented at the angling-guide community level, it is critical that the intervention agency/ies is seen to be at a similar level.

Intervention 1: establishing the community with brand identity

In southern Africa, marine shore-based angling-guides are connected informally through social and competitive angling clubs, common social circles, communities of practice, social-media and through fishing-tackle manufacturers and retailers who often employ some of them as "pro-staff". However, because there is no formal legislation requiring registration or training in South Africa, Namibia, Mozambique or Angola (or in many other parts of the world), there is no clear access point for interventionists to establish the essential inter-personal contact with large segments of the marine shore-based angling-guide community. Consequently, it is difficult to deploy a CBSM approach when the community is difficult to gather. One potential solution is to start a social branding initiative (e.g. NPO, NGO), under which the intervention

can be marketed. In much the same way as the "KeepFishWet" campaign has garnered a significant social following (Danylchuk 2018), a branded initiative aimed at the marine-shore-based angling-guide community may be able to develop sufficient trust and credibility as a grassroots organisation. Given that the CBSM approach is a long-term intervention effort, the time, effort and cost to design a branding initiative of sufficient social-value using social-marketing techniques may allow for the formalisation of marine shore-based angling-guides into a social-movement. This could improve access to the community by increasing motivation to participate in workshops and other outreach efforts under the auspices of the brand at a later date, and create the opportunity for essential communication between members.

Intervention 2: development of a freely available, tailored best-practice manual

While information-based campaigns alone to improve environmental behaviour have been criticised for failing to initiate mass-scale behaviour change (Gifford 2014; Schultz; e.g. Mannheim et al. 2018), this does not warrant their preclusion. The dissemination of scientifically grounded best-practice angling information is critical to ensure that angling-guides are intellectually equipped to behave pro-environmentally. The distribution and dissemination of specific how-to information is important, especially for angling-behaviours which have best-practices which demand critical skill, such as "venting" fish for the relief of barotrauma (Curtis et al. 2015; Ferter et al. 2015). In a review by Sims & Danylchuk (2016), less than 9% of recreational angling NGOs mentioned "catch-and-release" in their websites, and fewer presented any best-practice information. Even when best-practice information was presented, it was often incorrect (Pelletier et al. 2007; Sims & Danylchuk 2016). Given that recreational angling is usually community orientated, many anglers will refer to grassroots organisations like angling clubs (e.g. RASSPL; Mannheim et al. 2018) and other such NGOs (e.g. KeepFishWet) for information regarding their angling practices (Sims & Danylchuk 2016), and angling-guides will likely do the same. The curation and synthesis of best-practice information in a manner relevant, easily accessible and readily digestible by angling-guides from the targeted SOP is critical, and will make it much more convenient for those seeking to improve their own behaviour, or that of their community. This resource can be incorporated into the web-page and linked into the social-media communications of the branded initiative mentioned in Intervention 1.

Best-practice manual for marine shore-based angling-guides

Developing a freely available, branded best-practice manual for marine shore-based angling-guides (or whichever SOP is being targeted) provides interventionists the opportunity to communicate additional, important messages. In addition to the carefully framed and directly relevant best-practice how-to and benefit information, angling-guides must be made aware of their potential impacts, not just on the resource, but on the behaviour of those they guide. Angling-guides may not be aware of their power to influence the behaviour of their clients, and this realisation may ignite a sense of responsibility to adopt their roles as educators and custodians of their fisheries resources. For example, this messaging could be included in the best-practice manual, with specific, relevant information such as:

⇒ *"you are extremely influential in the recreational angling community"*
⇒ *"most anglers will look to you as an example of how they should behave"*
⇒ "*89% of your clients believe that your behaviour is worth copying*"
⇒ *"91% of your clients think of you as a role-model"*
⇒ *"you are a leader in the recreational angling community"*

This messaging can also include information about how other angling-guides feel about those best-practice behaviours and responsibilities, thereby adjusting misperceptions of how others behave by making the social norm visible. For example, this messaging could include:

⇒ *"most marine shore-based angling-guides use single j-hooks on their lures"*
⇒ *"most marine shore-based angling-guides only allow their clients 30 seconds for photos"*
⇒ *"most marine shore-based angling-guides forbid their clients from using treble hooks"*
⇒ *"89% of marine shore-based angling-guides agree that they have the responsibility to educate their clients on catch-and-release best practices and conservation"*
⇒ *"89% of marine shore-based angling-guides agree that angling-guides are responsible for conserving fish stocks"*

This additional messaging on social norms and environmental responsibility is especially important for those angling-guides who do not have a strong network of angling-guide peers. This messaging may have reach beyond that of other strategies, which rely on inter-personal contact, reaching those who are isolated, poorly connected, independent and/or self-employed. Additionally, a best-practice manual provides a simple basis on which angling-guides and outfitters/employers can establish codes-of-conduct. The extant C&R literature can be

inaccessible, complex and misinterpreted by those in the guiding community that are seeking to improve their angling-behaviour and this may result in pervasive misconceptions of best-practices and the adoption of incorrect behaviours in an effort to be pro-environmental. If existing organisations, in which members already have trust, use this resource to make "in-house" efforts to improve their community segment's behaviour, then messaging and communication may be even more effective and far-reaching.

Intervention 3: promoting social-diffusion through social-media communication

A central tenant of the CBSM approach is to emphasize personal contact and interaction when communicating pertinent information with the members of the target community, because individuals appear to respond better to pleas made by other individuals (McKenzie-Mohr 2011). While the communication and messaging built into the best-practice manual described in Intervention 2 is important, it lacks the ability to interact with or provide feedback to angling-guides about their actual behaviour. Many angling-guides in southern Africa rely strongly on social-medias like Instagram®, Facebook® and YouTube® for marketing their business. The tremendous social-value placed by both angling-clients and angling-guides on photographs, and more recently videos, of memorable catches means that social-media is an important arena of discussion and interaction between members of this community. Using these social-media platforms affiliated with the branded initiative described in Intervention 1, interventionists can actively communicate captivating and memorable information to angling-guides using vivid imagery (including video) and carefully framed messages. Furthermore, social-media provides interventionists the opportunity to provide positive feedback on angling-guides' posts depicting the best-practice behaviours which the intervention seeks to promote. The nature of social-media means that this positive feedback is visible, not only to those receiving it, but other members of the community as well. This positive feedback may eventually become a non-monetary incentive for the best-practice behaviours in the form of social-approval and prestige, provided the branded initiative is perceived as having sufficient social-value. With time, angling-guides who consistently display best-practices online can perhaps be awarded an endorsement or brand ambassador status. Given that this potentially prestigious seal of approval is also visible to angling-clients, other angling-guides may be even more inclined to seek out these incentives to remain competitive in the market they presume finds this approval socially-desirable.

Prominent angling-guides with high-profile media presences may be useful in communicating best-practices if recruited into the intervention. If these angling-guides (i.e. influencers) with a presence in the traditional (e.g. TV) or alternative (e.g. YouTube®) media agree to assist in the promotion of the best-practice behaviours in their content, their social-influence may lend important credibility to both the message and the brand itself, thereby increasing social-impact. Given their social-standing in the angling-guide community, their depicted best-practice behaviours may have significant impact on how others perceive the social norm. By making these best-practice behaviours visible to other members of the community, they may increase the sense of "ought" associated with the injunctive social-norms of best-practices. This may be mutually beneficial, as independent media personalities (e.g. YouTubers) are likely to accept opportunities to produce meaningful content and increase traffic to their platforms. Additionally, those angling-guides who agree to cooperate with interventionists may enjoy the associated prestige, and may be able to capitalize on their ethical leadership by up marketing their business on the basis of the brand endorsement/affiliation.

Intervention 4: interactive presentations, workshops and branded certification

One of the principle focusses of the CBSM approach is to carry out interventions at the community level, relying heavily on inter-personal contact. This was especially evident in the success of the long-term intervention effort by the Southern African Fisheries Ecology Research (SAFER) Lab in the RASSPL competitive angling community (Mannheim et al. 2018). This intervention effort relied heavily on workshops, presentations and feedback sessions, combining informational and structural approaches to change RASSPL angler behaviour. As such, the core of intervention efforts to change angling-guide behaviour must take place with members of the angling-guide community physically present. This provides interventionists with the opportunity to use a range of behaviour change tools which leverage cognitive biases to promote behaviour change, such as obtaining commitments (individual or group, verbal or written) to behave responsibly. Integrating commitments into these in-person meetings can bolster angling-guide commitment to PEB intentions, and build essential community support for responsible angling behaviours by altering injunctive social norm to align with best-practices. If members of the community observe the commitments of others, they may feel more compelled to maintain commitments themselves. Additionally, the observed support of the community towards personal and community goals for sustainability will correct misperceptions of what is acceptable (injunctive social norm), and steer angling behaviour more effectively in the absence of scrutiny.

While existing angling-guide organisations may provide access to segments of the guiding community directly, it is difficult for interventionists to reach the portion of the industry which is not strongly affiliated. As previously mentioned, as with guides in all facets of angling, many marine shore-based angling-guides in southern Africa are self-employed, or operate independently in isolated regions where the industry is less formalised or unified. While these individuals can perhaps be reached with media-based outreach campaigns, they will not be as easily recruited to participate in workshops without sufficient incentives. Consequently, without incentives to participate they may only be subject to the information-based campaigns on which most angling interventions have relied to date. Options to incentivise participation in presentations, workshops, certification and other activities where inter-personal intervention tools can be implemented is an important consideration. One potential solution to reaching these isolated community members lies in promoting the desirability of certified angling-guide training. As stated previously, it is impossible to enforce mandatory training globally, but a market-driven demand for certified, trained angling-guides may drive booking-agents and angling-clients to favour/recruit angling-guides who meet sufficient requirements of training. Assuming that the social-desirability and prestige associated with branded certification provides sufficient incentives, many angling-guides will seek the benefits of certification by participating in relevant training programs and workshops in order to remain competitive. This may provide interventionists with access to these isolated segments of the population by incorporating their messaging and intervention strategies into training materials (e.g. best-practice manuals) and workshops.

Training workshops are an ideal opportunity to not only communicate important information about best-practices and their benefits in presentations, but also to leverage cognitive biases (e.g. social conformity, internal consistency) to bolster commitment to best-practice behaviours. However, it is essential that participation in these workshops is not only incentivised, but made as convenient, enjoyable and beneficial as possible for those participating. Firstly, it is likely that angling-guides will be unwilling to pay for costly training and certification, and as such interventionists must endeavour to provide the opportunity to become certified at little to no extra cost of participation. Secondly, interventionists and those seeking to affect behavioural change must accept that the angling-guides' participation in workshops is likely more valuable to the intervention than it is to those participating. Interventionists must be willing to regularly conduct workshops and presentations in several locations, and for small groups if necessary, to achieve sufficient participation with community

members who may have little incentive to participate if it is inconvenient. Lastly, those conducting workshops must continue to build angling-guide trust and confidence in the brand by carefully framing messaging as supportive, avoiding coercive tactics and by providing angling-guides the opportunity to communicate, ask questions and provide feedback.

Intervention 5: reminders for angling-guides and clients to use best-practices

A likely deliberate benefit of the slogan "KeepFishWet" is that it is, in itself, a specific, self-explanatory prompt for a fundamental best-practice. Prompts are powerful reminders to behave in a manner we may otherwise forget, and the prompt to "KeepFishWet", depicted in social-media "hashtags" (i.e. #keepfishwet), bumper stickers and decals on all manner of angling equipment and apparel, serves as an efficient reminder to limit air-exposure. Additionally, the "KeepFishWet" brand has the intrinsic social-value that drives individuals to display their loyalty in the form of hashtags on social-media, branded decals on vehicles, angling gear and other angling apparel, which dramatically increases their visibility. Prompts can take many forms, and serve as visual or auditory cues to perform a behaviour (e.g. signs to reduce littering - Reiter & Samuel 1980; Durdan et al. 1985; Houghton 1993; or conserve household energy - Sussman & Gifford 2012). Guide-level intervention campaigns must consider that carefully designed, highly visible prompts incorporated as close as possible to the actual behaviour can bolster adherence to best-practice intentions and commitments, especially for behaviours that are easily forgotten or overlooked (Sussman & Gifford 2012), such remembering to always carry pliers and minimize air-exposure.

Prompts for marine shore-based angling-guides

For an intervention to promote best-practices to marine shore-based angling-guides, manipulating the characteristics of angling-equipment may serve as a visual prompt. For example, measuring mats (Figure 5.4a), which are commonly used in marine shore-based fisheries, provide a considerable surface-area for branding and visual prompts to promote best-practices. Measuring mats can be tailored to incorporate branding and bold text with slogans which prompt desired behaviours. Slogans, such as "**put me back in the water**", can be placed on measuring mats to prompt angling-guides to limit air-exposure while measuring a clients catch, and quickly return the fish to the water-filled container. These mats can be distributed at no cost after the training workshops described in Intervention 4, thereby overcoming other potential barriers such as economic cost or inaccessibility of suitable equipment. In a similar fashion, stickers/decals with a graphic representation of a pair of pliers can be distributed to be

Figure 5.4: Photographs of some marine-shore-based angling best-practices, behaviours and relevant equipment. (a) a fish placed on the measuring mat often used in marine-shore-based fisheries, highlighting the space available branding and prompts (photo credit: *Ryan Foster*). (b) example of an angler about to measure his catch while using a brightly coloured unhooking container which may be suitable for the recommended best-practice. (c) example of anglers congregating around their equipment on the beach in between angling activities.

Figure 5.5: Catch photographs shared by members of the southern African marine-shore-based recreational angling community where the best-practice behaviour of holding the fish above the water-filled bucket container is clearly visible, not only to the photographer, but also those who view the photographs later on social-media. (photo credits*: Edward Butler, Kirsten Ball, Brett Pringle, Ryan Foster*)

applied to tackle-boxes to remind angling-guides to don their unhooking equipment before angling begins. Similarly again, brightly coloured, unhooking containers (as used in RASSPL

intervention by Mannheim et al. 2018; e.g. Figure 5.4b) can be adorned with slogan prompts such as "**take your photos – not your time**" or "**30 seconds or less**" which are visible to angling-guides while they photograph the catch above the water-filled container (e.g. Figure 5.5). This prompt has the added benefit of being visible, not only to those present, but also to those who later view the photographs on social-media (e.g. Figure 5.5).

During guided-angling trips in marine shore-based fisheries, it is common practice for everyone to place their equipment together in a central area above the high-tide mark, usually in close proximity to a large cooler-box filled with ice, cooldrinks and snacks (e.g. Figure 5.4c). Throughout the angling day, everybody on the trip is constantly travelling from their equipment to the shore-line and back, either to change lures, re-bait their hooks, adjust their equipment setup, to retrieve something to drink/eat or for respite from harsh sun or cold seawater. Visual prompts can be placed on larger pieces of equipment, such a tackle-boxes and cooler-boxes, and will be readily noticed by all those present, many times throughout the day of angling activities. Prompts which target behaviours which are sometimes beyond angling-guide control, such as hook choice, may be useful for ensuring all anglers are prompted to perform the best-practice, and reminded of what the social-norm is. For example, a large decal depicting a treble-hook overlayed with the prohibition symbol (red circle with a line through it) applied to the lid of a cooler-box will ensure that anglers will be routinely prompted to avoid using treble hooks every time they open the lid. This is especially useful as it can be difficult for angling-guides to maintain control of every choice their clients make, especially in large groups. Developing a trusted brand with intrinsic social value may allow the distribution of attractive branded decals or branded equipment with specific prompts aimed at angling-guide behaviour to be an effective tool in this space. This is because the individuals will have impetus to display those prompts on their equipment, or use them when on guided-angling trips or when interacting with others online (e.g. *#trebles=troubles*).

Intervention 6: overcoming economic barriers to using suitable equipment

A considerable barrier to best-practices which require additional equipment is their costs which present significant financial barriers. For example, the best-practice recommendation to use a waterproof camera instead of a cell-phone may require significant investment in excess of $200 (USD). Similarly, the recommendation to not use treble-hooks may incur significant extra cost to purchase hooks over-and-above that provided by manufacturers on expensive lures. While the simplest manner to overcome this barrier is to just provide angling-guides with the correct

equipment, it is likely beyond the ability of interventionists to provide this expensive equipment for free. One potential solution is to collaborate with relevant manufacturers and retailers to provide those angling-guides who have participated in workshops, presentations or certification the opportunity to purchase necessary equipment from a pre-approved short-list of best-practice essentials at a considerably reduced price, perhaps even at cost or further subsidised. If the branding initiative has sufficient social-value, there may be considerable benefits for those businesses willing to collaborate which can be leveraged for this service. While this can be seen as a monetary incentive, which should be met with caution if not available in perpetuity, the service would only be available for those items essential for the best-practices being promoted for which there is a considerable economic barrier. Furthermore, this will highlight that the brand understands the community, and shows support for the meaningful solutions recommended.

CBSM Step 4: *Piloting the guide-level intervention*

A key principle of the CBSM approach is to pilot the intervention on a small scale to ensure it is effective in addressing the problematic behaviours identified. Piloting not only ensures that resources are not wasted on ineffective interventions, but also provides an opportunity to readjust the strategies before they are implemented on a broadscale. There are many research methods and tools to measure change statistically, and ideally piloting should be conducted repeatedly until the level of behaviour change desired is reached, although this is rarely done. It is a failing of traditional programs to develop broadscale interventions without trial, and not evaluate their effectiveness after implementation. Angling-guide intervention pilots could be conducted within existing angling-guide networks or organisations, such as the group of angling-guides observed during the Chapter 4 case study. The CBSM approach is a long-term intervention strategy to foster meaningful behaviour change, and therefore interventionists must understand that it will take considerable and consistent effort to make meaningful strides. The implementation of a poorly tested angling-guide intervention is a misuse of resources, and will fail to enact the changes in resource use behaviours which this space so desperately needs.

CBSM Step 5: *Broad-scale implementation and evaluation*

After broad-scale implementation, interventionists must evaluate the effectiveness of the intervention. The CBSM approach stresses that evaluation of actual behaviour change is critical, however, despite the cost of implementing interventions, post-implementation

evaluations are rare. As such, efforts to intervene at guide-level must consider that simply designing and implementing an intervention is not sufficient, and effort must be made to evaluate the impact of these outreach programs on angling-guide's actual behaviour. Furthermore, it is stressed that while self-reported measures are useful in evaluating interventions post-implementation, their susceptibility to several measurement and cognitive biases means that evaluations of program effectiveness must endeavour, where possible, to evaluate behaviours directly. While it is likely that these aspects of the CBSM approach add considerable time and cost to programs, they are essential to refine the strategy and make it more applicable in other segments. Furthermore, the evaluations will highlight where finances can be directed to achieve maximum impact, and may serve to motivate why a particular intervention program requires more funding.

It is apparent that angling-guides provide a potentially powerful outreach opportunity to improve recreational angler behaviour, but they require intervention to ensure that this influence is steered constructively. Community based social-marketing appears to be a suitable approach for interventionists to address problematic angling-guide behaviour on guided-angling-trips, provided interventions can achieve sufficient interaction with the guiding community in question. As previously mentioned, it is difficult to assign responsibility for this task, and the extent and reach of the interventions will depend on the resources available to those who undertake them. Fortunately, the CBSM principles apply to communities of virtually any size, and interventions can be structured for a single community of practice utilising a single resource (e.g. South African marine-shore-based "rock-and-surf" angling-guides), or a large angling-guide organisation, with members who operate around the world (e.g. IGFA Captains and Guides program). The exact mechanisms by which the program attempts to alter the problem behaviours will depend not only on the context, but also the resources available to interventionists, because some forms of outreach are much more costly than others. While training has here been touted as a key opportunity to conduct community-based intervention on a broad-scale, this will depend on the ability of the branding initiative to create a market-driven demand for training (by angling-guides, clients and middle-men), the availability of certified training providers and comprehensive and appropriate training materials to teach best-practices effectively. Future efforts should endeavour to develop decision making tools (angling-guide intervention tool-kit) and collate resources (e.g. best-practice manual for angling-guides) for recreational angling NGOs and grassroots angling organisations to design effective intervention programs themselves (e.g. clubs, representative groups etc), thereby

utilising a wide range of potential funding streams to execute intervention programs effectively.

To conclude, the aim of this thesis was to explore the role angling-guides might play in the global endeavour to improve the resource use behaviours of the recreational angling community. The chapters herein demonstrate that angling-guides are likely perceived as role-models by their angling-clients, and as such they likely have considerable social-impact in the recreational angling community. This presents interventionists the opportunity to exploit this far-reaching influence to efficiently promote the unenforceable, pro-environmental angling ethics this community so desperately needs in order to meet sustainability goals. However, not all angling-guides' knowledge, attitudes and behaviours were pro-environmental, and their strong influence may be detrimental to conservation efforts if they exacerbate the problematic behaviours at hand. As such, angling-guides require formal intervention to ensure their influence is in a pro-environmental manner, and thereby contributing to the global conservation endeavour. The transactional relationship between angling-guides and their angling-clients presents a considerable barrier to changing their behaviour, because angling-guides appear to favour client satisfaction over pro-environmental behaviour. Interventions must therefore be carefully designed to overcome these barriers (among other specific barriers), and the community based social marketing approach appears to be a suitable tool to foster behaviour change within this community. While only an exploratory investigation with a small case-study, this contribution presents a stepping stone for those seeking to enact actual behaviour change in this space. Future efforts must explore the community based social marketing approach for intervention at the community level within specific fisheries, styles of participation and communities of practice to encourage the social-diffusion of responsible recreational angling ethics around the world.

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