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## Sharks and people: Insight into the global practices of tourism operators and their attitudes to Shark behaviour

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## ABSTRACT

Shark tourism is a popular but controversial activity. We obtained insights into this industry via a global e-mailed questionnaire completed by 45 diving/snorkelling operators who advertised shark experiences (shark operators) and 49 who did not (non-shark operators). 42% of shark operators used an attractant to lure sharks and 93% stated they had a formal code of conduct which 86% enforced "very strictly". While sharks were reported to normally ignore people, 9 operators had experienced troublesome behaviour from them. Whilst our research corroborates previous studies indicating minimal risk to humans from most shark encounters, a precautionary approach to provisioning is required to avoid potential ecological and societal effects of shark tourism. Codes of conduct should always stipulate acceptable diver behaviour and appropriate diver numbers and shark operators should have a moral responsibility to educate their customers about the need for shark conservation.

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### 1. Introduction

The historical portrayal in many cultures of sharks as dangerous killing machines has tended to instil in people a fear of sharks that can be difficult to overcome (Neff and Hueter, 2013; Whatmough et al., 2011). In reality sharks rarely attack humans (West, 2011) and observations indicate sharks demonstrate a lack of interest in humans when in close proximity (Neff and Hueter, 2013). By contrast, humans have rendered three-quarters of pelagic sharks and rays at an elevated risk of extinction through overfishing (Dulvy et al., 2008). It is estimated that each year, between 73 (Clarke et al., 2006) and 100 million (Worm et al., 2013) sharks are traded worldwide and the true total catch is likely to be significantly greater given the difficulty of accounting for bycatch, discards and artisanal fishing (Worm et al., 2013). Compounding the problem of overexploitation, sharks are characterised by slow growth, high longevity, late age of sexual maturity and low fecundity (Cortés, 2002; Ferretti et al., 2010), which makes populations slow to recover from anthropogenic impacts including direct and indirect effects from, amongst others, fishing, marine pollution and habitat destruction. (e.g. Baum and Blanchard, 2010; Baum et al., 2003; Ward-Paige et al., 2012).

Amid declining shark population trends, in recent years there has been a surge in shark-specific tourism to SCUBA dive or snorkel with them. Research into diver perception of sharks shows a gradual change in attitude towards them has occurred, whereby 'excitement', has replaced 'fear' such that many people are now attracted to the thrill of diving with these top predators (Gallagher and Hammerschlag, 2011; Whatmough et al., 2011). Places where sharks congregate due to high natural abundances of food are obvious spots for shark tourism to develop (Gallagher and Hammerschlag, 2011). For instance, whale shark tourism first developed in 1989 at Ningaloo Reef, Western Australia where 300–500 whale sharks gather annually to feed on seasonal coral spawn (Catlin and Jones, 2010). This site has become internationally renowned and by 2010 attracted around 10,000 people a year (Catlin and Jones, 2010).

People will pay highly for shark experiences (e.g. Farr et al., 2014); for example, in 2014 it cost up to US\$2,900 for a 4 day great white cage diving trip to Isla Guadalupe, Mexico.<sup>1</sup> A recent estimate suggests that shark watching generates over 314 million USD and supports more than 10 thousand jobs worldwide (Gallagher and Hammerschlag, 2011). Consequently the activity can help benefit

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<sup>1</sup> Solmar V Great White Shark Adventures, (2013), Great White Shark Diving at Isla Guadalupe. Retrieved February November 2517th 20143, <http://www.solmarv.com/schedules.html>.

local economies (Topelko and Dearden, 2009; Vianna et al., 2011) and could thereby create an economic incentive to conserve sharks (Gallagher and Hammerschlag, 2011; Maljković and Côté, 2011). In Palau, for example, it has been estimated that the value of an individual reef shark over its life time is about US\$1.9 million based on the revenue it generates from tourism (Vianna et al., 2010). By contrast a fisher could only expect to make US\$20 – US\$90 from catching a shark (Vianna et al., 2010). With increasing interest in shark tourism for its economic and potential conservation value, greater knowledge is required into the effects such activities may have on sharks as well as the potential for increased risks to the tourists themselves.

In many countries dive operators attract sharks through provisioning (i.e. feeding, e.g. Hammerschlag et al., 2012), with some allowing their clients to do this by hand (Orams, 2002; Semeniuk et al., 2007). In other places such as Florida, Hawaii and South Africa feeding is prohibited as a result of fears that the practice could increase risk to tourists (Hammerschlag et al., 2012; Maljković and Côté, 2011). Feeding sharks results in the concentration of large predatory animals in close proximity to tourists and acts to encourage their consumption of a non-natural food source. Aside from being potentially dangerous to people, it is a controversial practice since little is known about how it affects shark behaviour and ecology (Hammerschlag et al., 2012; Maljković and Côté, 2011; Orams, 2002) although there is a growing interest and consequently an increasing literature on this subject (e.g. Barker et al., 2014; Brunnschweiler et al., 2014; Huveneers et al., 2013). Some studies have indicated limited or no evidence for shifts in shark behaviour following long-term provisioning whilst others indicate increased residency and aggression. For example, Maljković and Côté (2011) investigated the effects of feeding on the behaviour of Caribbean reef sharks that had been provisioned for over 20 years. The authors concluded that a small number of larger sharks monopolised more than 50% of the bait on offer but there was no evidence for shifts in behaviour, such as different degrees of residency and daily minimum travel distances, which may have affected ecological roles. Conversely, research into provisioned sicklefin lemon sharks showed that shark residency significantly increased at feeding sites, particularly of males, as did intraspecific and interspecific aggression (Clua et al., 2010). In this study the authors concluded there to be potential for long-term losses in genetic variability amongst provisioned sharks due to the aggregating effect and the increased potential for inbreeding.

Whilst some shark diving and snorkelling trips seek to experience sharks in their natural environment, great white cage diving operators deliberately try to change shark behaviour. Baited lines encourage great whites to remain at the surface, whilst normally these ambush predators stalk their prey from below (Laroche et al., 2007; Martin et al., 2005). Encouraging such behavioural changes could therefore have repercussions throughout the ecosystem by affecting both the behaviour of the predator and the prey species. However, evidence to date is contrary (e.g. Bruce and Bradford, 2013; Laroche et al., 2007) and may depend on the quantity and reliability of food rewards offered (Clua et al., 2010).

In general, a perception exists that provisioning wildlife does not conflict with conservation goals and may even have a positive effect, although little research has investigated the latter view (e.g. Dubois and Fraser, 2013; Topelko and Dearden, 2009). By contrast, there is a large volume of literature for a broad range of vertebrates which concludes that being fed by humans may lead to a variety of impacts, including increased aggression and 'begging' behaviours (Hodgson et al., 2004 (rock-wallabies); Hsu et al., 2009 (primates); Pinto de Sá Alves et al., 2013 (river dolphins); Ram et al., 2003 (primates)) as well as reduced body condition (Amo et al., 2006 (lizards)) and juvenile fitness (Foroughrad and Mann, 2013 (dolphins)). Given the shortage of empirical evidence about any

potential ecological effects of shark tourism, advocates who favour this activity have argued that so long as the practise is sensibly performed it should allow people to enjoy something which will assist in ridding sharks of their dangerous reputation and thereby be of assistance to conservation efforts (Dobson, 2008; Meyer et al., 2009). However, concerns that provisioning causes habituation of sharks to humans, which may result in increased conflict with people (Dobson, 2008; Topelko and Dearden, 2009) cannot be dismissed and should be addressed with appropriate management to regulate shark tourism to reduce potential problems. Common measures used are control on tourist numbers and the promotion of appropriate behaviour from people towards sharks (e.g. Smith et al., 2010) although practices differ considerably between countries. For example in South Africa, great white cage diving is regulated by the Government's Marine Living Resources Act 1998 which makes it illegal for tourism operators to feed great whites, although they can place a fish-based chum slick in the water and use a fish-based bait tethered on a rope to entice sharks towards the cage (Johnson and Kock, 2006). By contrast whale shark tourism at Tofo Beach, Mozambique has no formal regulation and as a result harassment of whale sharks by tourism operators and their clients appears to be common (Pierce et al., 2010). The controversial nature and risks involved in feeding sharks has prompted several areas of the world to ban it in their waters including the Cayman Islands, Hawaii and Florida (Dobson, 2008).

Many papers exist which aim to assess behavioural changes in sharks at provisioning sites (e.g. Bruce and Bradford, 2013; Brunnschweiler et al., 2014; Clua et al., 2010; Hammerschlag et al., 2012; Huveneers et al., 2013; Laroche et al., 2007) but few define and describe the details of its practise. Without knowledge of existing practices, informing decision-making in terms of relevant management of the shark tourism industry is problematic. In this global survey we obtain insights into SCUBA/snorkelling tourism operators' attitudes to shark behaviour based on responses to an e-mail questionnaire sent to a sample of diving and/or snorkelling operators who either specifically advertised shark experiences or who did not. On the basis of their responses we describe the varied practices of shark tourism, the differing levels of risk it poses to humans and management measures adopted. Finally we highlight how shark tourism could be improved for the benefit of people, sharks and the environment.

## 2. Materials and methods

In 2011 we conducted internet searches and consulted diving magazines to identify dive or snorkel operators who advertised trips where the specific intention was for clients to encounter sharks (hereafter termed shark operators). Concurrently, we also identified companies who operated in areas where sharks were likely to occur but who did not overtly advertise shark dives (hereafter termed non-shark operators). In total, we sent out three e-mail questionnaires in which we guaranteed anonymity to all respondents. The first questionnaire (Appendix A) targeted 128 shark operators to request information regarding: shark species encountered, type of habitat most commonly dived/snorkelled in, maximum number of participants allowed on a shark trip, whether sharks are fed, and if so, how regularly and on what. We also asked if they had a shark encounter code of conduct, and if so what it involved. To all who responded, we sent a follow-up survey (Appendix B) which asked whether there were any local concerns regarding shark encounter tourism, and how sharks have been observed behaving towards tourists. These questions were not included in the initial questionnaire in case their sensitive nature deterred shark operators from responding to our first survey. Our third questionnaire (Appendix C) targeted 101 non-shark operators and requested information concerning the shark species they

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