Manta ray tourism management, precautionary strategies for a growing industry: a case study from the Ningaloo Marine Park, Western Australia

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Abstract

Localised population declines and increased pressure from fisheries have prompted the promotion of manta ray interaction tourism as a non-consumptive, yet economically attractive, alternative to the unsustainable harvesting of these animals. Unfortunately, however, wildlife tourism activities have the potential to adversely impact focal species. In order to be sustainable, operations must be managed to mitigate negative impacts. A preliminary assessment of reef manta ray, Manta alfredi, behaviour identified short-term behavioural responses during a third of tourism interactions in the Ningaloo Marine Park, Western Australia. Although it remains unknown whether these responses translate to biologically significant impacts on the population as a whole, it is proposed that the precautionary principle be used to guide management intervention in the absence of conclusive evidence of the magnitude of tourism impacts. The principle supports the implementation of precautionary strategies to protect species and their environment from harm, even when the extent of the harm is yet to be...
confirmed. An increase in the level of industry management is recommended, including the implementation of a licensing system and adherence of all operators to a mandatory code of conduct during manta ray interactions. Considering the well designed and precautionary-driven management program of the Ningaloo whale shark tourism industry operating within the same marine park, a management program with the same underlying principles and objectives is deemed to be an ideal framework to build a comprehensive management plan for the manta ray interaction industry.

**Additional keywords:** Manta alfredi, precautionary principle, wildlife tourism.

**Introduction**

Snorkelling or diving with manta rays in the wild is a highly sought after tourism experience and manta rays are swiftly becoming significant drawcards in several locations worldwide (O’Malley *et al.* 2013). Despite their iconic status, both species of manta ray, *Manta birostris* and *Manta alfredi*, are classified as ‘vulnerable’ on the IUCN Red List of Threatened Species (Marshall *et al.* 2011a, 2011c). Localised population declines have been reported, generally from regions in which targeted manta ray fisheries operate. Decreased sighting rates and elevated anthropogenic mortality indicate population decline in the Philippines, Indonesia, India, Sri Lanka and Mexico (Marshall *et al.* 2011a, 2011c; Ward-Paige *et al.* 2013). Most notably, in Mozambique an 88% decline in sightings was recorded over an eight-year period (Rohner *et al.* 2013). Target fisheries are driven by the demand for branchial filter plates (or gill-rakers), which are highly prized in Asian markets for use in Chinese health tonics (Shen *et al.* 2001; Dewar 2002; White *et al.* 2006; Rajapackiam *et al.* 2007). Due to small, isolated populations, and characteristics associated with their conservative life history, manta rays are considered highly susceptible to overexploitation, with a reduced ability to recover from depletion (Dulvy *et al.* 2008; Camhi *et al.* 2009; Deakos *et al.* 2011).

Population declines and intensifying fishing pressure have prompted the promotion of manta interaction tourism as a non-consumptive, economically attractive alternative to consumptive uses of manta rays (Anderson *et al.* 2011; O’Malley *et al.* 2013). Manta ray-focused tourism operations exist
in 25 different countries across the world; the direct annual revenue from these operations is estimated at over US$73 million, and total economic impact at US$140 million (O’Malley et al. 2013). The potential of intensive tourism to affect the natural behaviour of manta rays has been recognised (Marshall et al. 2011c), and the temporary displacement of resident manta rays from an aggregation site in French Polynesia has already been reported (de Rosemont 2008). In comparison to consumptive uses such as fishing, tourism is undoubtedly a more sustainable use of manta rays as a resource, yet it is crucial that proper management strategies are implemented to ensure that tourism activities are not negatively impacting populations.

Although manta ray tourism industries have been established in many countries, formal management programs implemented and enforced by government or other agencies are rare. In Ecuador, Parque Nacional Machalilla authorities limit daily vessel and diver numbers, permitting three vessels with a maximum of eight divers each to interact with mantas in the waters of Isla de la Plata (A. Marshall, pers. comm.). In other major tourism locations such as Mozambique, Indonesia and the Maldives, regulation of tourism activities is usually devolved to local dive centres or conservation NGOs operating in the area. Operator standards, voluntary guidelines and codes of conduct for manta ray interactions have been developed (MPRF 2002, 2013; MMF 2015), yet the enforcement of these codes is generally reliant on self-regulation by operators.

A high proportion of manta ray tourism sites are located along the coasts of developing nations (O’Malley et al. 2013). Although the expansion of such tourism industries has the potential to significantly boost and diversify local economies (Mansperger 1995; Cater and Cater 2008), typically there are significant problems with the design and implementation of effective management strategies (Quiros 2007; Schleimer et al. 2015). Longitudinal data are of great importance when assessing the impact of tourism on focal species. In the interest of minimising impacts on a global scale, locations that have well established tourism industries and long-term datasets are ideal sites to develop management frameworks that can be applied to similar wildlife tourism sites across the globe (see Bejder et al. 2006; Schleimer et al. 2015).
Despite the rising popularity of manta ray interaction tourism, there is a current shortage of published information relating to the impacts or management of such activities. Based on a case study of tourism in Australia’s Ningaloo Marine Park, we advocate the use of the precautionary principle to guide management in the absence of conclusive evidence of the existence and magnitude of tourism impacts. The current level of industry management will be outlined and a summary of findings will be presented from a preliminary assessment of the impact of tourism interactions on *M. alfredi*, hereafter referred to as manta rays. Ultimately, using an example of an effective, pre-existing tourism management program, recommendations will be given for the implementation of precautionary management strategies designed to mitigate potential impacts and ensure the sustainability of the manta ray tourism industry.

**Tourism management and the precautionary principle**

The precautionary principle is a concept that has evolved over recent decades and has been incorporated into international environmental policy, law and management (UNESCO 2005). The principle mandates action to be taken to protect species and the environment from harm, when such harm is scientifically plausible but not yet verified (Calver *et al.* 2011). It supports the idea that if protective action is only undertaken once harm is evident, then it is typically too late to avoid the consequences or prevent further harm (Cooney 2004; Fennell and Ebert 2004).

A level of uncertainty is inherent with the management of all natural systems, which the precautionary principle acknowledges and compensates for accordingly (Acott *et al.* 1998; Fennell and Ebert 2004). In the context of wildlife tourism the uncertainty lies in the nature and extent of impacts on target species and ecosystems. Precaution has already been integrated into the development and implementation of management strategies for marine wildlife tourism industries in New Zealand (Cater and Cater 2001; Richter *et al.* 2006) and Ireland (Berrow 2003). Managers have recognised the value of the precautionary principle as a proactive planning tool, one that aims to mitigate potential impacts whilst ensuring the sustainability of tourism activities (Fennell and Ebert 2004).
Case study: Ningaloo manta ray interaction tourism

The Ningaloo manta ray interaction industry operates year-round within the waters of the Ningaloo Marine Park (NMP). Commercial tour vessels depart daily, taking tourists to participate in snorkelling interactions with manta rays. A trained guide who supervises and directs the swimmers whilst in the water leads these interactions, and is hereafter referred to as ‘the guide’. Industry management is the responsibility of the Western Australian Government Department of Parks and Wildlife (DPaW). The industry has experienced significant growth since its inception in the early 1990s, when a single vessel with a maximum capacity of 12 passengers began conducting intermittent tours. Five dedicated manta ray tourist vessels now operate from Coral Bay, with the combined potential to accommodate a maximum of 139 passengers each day.

Bateman Bay is a known aggregation site within the NMP for manta rays, which predominantly use the waters for feeding and visiting reef cleaning stations located within the bay. During the months of June–November, mating chains and courtship interactions are observed and large feeding aggregations of up to 70 individuals occur between March and May (McGregor et al. 2008). Long-term photo-identification (photo-ID) studies have identified ~800 individuals to date (F. McGregor, unpubl. data), and have revealed a core resident population consisting of ~40–50 individuals, mostly mature females (McGregor et al. 2008).

Current management

In regard to manta ray tourism, the current level of industry management and regulation is relatively minimal. Commercial operators are not required to possess a specific manta ray interaction licence to conduct tours and operate under a general E-Class Commercial Tour Operator licence issued by DPaW that permits commercial activity within the NMP. Tour operators can choose to adhere to a voluntary code of conduct for manta ray interactions developed to minimise impacts on manta ray behaviour. The code of conduct outlines minimum distances for vessels and swimmers, a limit on the
number of swimmers permitted in the water, as well as recommendations for swimmer behaviour and vessel operation. The main points are outlined below, and the full code of conduct is described in Daw (2009).

1. No more than 20 passengers should be carried on any manta ray tour vessel.

2. The number of people interacting with a manta ray at any one time is recommended to be limited to seven passengers plus two guides, but shall not exceed 10 passengers plus two guides.

3. Persons must maintain a distance of 2 m or more from a manta ray at all times.

4. Persons may not attempt to touch a manta ray, approach it head-on nor block its path of travel.

5. Vessels must maintain a distance of 15 m from a manta ray and may not block its path of travel.

6. Vessel speeds may not exceed 8 kn within 100 m, or 5 kn within 30 m of a manta ray. Vessels shall not make way within 15 m of a manta ray.

7. Only one vessel is permitted within the 100 m contact zone, for a maximum of 60 min, or 30 min if another vessel is waiting.

8. No vessels are permitted within 30 m of known cleaning stations during documented aggregation seasons.

9. Diving below the surface is not permitted within 30 m of known cleaning stations.

The development of the code of conduct was prompted in 2006 by concerns expressed by operators and tourists regarding the nature of manta ray interactions. These concerns were predominantly regarding disturbance of manta rays visiting cleaning stations or engaged in courtship activities, inappropriate vessel operation, and the increasing number of tourists per swim group. Additionally, reports were received of seemingly aggressive behaviour towards swimmers in close proximity
including incidents of manta rays ramming, fin slapping and breaching upon swimmers (McGregor et al. 2008; Daw 2009).

The code of conduct superseded a voluntary code of conduct that was designed in 2002 as a self-regulating set of guidelines, to which compliance was the choice of the operator (Daw 2009). Management assessment in 2007 revealed a lack of awareness of the voluntary code of conduct and DPaW continued to receive reports of non-compliance and inappropriate operations by commercial operators (Daw 2009). Similar issues with the use of voluntary codes of conduct in marine tourism have been previously raised elsewhere, with several studies deeming them ineffective (Scarpaci et al. 2003; Garrod and Fennell 2004; Allen et al. 2007). Consequently, the new (still voluntary) code of conduct was developed (Daw and McGregor 2008), achieving widespread industry support for its implementation and for increased management of the manta ray interaction industry (Daw 2009). However, despite the recommendation that operator compliance immediately be made a condition of commercial tour licenses, mandatory compliance to the code of conduct is yet to be implemented.

**Behavioural responses of manta rays to tourism interactions**

In response to concerns raised by operators and observed behavioural changes during tourism interactions (F. McGregor, unpubl. data), a preliminary assessment of the impact of tourism interactions on manta ray behaviour was conducted (Venables 2013). The study aimed to determine the frequency, form and influencing factors of short-term behavioural responses to in-water tourism interactions. In total, 98 interactions were observed between April and July 2013. Behavioural responses were exhibited by manta rays during 34.1% of interactions with swim groups ($n = 91$) and 15.5% of interactions with tour vessels ($n = 98$). Forms of behavioural response ranged from immediate avoidance responses, such as changes in swimming speed, direction and abrupt movements, to changes in behavioural state, including the termination of feeding behaviours and departure from cleaning stations. Several factors were found to influence the occurrence of a
behavioural response, including the initial behavioural state and maturity of the manta ray, the amount of surface splashing, and the approach strategy of swim groups.

Although the nature of these responses may seem minor or short-lived, wildlife tourism impacts have been described as cumulative rather than catastrophic (Bejder et al. 1999), meaning that seemingly insignificant disturbances can accumulate incrementally into a significant impact when repeatedly experienced over time. Definitively linking short-term responses to long-term impacts on the population will require considerable research effort and long-term data collection. Since the potential for impact has been identified, invoking the precautionary principle will provide a rationale for protective management intervention to mitigate potential harm whilst awaiting confirmation of the extent of these impacts.

Management of whale shark tourism interactions in the Ningaloo Marine Park

Operating within the same MPA, and under the management of DPaW, is the Ningaloo whale shark interaction industry. Described as ‘ecologically sustainable’ (Mau 2008), the industry operates under a comprehensive and well developed management program (see DPaW 2013). The primary method of industry management is a well established licensing system that has been in place since 1993 (Mau 2008; Catlin et al. 2012). This licensing regime has capped the number of whale shark commercial operations licenses (WSCOLs) available to operators at 15. WSCOLs have established conditions and terms of operations that operators must adhere to, or risk the confiscation or termination of their licence. Adherence to a whale shark interaction code of conduct (WSICC) is mandatory for licenced operators (Catlin et al. 2012).

Developed by DPaW with industry consultation in 1995, the WSICC is designed to minimise negative impacts on whale sharks and ensure tourist safety during interactions (Mau 2008; Catlin and Jones 2010). The WSICC outlines minimum separation distances for swimmers and maximum numbers of swimmers permitted during an interaction, and forbids any touching or riding of whale sharks as well as the use of flash photography and motorised propulsion aids. Minimum distances, speed and time
limits and maximum passenger numbers are outlined for vessels, and rules are set for times at which multiple vessels are present. To ensure compliance with licence conditions, DPaW conducts regular monitoring throughout the whale shark season, in the form of vessel patrols, industry vessel placements, ‘covert operations’ and periodic aerial surveillance (DPaW 2013).

Research, monitoring and education are recognised as important elements of industry management. Licenced operators are required to aid in data collection by submitting ID photos and recording information on whale shark encounters and tourism interactions. These data are reported to management on a daily basis through the use of an on-board GPS-based electronic logbook system. The electronic logbook system automatically records GPS coordinates of commercial vessels to create daily tracks, and operators are required to input information such as passenger numbers, GPS coordinates of interactions, whale shark size, sex, direction of travel and whether it was shared with another vessel (DPaW 2013). These data assist in the monitoring of industry status and seasonal patterns (Mau and Wilson 2008), and can also contribute to research into whale shark ecology, biology and population demographics, which are essential for identifying impacts and advising management (Gill et al. 2001; Bejder and Samuels 2003; Lusseau and Higham 2004). DPaW also supports and sponsors scientific research into whale shark behaviour, movement and migration patterns and population demographics (Mau 2008; Mau and Wilson 2008), and the potential impacts of tourism (Norman 1999, 2002). As it is presently unclear whether tourism interactions in NMP are having negative impacts on individual whale sharks or the population as a whole, DPaW have adopted a precautionary approach to all aspects of industry management until definitive conclusions have been reached (Mau 2008; DPaW 2013).

**Recommendations for the management of manta ray tourism**

As a response to the preliminary evidence of behavioural changes during tourism interactions, industry expansion and the potential for continued growth, precautionary management intervention is highly recommended. Considering that the management of the whale shark tourism industry in NMP
is driven by a precautionary approach (Mau 2008; DPaW 2013), it would seem appropriate to adopt an equally proactive attitude towards the management of the Coral Bay manta ray interaction industry. Precautionary actions will ideally serve as temporary measures implemented until the scale of impacts are confirmed. If impacts are considered minor, management can relax precautionary actions. Alternatively, if impacts are found to be biologically significant, actions should continue and be refined according to improved knowledge. With conclusive identification of impacts, these measures will become preventative (mitigating a known risk), as opposed to precautionary (taking care in the case of uncertainty) (Deville and Harding 1997).

Due to the similarities between the two industries, the whale shark tourism management program is an ideal model on which to base a management plan for the Ningaloo manta ray interaction industry. Consultation with operators, scientists and industry experts should also play a vital role in the development of a management program. The implementation of a licensing system is advised; permitting only licenced operators to conduct manta ray interaction tours within NMP. Licensing will enable management to control industry growth and therefore regulate the extent of tourism pressure on the manta ray population. It will also allow for regulation of the quality of the tourism experience, ensuring that all operators provide a safe, enjoyable and educational experience.

It is recommended that as a licensing condition all operators be required to adhere to a mandatory code of conduct, based on the code of conduct developed by Daw (2009). An electronic logbook system should be integrated to enable operators to assist in industry data collection, including daily passenger numbers, GPS locations of manta ray sightings, size, sex and behaviour of manta rays. Photo-ID methods are an effective way of gathering important biological and ecological data and monitoring population health over time (Marshall et al. 2011b; Marshall and Pierce 2012), and manta ray tours are an ideal platform for obtaining regular and on-going photo-ID data. However, as there is potential for behavioural change as a result of ID photo attempts that are inopportunistically executed (Venables 2013), guides must be appropriately trained in best-practice methods that ensure minimal disturbance to the manta ray. It is also recommended that guides undergo basic training in manta ray biology, ecology and behaviour. In order to supplement funding of management and research, it is
advised that a ‘user pays’ system be adopted, by which a levy is added to the tour price and transferred to management by commercial operators. This system has been successfully implemented into management of the whale shark industry in NMP (see DPaW 2013).

Specific recommendations for the mandatory code of conduct based on the results of preliminary impact assessment (Venables 2013) include the following:

1. Full support be given to include points (1)–(9) described earlier in this paper from Daw (2009); however, it is recommended that the minimum distance a person must maintain from a manta ray be amended from 2 m to 3 m.

2. Freediving should be restricted to one person at a time and only ever behind or to the side of the manta ray.

3. The ‘guide first’ approach strategy is recommended. Guides should initially swim with the manta ray on their own to assess the animal’s behaviour and temperament then direct the swim group accordingly; this may include prohibiting freediving during the interaction.

4. Surface splash should be kept to a minimum. Passengers should be directed to sit and slide into the water upon entry and undergo a preinteraction snorkelling demonstration of swimming techniques to minimise splash.

5. Interactions with mating chains (one female followed by two or more males) should be treated with further caution. Swimmer numbers should be limited to seven (plus guides) and interactions may not exceed 10 min per group. Freediving should be prohibited and the minimum distance between swimmer and manta ray increased to 5 m. Guides must instruct the group to stay on the surface and watch only, without following the mating chain.

Minimising disturbance is dependent on the compliance of operators and tourists to a code of conduct. A certain degree of education, enforcement and monitoring of a future code of conduct and other licensing conditions is therefore required, especially in the initial period of implementation (Scarpaci et al. 2003; Samuels and Bejder 2004; Allen et al. 2007). An acceptable level of compliance should
be determined and regular assessment of licenced operators and compliance monitoring is necessary. To ensure truly sustainable management practices, any implemented strategies must be dynamic, adaptive and regularly reassessed.

Continued monitoring of tourism interactions, sighting rates and behavioural changes is necessary to determine the magnitude of impacts on individuals and on the population as a whole. Such information can aid in further development of effective management strategies, specifically the code of conduct. Moreover, management support of further research into population size, structure and dynamics, habitat usage and long-distance movement patterns of the Ningaloo manta ray population is advised. Combined with information from existing long-term datasets, this knowledge is essential to the understanding of potential impacts, and will facilitate more specific recommendations for the sustainable management of the tourism industry.

The introduction of a well designed management program for the Coral Bay manta ray interaction industry could potentially provide a model that can be adapted and implemented in other manta ray tourism locations worldwide. With an on-going photo-ID catalogue, longitudinal data from over a decade of research effort (McGregor et al. 2008; McGregor 2012) and access to the necessary resources and expertise, NMP is an ideal location for developing an effective management framework that can be applicable elsewhere. This approach would promote sustainable, minimal-impact manta ray tourism and provide a level of precautionary protection not only for the Ningaloo population but also for manta ray populations in other major tourism locations across the globe.

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