



Review

Deleterious behaviors and risks related to close interactions between humans and free-ranging dolphins: A review

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ABSTRACT

Nature-based tourism has surged in recent years with the desire for up-close interactions and "connections" with wild animals. The conservation value, animal welfare considerations, visitor satisfaction, and profitability of wildlife tourism are often in direct conflict with trade-offs commonly accepted. In this paper, we reviewed more than four decades of literature on the deleterious behaviors and risks documented during close tourist and other recreational interactions between humans and free-ranging dolphins and encounters between humans and lone, sociable dolphins. Our compilation provides a geographical, chronological, and qualitative overview of these encounters, reviews both humans' and dolphins' deleterious behaviors during interspecific interactions and summarizes the main risks to both humans and dolphins during close encounters. Based on this review, we outline and discuss how both animal welfare and human safety should be managed such that these activities are sustainable; the demand for personal wildlife experiences continues to grow at an alarming rate and the economic pressures placed on wild animal populations run the risk of damaging the very environmental assets that support this industry if they cannot be managed effectively.

1. Introduction

In an increasingly urbanized world where encounters with "wild" animals seem to satisfy a human need to reconnect with nature (Miller, 2005; Newsome et al., 2005 in Garrod, 2007), many wildlife viewers want more than "just to observe"; they want to make contact with exotic, rare, and charismatic species through regular and thrilling interactions (Moeran, 1983 in Cater, 2008; Newsome and Rodger, 2008). In parallel, a rising number of commercial operators market their wildlife tours with the promise of close-up views (Knight, 2009), with opportunities ranging from walks and hikes to get close to apes and monkeys (Fa, 1992; Johns, 1996; Grossberg et al., 2003; Sandbrook and Semple, 2006), penguins (Fowler, 1999; Ellenberg et al., 2006, 2007), dingoes (*Canis lupus dingo*, Orams, 2002), bears (Smith et al., 2005), iguanas (Hines, 2011), or sea lions (Corral et al., 2017), to elephant rides that allow close encounters with rhinoceros (Lott and McCoy, 1995). Close in-water encounters as part of snorkeling and scuba diving activities focusing on different aquatic species are expanding as well (e.g., turtles, Tapper, 2006; rays, Semeniuk et al., 2009; sharks, Brena et al., 2015;

manatees, Shackley, 1992; seals, Scarpaci et al., 2005; Scheer, 2020; whales, Mangott et al., 2011; and dolphins, Samuels et al., 2000).

1.1. Focus on close interactions with dolphins

Since the 1950s, there has been renewed enthusiasm for dolphins, popularized by marine parks, television, and cinema (Fraser et al., 2006; Forestell, 2009). The great sociability and pseudo smile of bottlenose dolphins (*Tursiops* spp.), which embody the human view of the dolphin, indeed favor a perception of these animals closer to myth and romanticism than reality (DeMares, 2000; Wearing et al., 2011; Wiener, 2015).

The market for watching wild dolphins surfed on the growth of the animal rights movement, which concurred to the closure of some dolphinarium (Hughes, 2001). From the mid-1980s, these iconic animals have experienced a rapid increase in demand for interaction opportunities in their natural habitat (Orams et al., 1996; Barnhill et al., 2022) leading to considerable development of whale and dolphin watching activities (i.e., commercial and recreational viewing in the wild, Hoyt, 2001; O'Connor et al., 2009).

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Dolphin watching encompasses operations that were first mostly conducted from boat and land. In-water encounters expanded significantly from the early 1990s and involve regular and close interactions between the public and these cetaceans worldwide (Senigaglia et al., 2020). Intentional, accidental (e.g., around human fisheries, Díaz López, 2017; Kovacs et al., 2017), and structured and unstructured food provisioning activities also occur in some places that promote close contact with dolphins in their natural settings (Newsome and Rodger, 2008). Finally, close encounters between humans and dolphins were popularized by the publicized presence of lone, sociable dolphins, which gave rise to particularly intimate relationships between these cetaceans and their admirers (Lockyer, 1990; Müller, 1998; Nunny and Simmonds, 2019).

1.2. Behavioral processes that facilitate close interactions between humans and wildlife

Bejder et al. (2009) consider responses of wildlife to non-lethal forms of human disturbance as “a continuum of individual tolerances (i.e., the intensity of disturbance that an individual tolerates without responding in a defined way, Nisbet, 2000).” Differences in levels of tolerance can eventually lead to sensitization or habituation of individuals involved in interactions, i.e., “adaptive behavioral modifications exhibited by individual animals in response to exposure to a stimulus that is repetitious or continuous” (Bejder et al., 2009). According to Knight (2009), two strategies may be used to facilitate close interactions between humans and wildlife: *habituation* and *attraction*. Habituation is a non-associative learning process that occurs where an initial disposition to escape from humans will wane as a result of repeated stimulation and be replaced by tolerance of a human presence (Thorpe, 1963). Habituation is usually achieved through a slow longitudinal process involving considerable effort on the part of humans (Bejder and Samuels, 2003). Attraction may be performed through some conditioning involving positive reinforcement (e.g., the provision of food; Orams, 2002; Smith et al., 2005) and can drastically speed up a process of familiarization (i.e., the experience of being familiar with humans, Whittaker and Knight, 1998; Newsome and Rodger, 2008). Young individuals are usually more responsive to habituation and conditioning than adult animals (e.g., bears, Gilbert, 1989; dolphins, Samuels and Bejder, 2004; macaques, Ménard et al., 2013). Both processes impact the “wild” quality of the behavior of the animals on view (i.e., their pattern of mobility is no longer informed by human avoidance, Knight, 2009), though they have a priori tourism benefits by ensuring predictable and reliable viewing of the wildlife on which operators base their business (Garrod, 2007).

1.3. Deleterious behaviors and risks related to close interactions between humans and wildlife

Numerous studies conducted over half a century on animals' behaviors displayed during close interactions between humans and wildlife and their consequences (e.g., Mattson et al., 1992; Newsome and Rodger, 2008; Ménard et al., 2013; Penteriani et al., 2017; Machernis et al., 2018; Nunny and Simmonds, 2019) have revealed that close encounters involve enough risks for humans and targeted species to call into question the usual considerations that such activities correlate primarily and directly with conservation (e.g., Isaacs, 2000; Neves, 2010; Dubois and Fraser, 2013; Barnhill et al., 2022). Globally, Geffroy et al. (2015) argue that increased tolerance and habituation to humans often reduce animals' fearfulness and antipredator strategies, with cascading effects on populations and communities. In a review on issues and impacts related to wildlife provisioning for tourism purposes, Orams (2002) reports that deliberate, long-term conditioning of wildlife through food provision alters natural behavior patterns at population levels related to intra- and inter-specific aggression with important health implications. For example, a long-term study on grizzly bears (*Ursus arctos horribilis*) thoroughly conditioned to man through food-

provisioning showed that such animals developed behavioral patterns that made them extremely dangerous, with bear-man interactions sometimes ending in human injury or death (Craighead and Craighead, 1971; Jope, 1985). In Africa, Brennan et al. (1985) described the human-animal conflict rising between artificially fed vervet monkeys (*Chlorocebus pygerythrus*) and tourists at a tourist lodge in Kenya, with pest primates attacking and injuring the tourists. Studies on Humboldt (*Spheniscus humboldti*) and yellow-eyed (*Megadyptes antipodes*) penguins exposed to unregulated tourism showed significantly lower breeding success in these animals compared to those living in undisturbed areas (Ellenberg et al., 2006, 2007). Semeniyuk et al. (2009) demonstrated that tourist-exposed southern stingrays (*Dasyatis americana*) exhibit hematological changes indicative of physiological costs of wildlife tourism.

Dolphins are no exception: Samuels and Bejder (2004) observed that the lives of conditioned free-ranging common bottlenose dolphins (*Tursiops truncatus*) were strikingly different from those of dolphins that did not interact with humans; conditioned dolphins were engaging in interactions with humans during most of the time they were studied and were remaining at a small location. Christiansen et al. (2016) found that the association with already conditioned animals strongly affected the probability of bottlenose dolphins becoming conditioned to human interactions and that conditioned dolphins were more likely to be injured by human interactions when compared with unconditioned animals. Nunny and Simmonds (2019) stressed that several lone, sociable dolphins were deliberately injured and killed by humans and that these animals are, to a great extent, at the mercy of people's desire to interact with them. A high occurrence of serious injuries and mortality of lone, sociable dolphins was likewise referenced by Samuels et al. (2000).

Indeed, many studies illustrate how paradoxical close relationships between man and wildlife can be, with some *nuisance* animals ultimately being destroyed by humans (e.g., grizzly bears, Mattson et al., 1992; dingoes, Dubois and Fraser, 2013; bottlenose dolphins, Vail, 2016) when their behaviors go beyond the limits of human tolerance.

Even so, close interactions between humans and dolphins are still actively promoted, sought out by humans, and being launched new in various locations where they often remain poorly or partially managed (Scarpaci et al., 2003; Finn et al., 2008; Sitar et al., 2016).

Within an ecological context requiring urgent and effective management of human interactions with wildlife, an updated review of the deleterious behaviors and risks documented for both dolphins and humans in the context of close interspecific encounters seems relevant to help promote animal welfare, human safety, and the viability of these activities in the near future. This is the goal of this review.

1.4. Structure of the review

We constrained our review to the deleterious behaviors and risks documented from the 1950s in ongoing tourist and other recreational activities involving close interactions between humans and free-ranging dolphins and encounters between humans and lone, sociable dolphins [see Lockyer, 1990 and Müller, 1998 for a review of lone, sociable dolphins documented before the 1950s]. We chose to compile data on lone, sociable dolphins apart from ongoing activities as interactions between humans and lone, sociable dolphins often illustrate the most intimate and sustained encounters that take place between humans and individual dolphins in their natural habitat.

Throughout this paper, we 1) provide a geographical, chronological, and qualitative overview of close encounters between humans and free-ranging dolphins, 2) review dolphins' and humans' deleterious behaviors documented during these interspecific interactions, and 3) identify the main risks recorded within these close interactions, for both dolphins and humans.

As previous work Samuels et al. (2000) and Nunny and Simmonds (2019) stated that lone, sociable dolphins are at high risk of being injured or killed in the context of their interactions with humans and human activities, we also compared the number of locations where

deleterious behaviors and risks were documented for ongoing activities and for lone, sociable dolphins.

Based on recommendations given in the reviewed literature, we then propose directions to promote animal welfare, human safety, and the establishment of sustainable activities (i.e., activities that ensure the balance between conservation values, animal welfare considerations, visitor satisfaction, and profitability).

2. Methods

It is difficult to succinctly provide comprehensive data on such a wide and ever-growing subject. To optimize our approach, we limited our research to a review of peer-reviewed papers and other references (details on references are available below) published from the 1950s for ongoing tourist and other recreational activities involving close interactions between humans and free-ranging dolphins (hereafter “ongoing activities”) and interactions between humans and lone, sociable dolphins (see Table 1 for a detailed definition of terms used in this review).

Most managers and wildlife biologists do not publish their work in peer-reviewed journals and most peer-reviewed papers on this topic originate from four countries (i.e., Australia, the United States, and New Zealand for ongoing activities, and the United Kingdom for lone, sociable dolphins). We thus decided to include material that was not published in peer-reviewed journals in order to highlight the tremendous and relatively recent global increase in close interactions between humans and dolphins in their natural habitat. Yet, peer-reviewed papers were privileged over any other type of reference when multiple sources were available for a specific situation.

Information was compiled and tallied to 240 sources (see Supplemental Tables 1a and b and Supplemental Tables' References for details on sources). We first used Google Scholar, open web searching and contacted authors to reference peer-reviewed papers ($n = 117$, 48.8 %) and graduate-level theses ($n = 14$, 5.8 %) using different combinations of the following keywords in English, Spanish and French: “swimming,” “diving,” “touching,” “feeding,” “wild,” “lone,” “sociable,” “solitary,” “dolphin(s),” “whale(s).” The same method was then used to reference books and book chapters ($n = 12$, 5.0 %), abstracts and presentations ($n = 14$, 5.8 %) and reports ($n = 40$, 16.7 %). We finally searched for official and tourism agencies', tour operators', NGOs', and local research programs' websites ($n = 26$, 10.8 %) as well as personal communications with people on site ($n = 15$, 6.3 %) to gather details from locations where data are deficient. Media sources ($n = 2$, 0.8 %) were included for two recent (i.e., 2020) cases involving lone, sociable dolphins. The number of peer-reviewed papers compiled for each country is shown in Fig. 1a and b.

All information available on the type of activities (e.g., swimming, scuba diving) encouraging close interactions, dolphin species involved, dolphins' and humans' deleterious behaviors, and risks documented for dolphins and humans were chronologically tabled for each location identified according to the decade when first interactions occurred. Dolphin identities and years of sightings were specified when known for lone, sociable dolphins. Calves born to lone, sociable female dolphins were not considered in results.

Some terms frequent in the literature, such as “dominant,” “boisterous,” or “harassment” typically lacked precision or clarification, but we chose to report the information as it was presented. Moreover, it was often a challenge to disentangle the specific effects of in-water encounters, food provisioning, or other features related to close interactions (e.g., the presence of boats) in the source material; thus, we reported deleterious behaviors documented in each location without distinguishing between their specific causes.

We then designed distribution maps showing locations, chronology, main species, and activities encouraging close interactions for ongoing activities and lone, sociable dolphins. In addition, we synthesized the information available on deleterious behaviors and risks documented for

Table 1
Glossary.

Term	Definition
Close interactions	We consider <i>close interactions</i> between humans and dolphins as occurring during wading, swimming, free diving, scuba diving, and/or food provisioning activities. They may be regular or occasional and may or may not involve physical contact between humans and dolphins.
Deleterious behaviors	<i>Deleterious behaviors</i> are gathered in behavioral categories adapted from Samuels and Spradlin (1995) . Dolphin deleterious behaviors are aggressive (e.g., jaw clapping), submissive (e.g., avoidance), sexual (e.g., rubbing genitals against humans), intrusive (e.g., begging), or abrupt (e.g., pushy) dolphin behaviors directed to humans and/or human activities. Reciprocally, human deleterious behaviors are aggressive (e.g., shooting at dolphin), sexual (e.g., provoking sexual response), intrusive (e.g., touching), or abrupt (e.g., jumping on dolphin) human behaviors directed to dolphins. No human submissive behavior was documented in references.
Dolphins	Free-ranging Odontocetes (toothed whales) from the Delphinidae, Iniidae, and Monodontidae families are referred to here as <i>dolphins</i> .
Locations	Geographical areas where close interactions between humans and free-ranging dolphins have been documented. <i>Location</i> may refer to a country or part of a country (e.g., territory, state, region, province, archipelago, island, city). Locations where few or no research is available on close interactions, or information is redundant (e.g., same species involved, same risks identified) are considered on a wider geographical scale (e.g., India, Northeastern Canada, Gulf Coast in the USA).
Lone, sociable dolphin	Dolphins that are typically solitary, may seek out human company, and/or reorient part or all of their social behavior toward humans rather than conspecifics are labeled <i>lone, sociable dolphins</i> (from Samuels et al., 2000 and Wilke et al., 2005). Known individuals which belonged or are still belonging to known dolphin groups reviewed in the ongoing activities category (e.g., “Old Charlie” in Monkey Mia, Australia) are not considered as lone, sociable dolphins.
Ongoing tourist and other recreational activities	<i>Ongoing activities</i> refer to up-to-date opportunities for regular (i.e., specific dolphins approached daily or seasonally) or occasional (i.e., dolphins approached opportunistically) close interactions between humans and free-ranging dolphins, excluding encounters between humans and lone, sociable dolphins. These activities may be commercial or non-commercial, and structured or unstructured.
Risks	Short- to long-term negative impacts (e.g., injury, impairment of intraspecific social behavior) on dolphins, humans and/or human activities resulting from close interactions between humans and free-ranging dolphins are defined as <i>risks</i> (adapted from Frohoff, 2000).

both dolphins and humans for each location for ongoing activities and lone, sociable dolphins. We used a χ^2 analysis to compare the number of locations where deleterious behaviors and risks were documented for ongoing activities and for lone, sociable dolphins. We concurrently created heatmaps from the proportion of locations where deleterious behaviors and risks were observed for ongoing activities and for lone, sociable dolphins to better visualize potential differences between both situations. This approach was found to be a good compromise to allow a global but rather detailed overview of the situation.

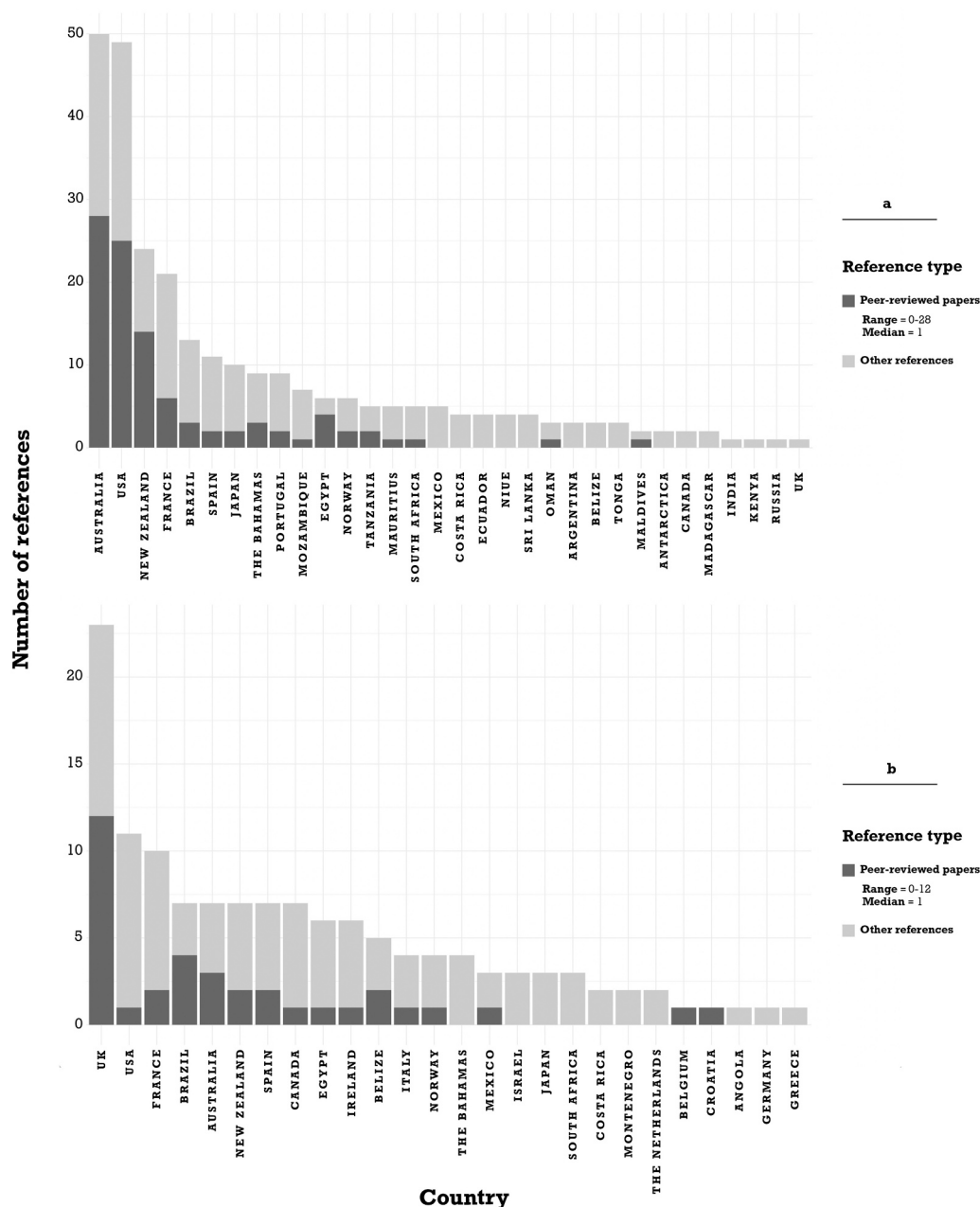


Fig. 1. Stacked bar plots showing the number of peer-reviewed papers (dark gray) and other references (light gray) compiled for each country where close interactions between humans and dolphins were documented for (a) ongoing activities and (b) lone, sociable dolphins. Range and median values are given in legend for peer-reviewed papers.

3. Results

3.1. Distribution of locations and activities encouraging close interactions

In 2022, we reviewed 54 locations distributed in 32 countries where ongoing activities occur (see Fig. 2). Still, we consider a majority of these locations ($n = 28$, 51.9 %) as being data deficient primarily because they are reported but have not been studied so far.

In five locations (9.3 %), interactions were first recorded in the 1960s and 1970s. Most locations ($n = 34$, 63.0 %) began engaging in these activities in the 1980s and 1990s and 15 locations (27.8 %) initiated activities between 2000 and 2020.

Fifty-three (98.1 %) locations offered wading, swim-with and/or free diving with dolphins, 16 (29.6 %) had scuba diving activities and eight (14.8 %) included food provisioning activities. Two (3.7 %) of the

locations reviewed prohibited swim-with dolphin activities recently [i. e., Northland Region in New Zealand (2019), and Bay of Biscay and Mediterranean Coast in France (2021)].

For lone, sociable dolphins, 47 locations distributed in 26 countries, and 135 different dolphins were identified between 1950 and 2022 (see Fig. 3). In 39 (83.0 %) of the locations considered, wading, swim-with, and/or free diving activities with these dolphins were recorded; scuba diving was documented in 17 (36.2 %) locations, and food provisioning of lone, sociable dolphins was identified in 18 (38.3 %) locations.

3.2. Species involved in close interactions

Twenty-five species were identified in ongoing activities and 12 species for lone, sociable dolphins. The species most identified in all types of close interactions with humans were bottlenose dolphins

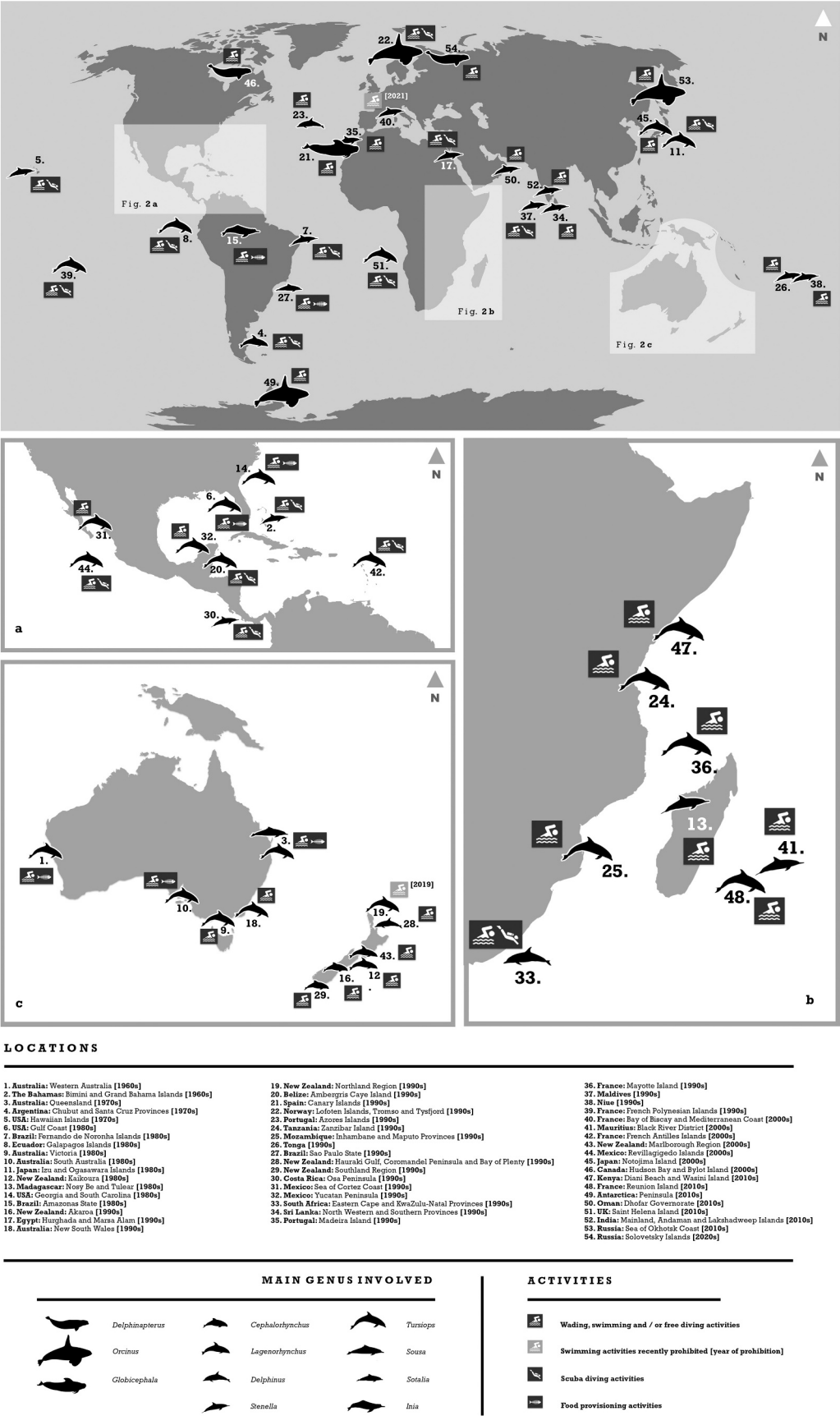


Fig. 2. Distribution of locations, activities and main dolphin genus involved in ongoing activities. The decade when activities began is given in brackets for each location. Locations are numbered chronologically based on accurate or approximate first year of activities.

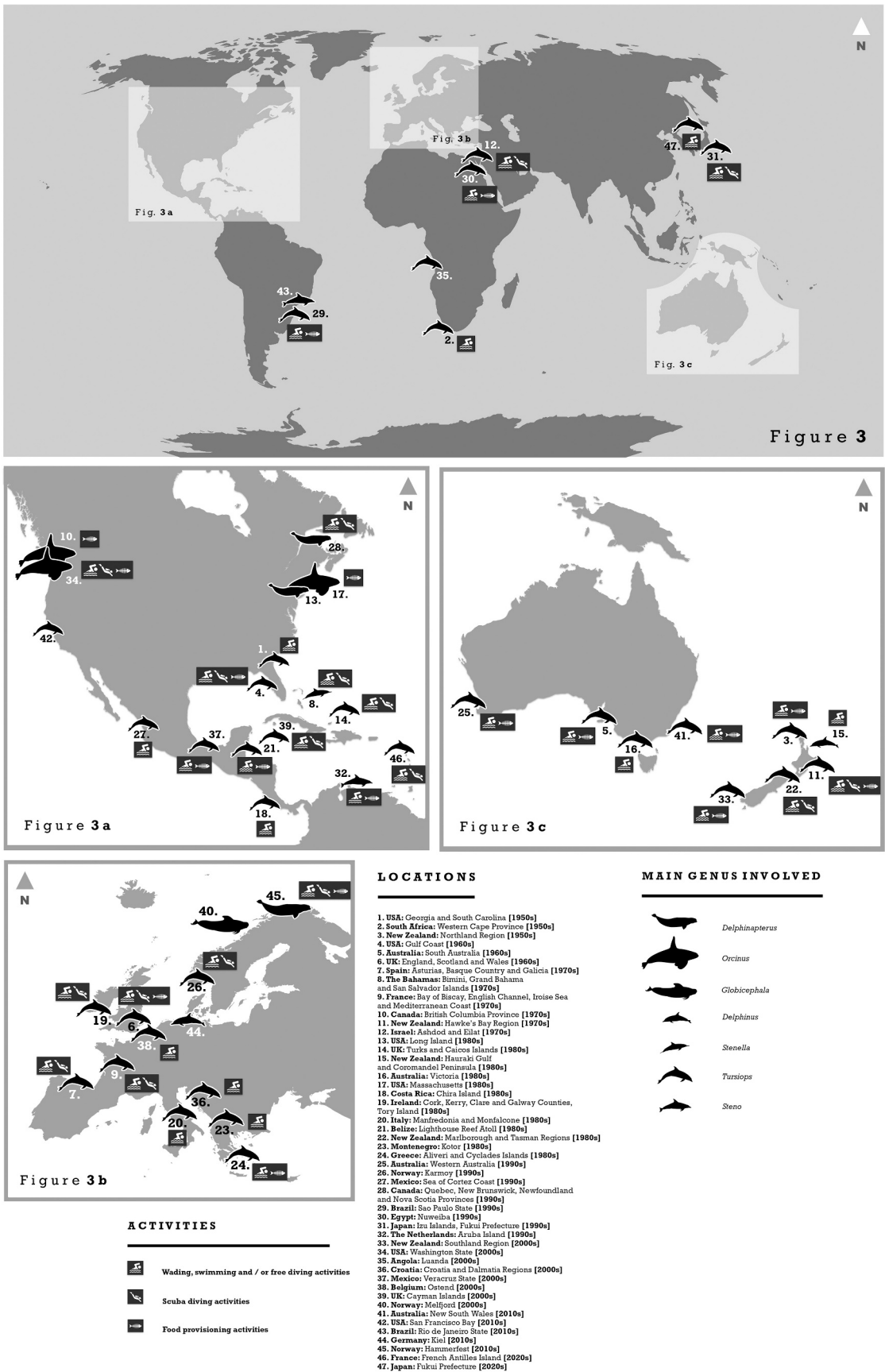


Fig. 3. Distribution of locations, activities and main dolphin genus involved for lone, sociable dolphins. The decade when lone, sociable dolphin(s) were first seen is given in brackets for each location. Locations are numbered chronologically based on accurate or approximate first year of close interactions.

[*Tursiops* spp., $n = 38$, (70.4 %) locations for ongoing activities; $n = 37$ (78.7 %) locations for lone, sociable dolphins].

In terms of individual lone, sociable dolphins, bottlenose dolphins outnumber other species as well ($n = 99$, 73.3 %) followed by 19 belugas (*Delphinapterus leucas*) representing 14.1 % of all lone, sociable dolphins reviewed.

Spinner dolphins (*Stenella longirostris*) were absent from the lone, sociable dolphins' database but were the second species most identified in ongoing activities ($n = 19$, 35.2 % locations). The species is specifically targeted by swim-with and free diving activities.

Other locally abundant species represented major targets for close interactions in ongoing activities (e.g., common dolphins, *Delphinus* spp.; dusky dolphins, *Lagenorhynchus obscurus*; pilot whales, *Globicephala* spp.) while some of them were opportunistically involved in swim-with activities (e.g., rough-toothed dolphins, *Steno bredanensis*).

3.3. Dolphins' and humans' deleterious behaviors

Dolphins' deleterious behaviors documented in the presence of humans and humans' deleterious behaviors documented in the presence of dolphins are detailed for each behavioral category in Table 2.

The proportion of locations where dolphins' and humans' deleterious behaviors were documented is shown for each behavioral category in Fig. 4.

Overall, the number of locations where dolphin deleterious behaviors were documented is higher for lone, sociable dolphins than for ongoing activities ($n_{\text{lone, sociable}} = 33$, $n_{\text{ongoing}} = 22$; χ^2 test, $df = 1$, $p < 0.05$). The number of locations where human deleterious behaviors were documented is likewise higher for lone, sociable dolphins ($n_{\text{lone, sociable}} = 34$, $n_{\text{ongoing}} = 23$; χ^2 test, $df = 1$, $p < 0.05$).

Table 2

Details on dolphins' and humans' deleterious behaviors.

Deleterious behaviors listed per category for ongoing activities and lone, sociable dolphins. Terms lacking precision are shown in quotes.

	From dolphins to humans/human activities		From humans to dolphins	
	Ongoing activities	Lone, sociable dolphins	Ongoing activities	Lone, sociable dolphins
Aggressive	Head shaking, jaw clapping, buzzing, charging, grabbing, pulling, biting humans	"Intolerance to humans," "sudden aggression and extreme violence," "dominant," "possessive," "unpredictable," "threat displays," "repelling" and "attacking" humans, emitting high, squeaking sounds, head shaking, jaw clapping, tail slapping, pushing humans down against the seabed, tossing humans clear of the water, splitting couples, pushing roughly, displacing, nipping, hitting, gripping, biting, rushing, ramming, breaching on, ducking, swapping with tail, pulling, dragging humans around, "abducting" humans out to sea	"Injuring," shooting at dolphins	"Threatening," "injuring," hitting, spearing, throwing explosives and shooting at dolphins, dragging dolphin to the beach, killing dolphins
Submissive	Avoidance	Avoidance	–	–
Sexual	–	Nudging with rostrum at humans' genital area, erection, rubbing genitals against humans, buoys, and boats, thrusting movements directed at humans, ejaculation	–	"Sexual behavior being actively encouraged by swimmers," stroking and provoking dolphins' sexual response
Intrusive	Begging, scavenging, depredating, touching humans, rubbing against boats	Begging, "soliciting physical contact," rubbing against humans, boats, buoys, and ropes, "interest in boats, paddles and oars," putting head or pushing flanks right up against boat engines and spinning propellers, interacting with chains, ropes, buoys and fishing gear, lifting anchors, entangling small boats	"Harassment," chasing, squealing, touching, rubbing, grabbing, holding onto dorsal fin, holding tail, riding dolphins	"Harassment," chasing, circling, touching, rubbing, grabbing, riding dolphin, holding onto fins, hanging on flippers, trying to tie objects to flippers, holding tail, shoving fingers onto blowhole, eyes, and ears, putting objects in blowhole, turning and spinning dolphin, opening dolphin's jaws
Abrupt	Approaching quickly, circling rapidly, pushy with humans	"Defensive," "boisterous," "snappy," pushy, swimming quickly, circling rapidly, dislodging fin towels, pulling at humans' flippers, nudging, holding humans by the snorkel or facemask, removing facemask, pulling hair, tapping head with rostrum, knocking off surfboards and water-skis, landing on and smashing up surfboards, leaping close to or over humans, preventing humans from returning to shore or vessels, pushing, lifting, bumping and tossing boats, towing small and large boats	–	Jumping from a bridge on top of dolphin

For ongoing activities, human intrusive ($n = 23$, 42.6 % locations) and dolphin submissive behaviors ($n = 16$, 29.6 % locations) were the deleterious behavioral responses most frequently documented with harassment, touching, and chasing being the most common human intrusive behaviors recorded toward dolphins. Dolphin intrusive behavioral responses were mostly represented by begging behavior in locations where dolphins are food provisioned.

Dolphin aggressive responses to human presence were documented in Western Australia, Fernando de Noronha in Brazil, French Polynesian Islands, Canary Islands and Hawaiian Islands where they were displayed by bottlenose dolphins, short-finned pilot whales (*Globicephala macrorhynchus*) and spinner dolphins. Aggressive behavior from humans to dolphins was documented in two locations (i.e., Western Australia and Gulf Coast in the USA) where dolphins were shot.

For lone, sociable dolphins, human intrusive behaviors ($n = 34$, 72.3 % locations) appeared most, and aggressive ($n = 13$, 27.7 % locations) human behaviors directed to lone, sociable dolphins were more common than for ongoing activities ($n = 2$, 3.7 % locations). Intrusive ($n = 25$, 53.2 % locations), abrupt ($n = 20$, 42.6 % locations), aggressive ($n = 20$, 42.6 % locations) and sexual ($n = 15$, 31.9 % locations) dolphin behaviors were likewise more documented than for ongoing activities; they were displayed by both male and female lone, sociable dolphins. No human submissive behavior was recorded either for lone, sociable dolphins or ongoing activities.

3.4. Risks for dolphins and humans

Risks documented for dolphins and humans were tallied with a total of 20 risks documented for dolphins, and five risks documented for humans/human activities. Details on risks and proportion of locations

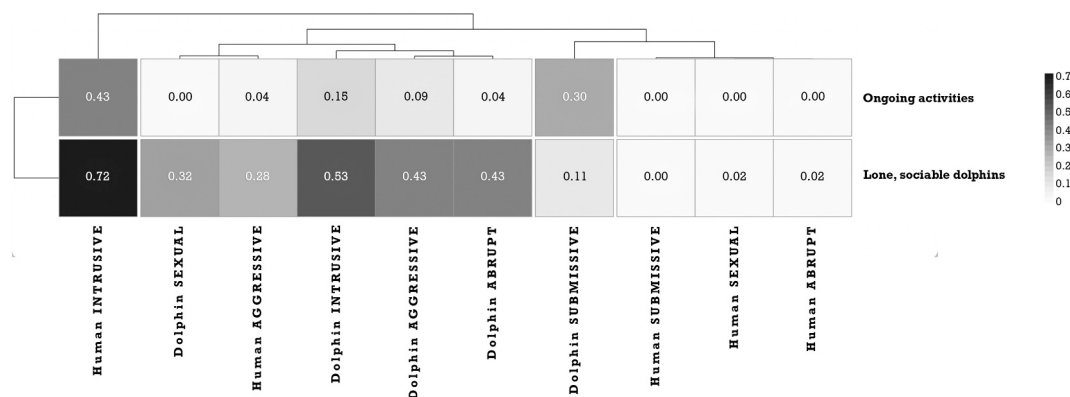


Fig. 4. Grayscale cluster heatmap representing the proportion of locations where dolphins' and humans' deleterious behaviors (shown as behavioral categories) were documented. The higher values are being represented by the darkest gray. Rows and columns were ordered according to hierarchical clustering based on average linkage and Euclidean distance.

where risks were documented are shown in Fig. 5.

Overall, the number of locations where risks were documented for dolphins is higher for lone, sociable dolphins than for ongoing activities (nlone, sociable = 38, nongoing = 28; χ^2 test, $df = 1$, $p < 0.05$). The number of locations where risks were documented for humans is likewise higher for lone, sociable dolphins than for ongoing activities (nlone, sociable = 21, nongoing = 6; χ^2 test, $df = 1$, $p < 0.05$).

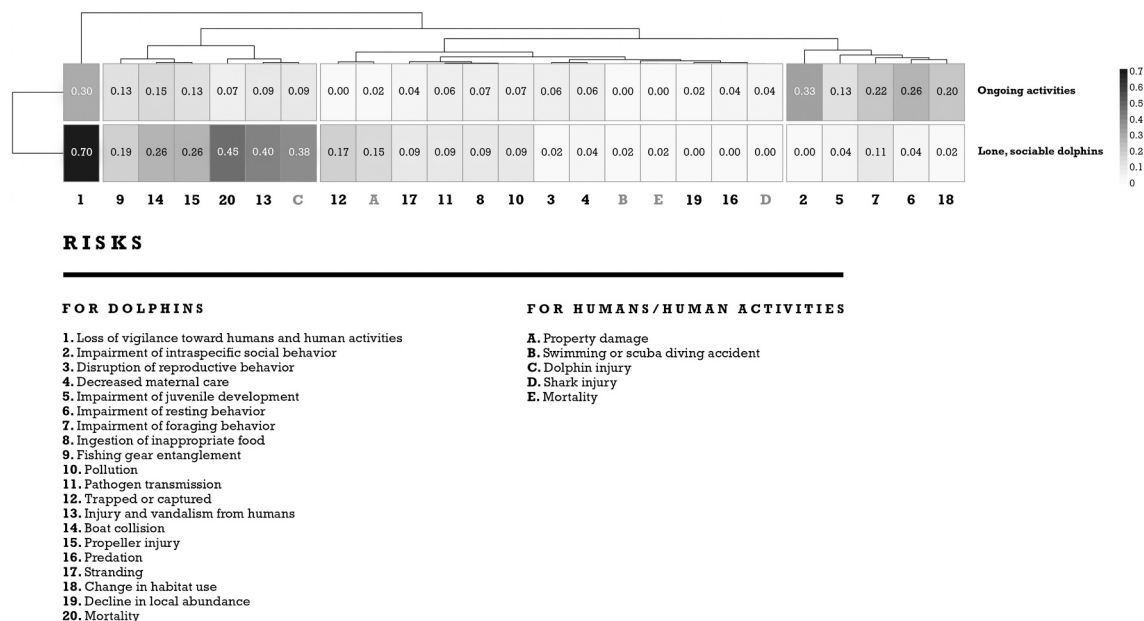
In addition, the risks most commonly reported for dolphins for ongoing activities are different in nature than those reported for lone, sociable dolphins. In both cases a loss of vigilance toward humans and human activities was reported in dolphins ($n = 33$, 70.2 % locations for lone, sociable dolphins; $n = 16$, 29.6 % locations for ongoing activities). However, the risks most frequently recorded in ongoing activities were an impairment of social ($n = 18$, 33.3 % locations), resting ($n = 14$, 25.9 % locations), and foraging ($n = 12$, 22.2 % locations) behaviors. A change in habitat use was also documented in 20.4 % of the locations reviewed.

For lone, sociable dolphins, mortality ($n = 21$, 44.7 % locations), injury and vandalism from humans ($n = 19$, 40.4 % locations), and injuries related to interactions with boats (collisions: $n = 12$, 25.5 %

locations; propeller wounds: $n = 12$, 25.5 % locations) were recorded most. In addition, interactions with lone, sociable dolphins involved humans being injured by dolphins in 38.3 % of the locations reviewed. One case of swimming accident was recorded in England, UK, where a man entered the water to swim with a lone, sociable dolphin in heavy seas and was trapped under cliffs before being saved by a rescue helicopter and one case of human mortality was recorded in Sao Paulo State, Brazil, and involved a lone, sociable dolphin ramming a man in response to abuse.

4. Discussion

First documented in the 1960s, regular close interactions between humans and free-ranging dolphins during ongoing tourist and other recreational activities increased dramatically since the 1990s, often as part of a new kind of *nature-based mass tourism* (Berle, 1990; Orams, 2002). These programs encompass widely distributed commercial and recreational, structured and unstructured activities, and involve 22 Delphinid, the two Monodontid (i.e., narwhal and beluga) and one Iniid (i.e., river dolphin) species in at least 54 locations worldwide. They take



RISKS

FOR DOLPHINS

1. Loss of vigilance toward humans and human activities
2. Impairment of intraspecific social behavior
3. Disruption of reproductive behavior
4. Decreased maternal care
5. Impairment of juvenile development
6. Impairment of resting behavior
7. Impairment of foraging behavior
8. Ingestion of inappropriate food
9. Fishing gear entanglement
10. Pollution
11. Pathogen transmission
12. Trapped or captured
13. Injury and vandalism from humans
14. Boat collision
15. Propeller injury
16. Predation
17. Stranding
18. Change in habitat use
19. Decline in local abundance
20. Mortality

FOR HUMANS/HUMAN ACTIVITIES

- A. Property damage
- B. Swimming or scuba diving accident
- C. Dolphin injury
- D. Shark injury
- E. Mortality

Fig. 5. Grayscale cluster heatmap representing the proportion of locations where risks for dolphins and humans were documented. Details on risks associated with close interactions between humans and free-ranging dolphins are reported in legend. The higher values are being represented by the darkest gray. Rows and columns were ordered according to hierarchical clustering based on average linkage and Euclidean distance.

the form of wading, swim-with, free diving, and/or scuba diving encounters with dolphins, and food provisioning activities.

Lone, sociable dolphins were recorded from the 1950s and involved 10 Delphinid and the two Monodontid species in 47 locations mainly distributed in North and Central America, Europe, Australia, and New Zealand.

Bottlenose dolphins are the primary species documented in any type of close interaction and the most popular in nature-based tourism and other recreational activities involving close interactions between humans and free-ranging dolphins. This is probably due to their wide distribution in coastal waters, rich behavioral repertoire (Lusseau, 2006) and tendency of some individual dolphins to show novelty-seeking behavior in the presence of human activities (Díaz López, 2020).

The spinner dolphin is the second most common species targeted in ongoing activities, but it is absent from the lone, sociable dolphin records. The predominance of spinner dolphins as a focus species in ongoing activities is probably due to the species' intertropical distribution in often shallow-coastal habitats and to its predictable diel behavioral patterns [the dolphins congregate in sheltered bays to rest and socialize during daylight hours (Norris and Dohl, 1980; Tyne et al., 2018; Shawky et al., 2020)].

The number of locations where dolphins' and humans' deleterious behaviors and risks were recorded was higher for lone, sociable dolphins than for ongoing activities. Moreover, except for human intrusive behaviors and a loss of vigilance of dolphins toward humans and human activities that are profusely mentioned in both situations, the deleterious behaviors and risks most frequently documented are different in nature for ongoing activities and lone, sociable dolphins.

For ongoing activities, dolphin submissive behavior (i.e., avoidance of human presence), impairments of social, resting, and foraging activities which are vitally important for the animals' welfare (e.g., Constantine, 2001; Christiansen et al., 2010; New et al., 2013; Senigaglia et al., 2016), and a change in habitat use were relatively frequent. Dolphin intrusive, aggressive, abrupt, and human aggressive behaviors were mostly reported in locations where dolphins are food-provisioned and/or regularly touched by people.

For lone, sociable dolphins, human aggressive and dolphin intrusive, abrupt, aggressive, and sexual behaviors were frequently documented as well as dolphin mortality, injury and vandalism from humans, injuries related to interactions with boats and humans being injured by dolphins. Despite the belief that it is riskless to interact with female dolphins (pers. obs.) both male and female lone, sociable dolphins displayed deleterious behaviors toward humans. This echoes a study conducted on swimmer-dolphin interactions in captivity where Samuels and Spradlin (1995) documented both male and female dolphins engaging in activity that put swimmers at risk.

These results should be interpreted with caution as most references focused on dolphins' rather than humans' behaviors. For example, it is noteworthy that no human submissive behavior was mentioned in all of the literature reviewed as we can presume that dolphin aggressive, sexual and/or abrupt behaviors directed to humans should provoke submissive responses from the people involved, such as flight behavior (Dixon, 1998). In addition, the risks identified for dolphins were more numerous and detailed than those reviewed for humans, which may be due in part to a lack of data sharing from people involved in interactions that did not meet their expectations. Behaviors and risks related to close interactions with lone, sociable dolphins likewise appear to be better documented than those associated with ongoing activities. This might be explained by the relatively easy access to these dolphins by a large number of people, a particularly high degree of tolerance from such animals to human proximity that may evolve into familiarity between both species (Lockyer, 1990; Müller, 1998) and a more contagious spread of communication related to the behaviors (e.g., aggressive, sexual) that may be considered funny or outrageous by the public (e.g., Bloom, 1991; Santos, 1997; Nunny and Simmonds, 2019).

Finally, deleterious behaviors and risks associated with close

interactions have been well studied in a few countries (e.g., Australia, the United States, New Zealand) from which most information on this subject is available. In many locations (e.g., Caribbean and Pacific Islands, Central America), incidents were scarcely if never reported neither for dolphins nor for humans which could be due to the relatively recent development of these activities and/or the fact that these locations are non or understudied. Consequently, our results are likely to underestimate the actual global increase in anthropogenic pressure on dolphins due to close tourist and recreational interactions and behavioral responses and risks associated over time.

4.1. Risks associated with increased dolphin tolerance to humans and human activities

Most studies did not document dolphin habituation or conditioning (except for Christiansen et al., 2016, and Senigaglia et al., 2019) but a general loss of vigilance concomitant with an increased tolerance toward humans and human activities. Samuels and Bejder (2004) described behaviors such as remaining close to humans and begging as being "indicative of chronic human interaction." Such behavioral shift was frequently mentioned in lone, sociable dolphins and dolphins that are food-provisioned and/or regularly touched by people where a higher proportion of deleterious human behaviors and risks for dolphins was also documented (Donaldson et al., 2012; Christiansen et al., 2016; Nunny and Simmonds, 2019). It illustrates how increased tolerance can make dolphins more vulnerable to deleterious encounters with humans and human activities.

In addition, the degree of tolerance of one or more dolphins to human presence will often determine the animals' popularity, with over-popularity sometimes leading to an escalation of the dolphins' behavior from punctual tolerance to increased confidence, assertiveness, pushiness, and eventual aggression toward humans (Dudzinski et al., 1995; Orams et al., 1996; de Sá Alves et al., 2011). The risks generated by this process are difficult to control and can lead to serious injury for humans. As a result, a dolphin once considered *friendly* can easily become viewed as a nuisance or threat and deliberately destroyed (Bryant, 1994; Knight, 2009). Food provisioning activities and/or regular physical contact between people and dolphins (e.g., scuba diving tourism at Rangiroa Atoll, French Polynesia, and Socorro Island, Mexico) can speed up the evolution of a *friendly* dolphin into a *trespasser* (Donaldson et al., 2012).

Finally, social learning can facilitate the acquisition of undesirable and maladaptive behaviors by conspecifics (Mazur and Seher, 2008) and impact the fitness and welfare of a biologically significant proportion of a dolphin population (Bejder and Samuels, 2003; Donaldson et al., 2012; Christiansen et al., 2016), with juvenile animals being particularly at risk (Samuels and Bejder, 2004; Cunningham-Smith et al., 2006; Ménard et al., 2013).

4.2. Management of close interactions

Forty years of research completed on the impacts of dolphin watching show that close interactions between dolphins and people, if not properly managed, appear to be another form of pollution that cannot be labeled *ecotourism* (Wall, 1997; Constantine and Bejder, 2007; Higham et al., 2009; Ménard et al., 2013).

Human intrusive behaviors were much more documented than any other deleterious behavior in this review and show that management of close encounters with wildlife is chiefly about managing human behavior (Fumagalli et al., 2021).

A general lack of knowledge about the species and behaviors observed, coupled with a natural tendency to anthropomorphism by operators and the general public, maintain the myth of a friendly and harmless dolphin (Delfour, 2007). In addition, the public will often seek encounters with wild dolphins like those offered by dolphinariums (Samuels and Bejder, 2004; Senigaglia et al., 2020), increasing the potential for inappropriate actions that could lead to a deleterious outcome

(Amante-Helweg, 1996; Wilke et al., 2005; Bearzi, 2017).

In the case of ongoing activities, such records have led to the implementation of locally adapted regulations like those developed in Monkey Mia, Bunbury and Tangalooma, Australia (Orams, 1997; Foroughirad and Mann, 2013; Senigaglia et al., 2019). In New Zealand, the Bay of Islands' bottlenose dolphin population became sensitized to swim attempts from commercial swim-with-dolphin boats and increased their avoidance of swimmers (Constantine, 2001), which resulted in a recent ban on swim-with dolphin activities in this area (Fumagalli et al., 2021). In mainland France, swim-with dolphin activities were legally prohibited in 2021 and three companies which had been offering swim-with dolphin tours on the Mediterranean coast for many years were recently sentenced for 'misleading business practices' and 'intentional disturbance of a protected wild species' (Le Figaro, 2022). In the USA, swim-with and feeding wild dolphins is illegal under the Marine Mammal Protection Act (Bryant, 1994; Samuels and Bejder, 2004) and tourism industries have long been under pressure to change their ways. In the main Hawaiian Islands, NOAA Fisheries recently published a final rule to prohibit swimming with and approaching spinner dolphins within 45 m to prevent their disturbance (NOAA Fisheries, 2021).

Nevertheless, all these initiatives are not being successful (Scarpaci et al., 2004; Foroughirad and Mann, 2013; Powell et al., 2018; Senigaglia et al., 2019) and various management indications (summarized in Table 3) were suggested in the literature reviewed that should help promoting animal welfare, human safety, and the establishment of sustainable activities.

4.3. Assessing animal welfare and considering interindividual differences

Caution is warranted when assessing close interactions and their impact on individuals, communities, and populations because of a lack of wild dolphin welfare studies and a lack of consistent management of human behavior toward the animals across interactions.

Physiological indicators (e.g., fecal glucocorticoid metabolites concentration, Millsaugh and Washburn, 2004; Shutt et al., 2014; Mercera et al., 2021) could help objectively assess stress levels experienced by individual animals in the context of repeated interactions with humans, especially in the case of animals that look undisturbed but may physiologically experience high level of stress due to human presence (Gill et al., 2001; Tyne et al., 2018). In addition, the study of certain behaviors (e.g., occurrence of affiliative social behaviors, Clegg et al., 2017) within an animal's repertoire is increasingly believed to be a relevant approach to measure welfare at an individual scale (Clegg and Delfour, 2018) and to pinpoint interindividual differences on various time scales (Martin and Réale, 2008; Díaz López, 2020).

Indeed, interspecific interactions will have disproportionate influences on different individuals depending on a range of factors such as sex, age, kinship, temperament, hormonal state, social relationships, previous experience with humans, current fitness, and life history strategies (Mattson et al., 1992; Lusseau, 2003; Lusseau and Bejder, 2007; Bejder et al., 2009; Higham and Shelton, 2011; Symons et al., 2014; Geffroy et al., 2015). A similar situation may thus be experienced differently by different individuals and impact their welfare in different ways (Olson et al., 1997; Ellenberg et al., 2009).

At one extreme, a bold dolphin may be actively and repeatedly looking for an interaction with humans (Samuels and Bejder, 2004; Martinez et al., 2012). At another extreme, shy individuals may respond to chronic human presence either by staying in suboptimal areas where they will tolerate the stress incurred (Smith and Blumstein, 2013; Tyne et al., 2018), avoiding the source of disturbance (Lusseau, 2003; Shawky et al., 2020) or leaving the location (Bejder et al., 2006). Bold individuals may take more risks and might thus suffer higher mortality (e.g., from boat strikes, retaliatory behaviors from humans, ingestion of inappropriate or contaminated items, Cunningham-Smith et al., 2006; Donaldson et al., 2010; Christiansen et al., 2016; Vail, 2016) than shy individuals (Bremner-Harrison et al., 2004; McDougall et al., 2006;

Table 3

Management indications.

Management indications to promote animal welfare, human safety, and the establishment of sustainable activities are listed with examples given in the literature reviewed.

Management indications	Examples	References
Minimization of human intervention	Strongly discourage habituation, conditioning and any type of interaction with humans; keeping (lone, sociable) dolphin's identity and location a secret.	Spradlin et al. (1999, 2001); Wilke et al. (2005); Corkeron (2006); Christiansen et al. (2016); Goodwin and Dodds (2019); Nunny and Simmonds (2019)
Precautionary, site-specific, and adaptive management	Consider threats of significant adverse impact on the behavioral patterns or physiological welfare of local dolphin populations, as well as safety concerns for humans; adjust and improve management actions regularly to accommodate new information.	Higginbottom et al. (2003); Constantine et al. (2004); Scarpaci et al. (2004); Tapper (2006); Allen et al. (2007); Carlson (2012); Fumagalli et al. (2019); Barnhill et al. (2022)
Collaboration between stakeholders	Tour operators, conservationists, academic institutions, government agencies and the local population should show mutual respect, communicate with each other, share information, and monitor current practices to ensure activities are managed sustainably.	Scarpaci et al. (2004); Allen et al. (2007); Lewis and Walker (2018); Nunny and Simmonds (2019)
Easily understood, adapted, and enforced regulations	Permits granted by the appropriate authority; no-go protected areas based on preferred habitats for socializing, resting, feeding; temporal zoning; prohibition of intrusive activities; safety distances; restricted number of operators, vessels, and swimmers; rangers on site; independent inspection of activities; penalties for breaches; publicized enforcement campaigns.	Green and Higginbottom (2001); Birtles et al. (2002); Constantine et al. (2004); Scarpaci et al. (2004); Wilke et al. (2005); Corkeron (2006); Cunningham-Smith et al. (2006); Allen et al. (2007); Carlson (2012); Christiansen et al. (2016); Powell et al. (2018)
Scientific monitoring	Evaluation of the environmental, social, and economic carrying capacity of the activity; continuous or regular ecological, biological and behavioral monitoring of dolphins targeted by activities; evaluation of management effectiveness and limits of acceptable changes.	Kinsman and Frohoff (2005); Corkeron (2006); Carlson (2012); Lewis and Walker (2018); Chazot et al. (2020); Barnhill et al. (2022)
Education, training, and supervision	Training of tour operators and other stakeholders; comprehensive briefings and guidelines in multiple languages including behavioral information and details on regulation, risks, and the protocol to follow in the water; public campaigns that increase awareness that wild animals should not be assumed to behave as do those in zoos or aquariums; presence of an appropriately trained guide to supervise people, avoid intrusive and disrespectful behaviors to	Sommer (1972) in Finlay et al., 1988; Forestell (1993); Orams (1994); Kinsman and Frohoff (2005); Tapper (2006); Curtin (2010); Carlson (2012); Christiansen et al. (2016); Bach and Burton (2017); Lewis and Walker (2018); Nunny and Simmonds (2019)

(continued on next page)

Table 3 (continued)

Management indications	Examples	References
Responsible communication	the animals, and act as a valuable conservation agent. Encourage realistic expectations to avoid disappointment and pressure on animals; discourage inappropriate communication such as guaranteed swim-with experiences, the promotion of illegal activities and greenwashing operations; create a label; promote responsible tour operators.	Corkeron (2006); Pirotta et al. (2014)
Genuine ecotourism	Promote multi-day tours that give more time to educate the public and relieve the pressure on animals; incorporate other activities to redirect the focus of the tour away from the dolphins; involve the public in data collection through citizen science; provide benefits to local communities.	Tapper (2006); Scarpaci and Parsons (2014)
Funding of conservation programs	Payment of an entrance and/or permit fee used to fund local conservation programs.	Kessler and Harcourt (2010)

Ménard et al., 2013; Smith and Blumstein, 2013; Geffroy et al., 2015). Integrating temperament into studies of the stress response of wildlife to humans (as suggested by Martin and Réale, 2008) could therefore help better understand the impact of close interactions on free-ranging dolphins.

5. Conclusions

From 1975, the potential impacts of whale and dolphin watching on cetaceans began to be discussed by the International Whaling Commission (IWC, 2018). Studies documenting the behaviors and risks associated with chronic and intrusive human-cetacean interactions have been published since, reiterating findings and suggestions. It would be interesting to conduct a thorough analysis of the extent to which these recommendations were efficiently implemented or not, and for what results. At last, to improve management of these interactions and the safety and welfare of both dolphins and humans, it is essential to consider the unique features of each operation and species observed as well as the contextual and multidimensional aspects of behavioral responses in order to reshape and adapt our modes of interactions while minimizing negative short- to long-term impacts on wildlife.

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CRediT authorship contribution statement

Pamela Carzon: Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Éric Clua:** Conceptualization, Project administration, Resources, Supervision. **Kathleen M. Dudzinski:** Conceptualization, Project administration, Resources, Supervision. **Fabienne Delfour:** Conceptualization, Methodology, Project administration, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

Declaration of competing interest

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

We confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed. We further confirm that the order of authors listed in the manuscript has been approved by all of us.

We confirm that we have given due consideration to the protection of intellectual property associated with this work and that there are no impediments to publication, including the timing of publication, with respect to intellectual property. In so doing we confirm that we have followed the regulations of our institutions concerning intellectual property.

We understand that the Corresponding Author is the sole contact for the Editorial process (including Editorial Manager and direct communications with the office). She is responsible for communicating with the other authors about progress, submissions of revisions and final approval of proofs. We confirm that we have provided a current, correct email address which is accessible by the Corresponding Author.

Data availability

Data will be made available on request.

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References

- Allen, S., Smith, H., Waples, K., Harcourt, R., 2007. The voluntary code of conduct for dolphin watching in port Stephens, Australia: is self-regulation an effective management tool? *J. Cetacean Res. Manag.* 9 (2), 159–166.
- Amante-Helweg, V., 1996. Ecotourists’ beliefs and knowledge about dolphins and the development of cetacean ecotourism. *Aquat. Mamm.* 22 (2), 131–140.
- Bach, L., Burton, M., 2017. Proximity and animal welfare in the context of tourist interactions within habituated dolphins. *J. Sustain. Tour.* 25 (18), 181–197. <https://doi.org/10.1080/09669582.2016.1195835>.
- Barnhill, K.A., Scott, J., Clark, H.P., Smith, A.J., 2022. Human-bottlenose dolphin interactions within wildlife tourism, ocean recreation and fisheries. *Coast. Stud. Soc.* 1–16. <https://doi.org/10.1177/26349817221117440>.
- Bearzi, M., 2017. Impacts of marine mammal tourism. In: Blumstein, D., Geffroy, B., Samia, D.S.M., Bessa, E. (Eds.), *Ecotourism’s Promise and Peril: A Biological Evaluation*, pp. 73–96. Cham, ISBN 978-3-319-58331-0.
- Bejder, L., Samuels, A., 2003. Evaluating the effects of nature-based tourism on cetaceans. In: Gales, N., Hindell, M., Kirkwood, R. (Eds.), *Marine Mammals: Fisheries, Tourism and Management Issues*. CSIRO Publishing, Collingwood, VIC, Australia, pp. 229–256.
- Bejder, L., Samuels, A., Whitehead, H., Gales, N., Mann, J., Connor, R., Heithaus, M., Watson-Capps, J., Flaherty, C., Krützen, M., 2006. Decline in relative abundance of bottlenose dolphins exposed to long-term disturbance. *Conserv. Biol.* 20 (6), 1791–1798. <https://doi.org/10.1111/j.1523-1739.2006.00540.x>.
- Bejder, L., Samuels, A., Whitehead, H., Finn, H., Allen, S., 2009. Impact assessment research: use and misuse of habituation, sensitisation and tolerance in describing wildlife responses to anthropogenic stimuli. *Mar. Ecol. Prog. Ser.* 395, 177–185. <https://doi.org/10.3354/meps07979>.
- Berle, P.A.A., 1990. Two faces of eco-tourism. *Audubon* 92 (2), 6.
- Birtles, R.A., Arnold, P.W., Dunstan, A., 2002. Commercial swim programs with dwarf Minke whales on the Northern Great Barrier Reef, Australia: some characteristics of the encounters with management implications. *Aust. Mammal.* 24 (1), 23–38. <https://doi.org/10.1071/AM02023>.
- Bloom, P., 1991. The diary of a wild, solitary, bottlenose dolphin (*Tursiops truncatus*), resident off amble on the North Northumberland coast of England, from April 1987 to January 1991. *Aquat. Mamm.* 17 (3), 103–119.
- Bremner-Harrison, S., Prodohl, P.A., Elwood, R.W., 2004. Behavioural trait assessment as a release criterion: boldness predicts early death in a reintroduction programme of

- captive-bred swift foxes (*Vulpes velox*). *Anim. Conserv.* 7, 313–320. <https://doi.org/10.1017/S1367943004001490>.
- Brena, P.F., Mourier, J., Planes, S., Clua, E., 2015. Shark and ray provisioning: functional insights into behavioral, ecological and physiological responses across multiple scales. *Mar. Ecol. Prog. Ser.* 538, 273–283. <https://doi.org/10.3354/meps11492>.
- Brennan, E.J., Else, J.G., Altmann, J., 1985. Ecology and behaviour of a pest primate: vervet monkeys in a tourist-lodge habitat. *Afr. J. Ecol.* 23, 35–44. <https://doi.org/10.1111/j.1365-2028.1985.tb00710.x>.
- Bryant, L., 1994. Report to Congress on Results of Feeding Wild Dolphins: 1989–1994. National Marine Fisheries Service, Office of Protected Resources. July 1994.
- Carlson, C., 2012. A review of whale watch guidelines and regulations around the world, version 2012. In: *Guidelines for Commercial Cetacean-watching Activities in the ACCOBAMS Area*.
- Cater, C.I., 2008. The life aquatic: scuba diving and the experiential imperative. *Tour. Mar. Environ.* 5 (4), 233–244. <https://doi.org/10.3727/154427308788714777>.
- Chazot, J., Hoarau, L., Carzon, P., Wagner, J., Sorby, S., Ratel, M., Barcelo, A., 2020. Recommendations for sustainable cetacean-based tourism in french territories: a review on the industry and current management actions. *Tour. Mar. Environ.* 15 (3/4), 211–235. <https://doi.org/10.3727/154427320X15943351217984>.
- Christiansen, F., Lusseau, D., Stensland, E., Berggren, P., 2010. Effects of tourist boats on the behaviour of Indo-Pacific bottlenose dolphins off the south coast of Zanzibar, Tanzania. *Endanger. Species Res.* 11, 91–99. <https://doi.org/10.3354/esr00265>.
- Christiansen, F., McHugh, K.A., Bejder, L., Siegal, E.M., Lusseau, D., Berens McCabe, E., Wells, R.S., 2016. Food provisioning increases the risk of injury in a long-lived marine top predator. *R. Soc. Open Sci.* 3, 160560 <https://doi.org/10.1098/rsos.160560>.
- Clegg, L.L.K., Delfour, F., 2018. Can we assess marine mammal welfare in captivity and in the wild? Considering the example of bottlenose dolphins. *Aquat. Mamm.* 44 (2), 181–200. <https://doi.org/10.1578/AM.44.2.2018.181>.
- Clegg, L.L.K., Rödel, H.G., Delfour, F., 2017. Bottlenose dolphins engaging in more social affiliative behaviour judge ambiguous cues more optimistically. *Behav. Brain Res.* 322, 115–122. <https://doi.org/10.1016/j.bbr.2017.01.026>.
- Constantine, R., 2001. Increased avoidance of swimmers by wild bottlenose dolphins (*Tursiops truncatus*) due to long-term exposure to swim-with-dolphin tourism. *Mar. Mamm. Sci.* 17 (4), 689–702. <https://doi.org/10.1111/j.1748-7692.2001.tb01293.x>.
- Constantine, R., Bejder, L., 2007. Managing the whale-and dolphin-watching industry: time for a paradigm shift. In: Higham, J.E.S., Lück, M. (Eds.), *Marine Wildlife and Tourism Management: Insights From the Natural and Social Sciences*. CABI, Wallingford, OX10 8DE, UK, pp. 321–333. <https://doi.org/10.1079/9781845933456.0321>.
- Constantine, R., Brunton, D.H., Dennis, T., 2004. Dolphin-watching tour boats change bottlenose dolphin (*Tursiops truncatus*) behaviour. *Biol. Conserv.* 117 (3), 299–307. <https://doi.org/10.1016/j.biocon.2003.12.009>.
- Corkeron, P.J., 2006. How shall we watch whales? In: Lavigne, D.M. (Ed.), *Gaining Ground: In Pursuit of Ecological Sustainability. Proceedings of an International Forum, the International Fund for Animal Welfare, Guelph, ON, and University of Limerick, Limerick, Ireland*, pp. 161–170.
- Corral, C.T., Szteren, D., Cassini, M.H., 2017. Short- and long-term changes in the intensity of responses of pinnipeds to tourist approaches in Cabo Polonio, Uruguay. *Appl. Anim. Behav. Sci.* 201, 111–116. <https://doi.org/10.1016/j.applanim.2017.12.012>.
- Craighead, J.J., Craighead Jr., F.C., 1971. Grizzly bear-man relationships in Yellowstone National Park. *Bioscience* 21 (16), 845–857. <https://doi.org/10.2307/3872593>.
- Cunningham-Smith, P., Colbert, D.E., Wells, R.S., Speakman, T., 2006. Evaluation of human interactions with a provisioned wild bottlenose dolphin (*Tursiops truncatus*) near Sarasota Bay, Florida, and efforts to curtail the interactions. *Aquat. Mamm.* 32 (3), 346–356. <https://doi.org/10.1578/AM.32.3.2006.346>.
- Curtin, S., 2010. Managing the wildlife tourism experience: the importance of tour leaders. *Int. J. Tour. Res.* 12, 219–236. <https://doi.org/10.1002/jtr.747>.
- de Sá Alves, L.C.P., Andriolo, A., Orams, M.B., de Freitas Azevedo, A., 2011. The growth of ‘botos feeding tourism’, a new tourism industry based on the boto (Amazon River dolphin) *Inia geoffrensis* in the Amazonas State, Brazil. *Stientibus Sér. Ciênc. Biológicas* 11 (1), 8–15. <https://doi.org/10.13102/scb140>.
- Delfour, F., 2007. Penser le dauphin et son monde. *Entre croyances anthropocentriques et démarche scientifique. Enfances PSY* 35, 35–45.
- DeMares, R., 2000. Human peak experience triggered by encounters with cetaceans. *Anthrozoös* 13 (2), 89–103. <https://doi.org/10.2752/089279300786999914>.
- Díaz López, B., 2017. Temporal variability in predator presence around a fin fish farm in the northwestern Mediterranean Sea. *Mar. Ecol.* 38, e12378 <https://doi.org/10.1111/maec.12378>.
- Díaz López, B., 2020. When personality matters: personality and social structure in wild bottlenose dolphins, *Tursiops truncatus*. *Anim. Behav.* 163, 73–84. <https://doi.org/10.1016/j.anbehav.2020.03.001>.
- Dixon, A.K., 1998. Ethological strategies for defence in animals and humans: their role in some psychiatric disorders. *Br. J. Med. Psychol.* 71, 417–445. <https://doi.org/10.1111/j.2044-8341.1998.tb01001.x>.
- Donaldson, R., Finn, H., Calver, M., 2010. Illegal feeding increases risk of boat-strike and entanglement in bottlenose dolphins in Perth, Western Australia. *Pac. Conserv. Biol.* 16 (3), 157–161. <https://doi.org/10.1071/PC100157>.
- Donaldson, R., Finn, H., Bejder, L., Lusseau, D., Calver, M., 2012. The social side of human-wildlife interaction: wildlife can learn harmful behaviours from each other. *Anim. Conserv.* 15 (5), 427–435. <https://doi.org/10.1111/j.1469-1795.2012.00548.x>.
- Dubois, S., Fraser, D., 2013. A framework to evaluate wildlife feeding in research, wildlife management, tourism and recreation. *Animals* 3, 978–994. <https://doi.org/10.3390/ani3040978>.
- Dudzinski, K.M., Frohoff, T.G., Crane, N.L., 1995. Behavior of a lone female bottlenose dolphin (*Tursiops truncatus*) with humans off the coast of Belize. *Aquat. Mamm.* 21 (2), 149–153.
- Ellenberg, U., Mattern, T., Seddon, P.J., Luna-Jorquera, G., 2006. Physiological and reproductive consequences of human disturbance in Humboldt penguins: the need for species-specific visitor management. *Biol. Conserv.* 133, 95–106. <https://doi.org/10.1016/j.biocon.2006.05.019>.
- Ellenberg, U., Setiawan, A.N., Cree, A., Houston, D.M., Seddon, P.J., 2007. Elevated hormonal stress response and reduced reproductive output in yellow-eyed penguins exposed to unregulated tourism. *Gen. Comp. Endocrinol.* 152, 54–63. <https://doi.org/10.1016/j.ygcen.2007.02.022>.
- Ellenberg, U., Mattern, T., Seddon, P.J., 2009. Habituation potential of yellow-eyed penguins depends on sex, character and previous experience with humans. *Anim. Behav.* 77, 289–296. <https://doi.org/10.1016/j.anbehav.2008.09.021>.
- Fa, J.E., 1992. Visitor-directed aggression among the Gibraltar macaques. *Zoo Biol.* 11 (1), 43–52. <https://doi.org/10.1002/zoo.1430110106>.
- Finlay, T., James, L.R., Maple, T.L., 1988. People's perceptions of animals: the influence of zoo environment. *Environ. Behav.* 20 (4), 508–528. <https://doi.org/10.1177/0013916588204008>.
- Finn, H., Donaldson, R., Calver, M., 2008. Feeding flipper: a case study of a human-dolphin interaction. *Pac. Conserv. Biol.* 14, 215–225. <https://doi.org/10.1071/PC080215>.
- Forestell, P.H., 1993. If leviathan has a face, does Gaia have a soul? Incorporating environmental education in marine eco-tourism programs. *Ocean Coast. Manag.* 20, 267–282. [https://doi.org/10.1016/0964-5691\(93\)90070-F](https://doi.org/10.1016/0964-5691(93)90070-F).
- Forestell, P.H., 2009. Popular culture and literature. In: Perrin, W.F., Würsig, B., Thewissen, J.G.M. (Eds.), *Encyclopedia of Marine Mammals*, second edition. Elsevier, pp. 898–913. <https://doi.org/10.1016/B978-0-12-373553-9.00206-6>.
- Foroughirad, V., Mann, J., 2013. Long-term impacts of fish provisioning on the behavior and survival of wild bottlenose dolphins. *Biol. Conserv.* 160, 242–249. <https://doi.org/10.1016/j.biocon.2013.01.001>.
- Fowler, G.S., 1999. Behavioral and hormonal responses of magellanic penguins (*Spheniscus magellanicus*) to tourism and nest site visitation. *Biol. Conserv.* 90 (2), 143–149. [https://doi.org/10.1016/S0006-3207\(99\)00026-9](https://doi.org/10.1016/S0006-3207(99)00026-9).
- Fraser, J., Reiss, D., Boyle, P., Lemcke, K., Sickler, J., Elliott, E., Newman, B., Gruber, S., 2006. Dolphins in popular literature and media. *Soc. Anim.* 14 (4), 321–349. <https://doi.org/10.1163/156853006778882402>.
- Frohoff, T.G., 2000. Behavioral indicators of stress in odontocetes during interactions with humans: a preliminary review and discussion. In: *International Whaling Commission Scientific Committee, SC/52/WW2*.
- Fumagalli, M., Cesario, A., Costa, M., Notarbartolo-di-Sciara, G., Harraway, J., Slooten, E., 2019. Population ecology and the management of whale watching operations on a data-deficient dolphin population. *Ecol. Evol.* 00, 1–15. <https://doi.org/10.1002/ece3.5565>.
- Fumagalli, M., Guerra, M., Brough, T., Carome, W., Constantine, R., Higham, J., Slooten, E., Stockin, K., Dawson, S., 2021. Looking back to move forward: lessons from three decades of research and management of cetacean tourism in New Zealand. *Front. Mar. Sci.* 8, 624448 <https://doi.org/10.3389/fmars.2021.624448>.
- Garrod, B., 2007. Marine wildlife tourism and ethics. In: Higham, J.E.S., Lück, M. (Eds.), *Marine Wildlife and Tourism Management: Insights From the Natural and Social Sciences*. CABI, Wallingford, OX10 8DE, UK, pp. 257–271.
- Geffroy, B., Samia, D.S.M., Bessa, E., Blumstein, D.T., 2015. How nature-based tourism might increase prey vulnerability to predators. *Trends Ecol. Evol.* 30 (12), 755–765. <https://doi.org/10.1016/j.tree.2015.09.010>.
- Gilbert, B.K., 1989. Behavioural plasticity and bear-human conflicts. Bear-people conflicts: proceedings of a symposium on management strategies. In: *Symposium Held 6-10 April 1987, Yellowknife, Northwest Territories, Canada*.
- Gill, J.A., Norris, K., Sutherland, W.J., 2001. Why behavioural responses may not reflect the population consequences of human disturbance. *Biol. Conserv.* 97, 265–268. [https://doi.org/10.1016/S0006-3207\(00\)00021-1](https://doi.org/10.1016/S0006-3207(00)00021-1).
- Goodwin, L., Dodds, M., 2019. Lone Rangers: A Report on Solitary Dolphins and Whales Including Recommendations for Their Protection, 2nd edition. Marine Connection.
- Green, R., Higginbottom, K., 2001. Negative effects of wildlife tourism on wildlife. In: *Wildlife Tourism Research Report Series: N°5, Status Assessment of Wildlife Tourism in Australia Series*. CRC Tourism.
- Grossberg, R., Treves, A., Naughton-Treves, L., 2003. The incidental ecotourist: measuring visitor impacts on endangered howler monkeys at a belizean archaeological site. *Environ. Conserv.* 30 (1), 40–51. <https://doi.org/10.1017/S0376892903000031>.
- Higginbottom, K., Green, R., Northrope, C., 2003. A framework for managing the negative impacts of wildlife tourism on wildlife. *Hum. Dimens. Wildl.* 8 (1), 1–24. <https://doi.org/10.1080/10871200390180118>.
- Higham, J.E.S., Shelton, E.J., 2011. Tourism and wildlife habituation: reduced population fitness or cessation of impact? *Tour. Manag.* 32, 1290–1298. <https://doi.org/10.1016/j.tourman.2010.12.006>.
- Higham, J.E.S., Bejder, L., Lusseau, D., 2009. An integrated and adaptive management model to address the long-term sustainability of tourist interactions with cetaceans. *Environ. Conserv.* 35 (4), 294–302. <https://doi.org/10.1017/S0376892908005249>.
- Hines, K.N., 2011. Effects of ecotourism on endangered northern bahamian rock iguanas (*Cyclura cyclura*). *Herpetol. Conserv. Biol.* 6 (2), 250–259.
- Hoyt, E., 2001. *Whale Watching 2001: Worldwide Tourism Numbers, Expenditures and Expanding Socioeconomic Benefits (Report From the International Fund for Animal Welfare)*. Yarmouth Port, MA, USA.

- Hughes, P., 2001. Animals, values and tourism – structural shifts in UK dolphin tourism provision. *Tour. Manag.* 22, 321–329. [https://doi.org/10.1016/S0261-5177\(00\)00070-4](https://doi.org/10.1016/S0261-5177(00)00070-4).
- International Whaling Commission, 2018. Whale watching: strategic plans. <https://iwc.int/management-and-conservation/whalewatching>. (Accessed 28 October 2022).
- Isaacs, J.C., 2000. The limited potential of ecotourism to contribute to wildlife conservation. *Wildl. Soc. Bull.* 28 (1), 61–69.
- Johns, B.G., 1996. Responses of chimpanzees to habituation and tourism in the Kibale forest, Uganda. *Biol. Conserv.* 78 (3), 257–262. [https://doi.org/10.1016/S0006-3207\(96\)00044-4](https://doi.org/10.1016/S0006-3207(96)00044-4).
- Joep, K.L., 1985. Implications of grizzly bear habituation to hikers. *Wildl. Soc. Bull.* 13, 32–37.
- Kessler, M., Harcourt, R., 2010. Aligning tourist, industry and government expectations: a case study from the swim with whales industry in Tonga. *Mar. Policy* 34 (10), 1350–1356. <https://doi.org/10.1016/j.marpol.2010.06.008>.
- Kinsman, C., Frohoff, T.G., 2005. The Whale Stewardship Project: Research and stewardship of solitary sociable beluga whales in Eastern Canada. In: Research and management of solitary, sociable odontocetes: Workshop workbook. Workshop on the research and management of solitary, sociable odontocetes. San Diego, California. (Accessed 10 December 2005).
- Knight, J., 2009. Making wildlife viewable: habituation and attraction. *Soc. Anim.* 17, 167–184. <https://doi.org/10.1163/156853009X418091>.
- Kovacs, C.J., Perrette, R.M., Cox, T.M., 2017. Social differentiation in common bottlenose dolphins (*Tursiops truncatus*) that engage in human-related foraging behaviors. *PLoS ONE* 12 (2), e0170151. <https://doi.org/10.1371/journal.pone.0170151>.
- Le Figaro, 2022. Nager avec les dauphins est illégal : trois entreprises de la Côte d'Azur condamnées (published on December 15, 2022). <https://www.lefigaro.fr/voies/nager-avec-les-dauphins-est-illegal-trois-entreprises-de-la-cote-d-azur-condamnees-20221215>.
- Lewis, S., Walker, D., 2018. Global Best Practice Guidance for Responsible Whale and Dolphin Watching: Tourism Activities Involving Wild Cetaceans (A Guide by the World Cetacean Alliance With Support From ClubMed). Brighton, UK.
- Lockyer, C., 1990. Review of incidents involving wild, sociable dolphins, worldwide. In: Leatherwood, S., Reeves, R.R. (Eds.), *The Bottlenose Dolphin*. Academic Press, London, UK, pp. 337–353.
- Lott, D.F., McCoy, M., 1995. Asian rhinos (*Rhinoceros unicornis*) on the run? Impact of tourist visits on one population. *Biol. Conserv.* 73 (1), 23–26. [https://doi.org/10.1016/0006-3207\(95\)90053-5](https://doi.org/10.1016/0006-3207(95)90053-5).
- Lusseau, D., 2003. Male and female bottlenose dolphins *Tursiops* spp. have different strategies to avoid interactions with tour boats in Doubtful Sound, New Zealand. *Mar. Ecol. Prog. Ser.* 257, 267–274. <https://doi.org/10.3354/meps257267>.
- Lusseau, D., 2006. Why do dolphins jump? Interpreting the behavioural repertoire of bottlenose dolphins (*Tursiops* sp.) in doubtful sound, New Zealand. *Behav. Process.* 73 (3), 257–265. <https://doi.org/10.1016/j.beproc.2006.06.006>.
- Lusseau, D., Bejder, L., 2007. The long-term consequences of short-term responses to disturbance experiences from whalewatching impact assessment. *Int. J. Comp. Psychol.* 20, 228–236.
- Machernis, A.F., Powell, J.R., Engleby, L.K., Spradlin, T.R., 2018. An Updated Literature Review Examining the Impacts of Tourism on Marine Mammals Over the Last Fifteen Years (2000–2015) to Inform Research and Management Programs. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, St. Petersburg, FL, July 2018.
- Mangott, A.H., Birtles, R.A., Marsh, H., 2011. Attraction of dwarf minke whales (*Balaenoptera acutorostrata*) to vessels and swimmers in the great barrier reef world heritage area – the management challenges of an inquisitive whale. *J. Ecotour.* 10 (1), 64–76. <https://doi.org/10.1080/14724041003690468>.
- Martin, J.G.A., Réale, D., 2008. Animal temperament and human disturbance: implications for the response of wildlife to tourism. *Behav. Process.* 77, 66–72. <https://doi.org/10.1016/j.beproc.2007.06.004>.
- Martinez, E., Orams, M.B., Pawley, M.D.M., Stockin, K.A., 2012. The use of auditory stimulants during swim encounters with Hector's dolphins (*Cephalorhynchus hectori*) in Akaroa Harbour, New Zealand. *Mar. Mamm. Sci.* 28 (3), E295–E315. <https://doi.org/10.1111/j.1748-7692.2011.00528.x>.
- Mattson, D.J., Blanchard, B.M., Knight, R.R., 1992. Yellowstone grizzly bear mortality, human habituation, and whitebark pine seed crops. *J. Wildl. Manag.* 56 (3), 432–442. <https://doi.org/10.2307/3808855>.
- Mazur, R., Seher, V., 2008. Socially learned foraging behaviour in wild black bears, *Ursus americanus*. *Anim. Behav.* 75, 1503–1508. <https://doi.org/10.1016/j.anbehav.2007.10.027>.
- McDougall, P.T., Réale, D., Sol, D., Reader, S.M., 2006. Wildlife conservation and animal temperament: causes and consequences of evolutionary change for captive, reintroduced, and wild populations. *Anim. Conserv.* 9, 39–48. <https://doi.org/10.1111/j.1469-1795.2005.00004.x>.
- Ménard, N., Foulquier, A., Vallet, D., Qarro, M., Le Gouar, P., Pierre, J.S., 2013. How tourism and pastoralism influence population demographic changes in a threatened large mammal species. *Anim. Conserv.* 17 (2), 115–124. <https://doi.org/10.1111/accv.12063>.
- Mercera, K., Pilot-Storck, F., Mercera, B., Gilbert, C., Delfour, F., 2021. Exploration of fecal glucocorticoid metabolites in the bottlenose dolphin (*Tursiops truncatus*) under human care by enzyme immunoassay. *Aquat. Mamm.* 47 (3), 227–238. <https://doi.org/10.1578/AM.47.3.2021.227>.
- Miller, J.R., 2005. Biodiversity conservation and the extinction of experience. *Trends Ecol. Evol.* 20, 430–434. <https://doi.org/10.1016/j.tree.2005.05.013>.
- Millsapugh, J.J., Washburn, B.E., 2004. Use of fecal glucocorticoid metabolite measures in conservation biology research: considerations for application and interpretation. *Gen. Comp. Endocrinol.* 138, 189–199. <https://doi.org/10.1016/j.ygcen.2004.07.002>.
- Müller, M., 1998. La place des dauphins solitaires et familiaux dans la socio-écologie des grands dauphins (*Tursiops truncatus*). Université Paris 6, Paris, France. Doctoral dissertation.
- Neves, K., 2010. Cashing in on cetourism: a critical ecological engagement with dominant E-NGO discourses on whaling, cetacean conservation, and whale watching. *Antipode* 42 (3), 719–741. <https://doi.org/10.1111/j.1467-8330.2010.00770.x>.
- New, L.F., Harwood, J., Thomas, L., Donovan, C., Clark, J.S., Hastie, G., Thompson, P.M., Cheney, B., Scott-Hayward, L., Lusseau, D., 2013. Modelling the biological significance of behavioural change in coastal bottlenose dolphins in response to disturbance. *Funct. Ecol.* 27, 314–322. <https://doi.org/10.1111/1365-2435.12052>.
- Newsome, D., Rodger, K., 2008. To feed or not to feed: a contentious issue in wildlife tourism. In: Lunney, D., Munn, A., Meikle, W. (Eds.), *Too Close for Comfort: Contentious Issues in Human-wildlife Encounters*. Royal Zoological Society of New South Wales, Mosman, NSW, Australia, pp. 255–270.
- Nisbet, I.C.T., 2000. Disturbance, habituation, and management of waterbird colonies. *Waterbirds* 23 (2), 312–332.
- NOAA Fisheries, 2021. Final rule to prohibit swimming with and approaching a Hawaiian spinner dolphin within 50 yards. <https://www.fisheries.noaa.gov/action/final-rule-prohibit-swimming-and-approaching-hawaiian-spinner-dolphins>. (Accessed 28 October 2022).
- Norris, K.S., Dohl, T.P., 1980. Behavior of the Hawaiian spinner dolphin, *Stenella longirostris*. *Fish. Bull.* 77, 821–849.
- Nunny, L., Simmonds, M.P., 2019. A global reassessment of solitary-sociable dolphins. *Front. Vet. Sci.* 5 (331) <https://doi.org/10.3389/fvets.2018.00331>.
- O'Connor, S., Campbell, R., Cortez, H., Knowles, T., 2009. Whale Watching Worldwide: Tourism Numbers, Expenditures and Expanding Economic Benefits (A Report From the International Fund for Animal Welfare). Yarmouth, MA, USA, 295 pp.
- Olson, T.L., Gilbert, B.K., Squibb, R.C., 1997. The effects of increasing human activity on brown bear use of an alaskan river. *Biol. Conserv.* 82 (1), 95–99. [https://doi.org/10.1016/S0006-3207\(96\)00151-6](https://doi.org/10.1016/S0006-3207(96)00151-6).
- Orams, M., 1994. Creating effective interpretation for managing interaction between tourists and wildlife. *Aust. J. Environ. Educ.* 10, 21–34. <https://doi.org/10.1017/S0814062600003062>.
- Orams, M., 1997. Historical accounts of human-dolphin interaction and recent developments in wild dolphin based tourism in Australasia. *Tour. Manag.* 18 (5), 317–326. [https://doi.org/10.1016/S0261-5177\(96\)00022-2](https://doi.org/10.1016/S0261-5177(96)00022-2).
- Orams, M., 2002. Feeding wildlife as a tourism attraction: a review of issues and impacts. *Tour. Manag.* 23, 281–293. [https://doi.org/10.1016/S0261-5177\(01\)00080-2](https://doi.org/10.1016/S0261-5177(01)00080-2).
- Orams, M.B., Hill, G.J.E., Baglioni, A.J., 1996. 'Pushy' behavior in a wild dolphin feeding program at Tangalooma, Australia. *Mar. Mamm. Sci.* 12 (1), 107–117. <https://doi.org/10.1111/j.1748-7692.1996.tb00308.x>.
- Penteriani, V., López-Bao, J.V., Bettega, C., Dalerum, F., Delgado, M.D., Jerina, K., Kojala, I., Krolf, M., Ordiz, A., 2017. Consequences of brown bear viewing tourism: a review. *Biol. Conserv.* 206, 169–180. <https://doi.org/10.1016/j.biocon.2016.12.035>.
- Pirotta, E., Thompson, P.M., Cheney, B., Donovan, C.R., Lusseau, D., 2014. Estimating spatial, temporal and individual variability in dolphin cumulative exposure to boat traffic using spatially explicit capture-recapture methods. *Anim. Conserv.* 18 (1), 20–31. <https://doi.org/10.1111/accv.12132>.
- Powell, J.R., Machernis, A.F., Engleby, L.K., Farmer, N.A., Spradlin, T.R., 2018. Sixteen years later: an updated evaluation of the impacts of chronic human interactions with bottlenose dolphins (*Tursiops truncatus*) at Panama City, Florida, USA. *J. Cetacean Res. Manag.* 19, 79–93.
- Samuels, A., Bejder, L., 2004. Chronic interaction between humans and free-ranging bottlenose dolphins near Panama City Beach, Florida, USA. *J. Cetacean Res. Manag.* 6 (1), 69–77.
- Samuels, A., Spradlin, T.R., 1995. Quantitative behavioral study of bottlenose dolphins in swim-with-dolphin programs in the United States. *Mar. Mamm. Sci.* 11 (4), 520–544. <https://doi.org/10.1111/j.1748-7692.1995.tb00675.x>.
- Samuels, A., Bejder, L., Heinrich, S., 2000. A Review of the Literature Pertaining to Swimming With Wild Dolphins. Marine Mammal Commission, Bethesda, Maryland.
- Sandbrook, C., Semple, S., 2006. The rules and the reality of mountain gorilla (*Gorilla beringei beringei*) tracking: how close do tourists get? *Oryx* 40 (4), 428–433. <https://doi.org/10.1017/S0030605306001323>.
- Santos, M.C.de O., 1997. Lone sociable bottlenose dolphin in Brazil: human fatality and management. *Mar. Mamm. Sci.* 13 (2), 355–356. <https://doi.org/10.1111/j.1748-7692.1997.tb00642.x>.
- Scarpaci, C., Parsons, E.C., 2014. Recent advances in whale-watching research: 2012–2013. *Tour. Mar. Environ.* 10 (1–2), 121–140. <https://doi.org/10.3727/154427314X1405688441941>.
- Scarpaci, C., Nugegoda, D., Corkeron, P.J., 2003. Compliance with regulations by 'swim-with-dolphins' operations in Port Phillip Bay, Victoria, Australia. *Environ. Manag.* 31 (3), 342–347. <https://doi.org/10.1007/s00267-002-2799-z>.
- Scarpaci, C., Nugegoda, D., Corkeron, P., 2004. No detectable improvement in compliance to regulations by 'swim-with-dolphin' operators in Port Phillip Bay, Victoria, Australia. *Tour. Mar. Environ.* 1 (1), 41–48. <https://doi.org/10.3727/154427304774865904>.
- Scarpaci, C., Nugegoda, D., Corkeron, P.J., 2005. Tourists swimming with Australian fur seals (*Arctocephalus pusillus*) in port Phillip Bay, Victoria, Australia: are tourists at risk? *Tour. Mar. Environ.* 1 (2), 89–95. <https://doi.org/10.3727/154427305774865787>.
- Scheer, M., 2020. Behaviors of grey seals (*Halichoerus grypus*) addressed towards human swimmers during experimental open water encounters off Heligoland, German

- Bight, North Sea. *Tour. Mar. Environ.* 15 (3-4), 159–171. <https://doi.org/10.3727/154427320X15945013137030>.
- Semeniuk, C.A.D., Bourgeon, S., Smith, S.L., Rothley, K.D., 2009. Hematological differences between stingrays at tourist and non-visited sites suggest physiological costs of wildlife tourism. *Biol. Conserv.* 142, 1818–1829. <https://doi.org/10.1016/j.biocon.2009.03.022>.
- Senigaglia, V., Christiansen, F., Bejder, L., Gendron, D., Lundquist, D., Noren, D.P., Schaffar, A., Smith, J.C., Williams, R., Martinez, E., Stockin, K., Lusseau, D., 2016. Meta-analyses of whale-watching impact studies: comparisons of cetacean responses to disturbance. *Mar. Ecol. Prog. Ser.* 542, 251–263. <https://doi.org/10.3354/meps11497>.
- Senigaglia, V., Christiansen, F., Sprogis, K.R., Symons, J., Bejder, L., 2019. Food-provisioning negatively affects calf survival and female reproductive success in bottlenose dolphins. *Sci. Rep.* 9, 8981. <https://doi.org/10.1038/s41598-019-45395-6>.
- Senigaglia, V., New, L., Hughes, M., 2020. Close encounters of the dolphin kind: contrasting tourist support for feeding based interactions with concern for dolphin welfare. *Tour. Manag.* 77, 104007. <https://doi.org/10.1016/j.tourman.2019.104007>.
- Shackley, M., 1992. Manatees and tourism in southern Florida: opportunity or threat? *J. Environ. Manag.* 34 (4), 257–265. [https://doi.org/10.1016/S0301-4797\(11\)80002-2](https://doi.org/10.1016/S0301-4797(11)80002-2).
- Shawky, A.M., Christiansen, F., Ormond, R., 2020. Effects of swim-with-dolphin tourism on the behaviour of spinner dolphins, at Samadai reef in the Egyptian Red Sea. *Aquat. Conserv. Mar. Freshwat. Ecosyst.* 2020, 1–12. <https://doi.org/10.1002/aqc.3332>.
- Shutt, K., Heistermann, M., Kasim, A., Todd, A., Kalousova, B., Profosouva, I., Petzelkova, K., Fuh, T., Dicky, J.-F., Bopalanognako, J.-B., Setchell, J.M., 2014. Effects of habituation, research and ecotourism on faecal glucocorticoid metabolites in wild western lowland gorillas: implications for conservation management. *Biol. Conserv.* 172, 72–79. <https://doi.org/10.1016/j.biocon.2014.02.014>.
- Sitar, A., May-Collado, L.J., Wright, A.J., Peters-Burton, E., Rockwood, L., Parsons, E.C.M., 2016. Boat operators in Bocas del Toro, Panama, display low levels of compliance with national whale-watching regulations. *Mar. Policy* 68, 221–228. <https://doi.org/10.1016/j.marpol.2016.03.011>.
- Smith, B.R., Blumstein, D.T., 2013. Animal personality and conservation biology: the importance of behavioral diversity. In: Carere, C., Maestripietri, D. (Eds.), *Animal Personalities: Behavior, Physiology and Evolution*. The University of Chicago Press, Chicago, USA, pp. 381–413.
- Smith, T.S., Herrero, S., DeBruyn, T.D., 2005. Alaskan brown bears, humans, and habituation. *Ursus* 16 (1), 1–10. [https://doi.org/10.2192/1537-6176\(2005\)016\[0001:ABBAH\]2.0.CO;2](https://doi.org/10.2192/1537-6176(2005)016[0001:ABBAH]2.0.CO;2).
- Spradlin, T.R., Drevenak, J.K., Terbush, A.D., Nitta, E.T., 1999. Interactions between the public and wild dolphins in the United States: biological concerns and the Marine Mammal Protection Act. In: Presented at the 'Wild Dolphin Swim Program Workshop' Held in Conjunction With the 13th Biennial Conference on the Biology of Marine Mammals, November 28, 1999.
- Spradlin, T.R., Nitta, E.T., Lewandowski, J.K., Barr, L.M., Brix, K., Norberg, B., 2001. Viewing Marine Mammals in the Wild: A Workshop to Discuss Responsible Guidelines and Regulations for Minimizing Disturbance (A Report From the Pre-conference Workshop Held Before the 14th Biennial Conference on the Biology of Marine Mammals). Vancouver, British Columbia, Canada.
- Symons, J., Pirota, E., Lusseau, D., 2014. Sex differences in risk perception in deep-diving bottlenose dolphins leads to decreased foraging efficiency when exposed to human disturbance. *J. Appl. Ecol.* 51 (6), 1584–1592. <https://doi.org/10.1111/1365-2664.12337>.
- Tapper, R., 2006. *Wildlife Watching and Tourism: A Study on the Benefits and Risks of a Fast-growing Tourism Activity and its Impacts on Species*. UNEP/CMS Secretariat, Bonn, Germany.
- Thorpe, W.H., 1963. *Learning and Instinct in Animals*. Methuen, London.
- Tyne, J.A., Christiansen, F., Heenehan, H.L., Johnston, D.W., Bejder, L., 2018. Chronic exposure of Hawaii Island spinner dolphins (*Stenella longirostris*) to human activities. *R. Soc. Open Sci.* 5, 171506. <https://doi.org/10.1098/rsos.171506>.
- Vail, C., 2016. An overview of increasing incidents of bottlenose dolphin harassment in the Gulf of Mexico and possible solutions. *Front. Mar. Sci.* 3 (110). <https://doi.org/10.3389/fmars.2016.00110>.
- Wall, G., 1997. Is ecotourism sustainable? *Environ. Manag.* 21 (4), 483–491. <https://doi.org/10.1007/s002679900044>.
- Wearing, S., Buchmann, A., Jobberns, C., 2011. Free Willy: the whale-watching legacy. *Worldw. Hosp. Tour. Themes* 3 (2), 127–140. <https://doi.org/10.1108/17554211111122998>.
- Whittaker, D., Knight, R.L., 1998. Understanding wildlife responses to humans. *Wildl. Soc. Bull.* 26, 312–317.
- Wiener, C., 2015. Flipper fallout: dolphins as cultural workers, and the human conflicts that ensue. In: Draheim, M.M., Madden, F., McCarthy, J.-B., Parsons, E.C.M. (Eds.), *Human-wildlife Conflict: Complexity in the Marine Environment*. Oxford University Press, pp. 137–158. <https://doi.org/10.1093/acprof:oso/9780199687145.003.0008>.
- Wilke, M., Bossley, M., Doak, W., 2005. Managing human interactions with solitary dolphins. *Aquat. Mamm.* 31 (4), 427–433. <https://doi.org/10.1578/AM.31.4.2005.427>.