SC/66a/WW/14

Low levels of compliance with national whalewatching regulations in dolphinwatching boat operators in Bocas Del Toro, Panama

A. Sitar, L.J, May-Collado, A.J. Wright, E. Peters-Burton, L. Rockwood and E.C.M. Parsons

INTERNATIONAL WHALING COMMISSION

Low levels of compliance with national whalewatching regulations in dolphinwatching boat operators in Bocas Del Toro, Panama

A. SITAR*, L.J, MAY-COLLADO[#], A.J. WRIGHT*, E. PETERS-BURTON[+], L. ROCKWOOD[Δ] AND E.C.M. PARSONS*

[*]Department of Environmental Science and Policy, [Δ]Department of Biology, [+]Educational Psychology Program George Mason University, Fairfax, Virginia, USA.

[#]University of Vermont, Department of Biology, 109 Carrigan Drive, Burlington, VT 05405, USA.

Abstract

In Bocas del Toro, Panama, unregulated dolphinwatching tourism has resulted in international concern. There are approximately 200-250 resident bottlenose dolphins (*Tursiops* spp.) in Bocas del Toro that are genetically isolated from other populations in the Caribbean. Over just three years (2012-2014), at least 10 resident dolphins have died due to boat collisions. Panama does, however, have official whalewatching guidelines. This study conducted a boat-based survey from July to August 2013, to evaluate compliance with these guidelines. Indeed, the results show that dolphinwatching boats in Bocas were frequently violating Panama's whalewatching guidelines. During 817 minutes of direct observation, boats were closer than the regulated 100 meters 71% of the time. Boat engines were only switched off or idle 31% of the time when vessels were 50m or closer. Only 55% of all dolphinwatching interactions observed were following the whalewatching guideline of 1-2 boats concurrently. Forty-five percent of the time, 3 to 15 boats were watching the dolphins. Results from this study provide evidence of a high level of noncompliance with Panama's whalewatching guidelines. Thus, these results indicate that the resident dolphin population in Bocas del Toro, Panama will be threatened if this unmanaged whalewatching tourism continues.

Introduction

There are concerns that unsustainable tourism development in Bocas del Toro, Panama, is starting to degrade the natural environment. Indications of this have become very apparent among locals, scientists, and even outside observers (Kayes 2005; Claiborne 2010). Even the leading guidebook Lonely Planet (Reid 2007) expressed these concerns stating:

> "*Unfortunately, the secret is out, and although locals have thus far welcomes the increase in tourism, bulldozers have already started clearing land for condos and*

> *resorts… It's difficult to predict the future of the islands, but one this is certain – see Bocas now, as the unspoiled beauty of the islands won't last forever*" (p. 681).

This note of alarm was expressed by Lonely Planet six years ago, and since then the sense of urgency has increased. At present, dolphinwatching trips are a major tourist activity in Bocas del Toro, with these trips being advertised in most hotels and restaurants. The sustainability of this dolphinwatching tourism is a cause for concern.

There are approximately 200-250 resident bottlenose dolphins (*Tursiops* spp.) in Bocas del Toro. These dolphins are genetically isolated from other populations in the Caribbean (May-Collado et al. 2012; IWC 2013a; Panacetacea 2013). Over a period of three years (2012-2014), at least 10 resident dolphins have died due to boat collisions (Panacetacea 2013). Panama does, however, have official whalewatching guidelines. Concern has been expressed that these whalewatching guidelines are unclear, not obeyed, and not enforced (May-Collado et al. 2014). Effectively, anyone who has a boat can take tourists out to watch the dolphins whenever and however they want. In Bocas del Toro at present, dolphinwatching is becoming an example of Hardin's "tragedy of the commons" (Hardin 1968). Concern about the impact of dolphinwatching in Bocas Del Toro on the dolphins, has attracted international attention. When the status of the dolphin population was raised at the 2012 meeting of the International Whaling Commission (IWC) (which incidentally was held in Panama), the IWC Scientific Committee stated that:

> "*The Committee **strongly recommends** that Panamanian authorities enforce the relevant whalewatching regulation (ADM/ARAP No. 01) and in particular promote adherence to requirements regarding boat number and approach speed and distances… The Committee **recommends** continued research to monitor this dolphin population and the impacts of tourism on it*" (p.80; IWC 2013b).

Legislation of whalewatching tourism

Meanwhile, in 1975, The International Whaling Commission (IWC) became concerned about the negative effects of whalewatching activities (Carlson et al. 2014). From then on

the IWC arguably became the global body for advocating and advising whalewatching impact research, education, and voluntary regulation development (Carlson et al. 2014). In 1996, the IWC Scientific Committee developed a set of whalewatching guidelines. They compiled whalewatching regulations from around the globe, to develop a set of "best practice" guidelines that could be available to any region (Carlson et al. 2014). These guidelines are now used internationally as benchmark voluntary whalewatching guidelines (International Whaling Commission 2014b):

- Operators should have a sound understanding of the behavior of the cetaceans and be aware of behavioral changes which may indicate disturbance.
- In approaching or accompanying cetaceans, maximum platform speed should be determined relative to that of the cetacean, and should not exceed it once on station.
- Use appropriate angles and distances of approach; species may react differently, and most existing guidelines preclude head-on approaches.
- Friendly whale behavior should be welcomed, but not cultivated; do not instigate direct contact with a platform.
- Avoid sudden changes in speed, direction or noise.
- Do not alter platform speed or direction to counteract avoidance behavior by cetaceans.
- Do not pursue (chase as opposed to follow), causing the whale to change its course or speed), head off, or encircle cetaceans or cause groups to separate.
- Approaches to mother/calf pairs and solitary calves and juveniles should be undertaken with special care; there may be an increased risk of disturbance to these animals, or risk of injury if vessels are approached by calves.
- Cetaceans should be able to detect a platform at all times; while quiet

operations are desirable, attempts to eliminate all noise may result in cetaceans being startled by a platform which has approached undetected; rough seas may elevate background noise to levels at which vessels are less detectable.

As noted above, Panama does have official whalewatching[1] guidelines which require that vessels:

- Do not get closer than 100m from the dolphins, unless approached by them. If approached, turn off your engine and enjoy the company! Don't turn the engine back on unless you make sure they are 100m far from you (Fig 1).
- Inside the Dolphin Bay, or when a group of dolphins is detected, travel no faster than 4 knots or 7km per hour. If you are following a group, your speed should be lower than the group's speed.
- Observation time should not exceed 30 mins.
- Do not travel perpendicular to the direction of the group. Always travel in a parallel position.
- A maximum of 2 boats should be observing dolphins at the same time and boats should be at least 200m apart from each other.
- Leave a 30 mins rest after each observation event.
- Do not feed the dolphins.
- Do not make loud noises. Music and loud sounds might disorient dolphins.
- Do not follow the dolphins when they are diving to ambush them when they re-emerge to breath.

Special considerations for groups with calves:

- Do not get closer than 250m from the dolphins, unless approached by them. If approached, turn off your engine and enjoy the company! Don't turn the engine back on unless you make sure they are 250m far from you.

[1] The term whalewatching is used throughout the rest of this paper, as the term refers to commercial activities that involve watching any wild cetacean, even though bottlenose dolphins are the primary target of the industry in Bocas Del Toro.

- Observation time should not exceed 15 mins.

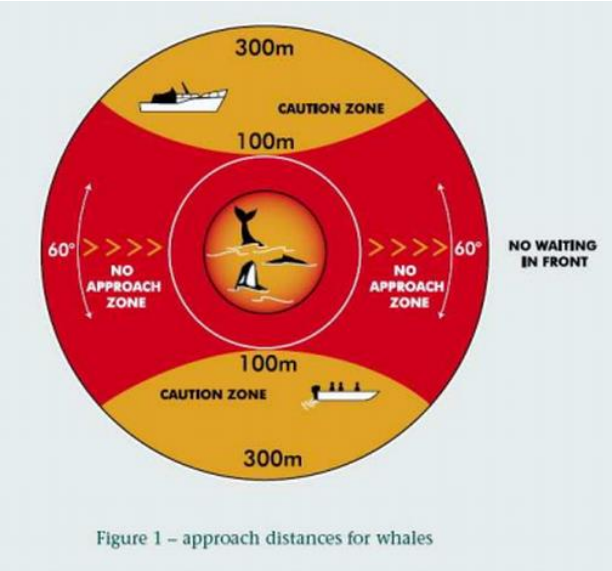

Figure 1. Approach distances for whalewatching vessels as outlined in Panamanian guidelines (República de Panamá Asamblea Nacional Legispan Legislación de la República de Panamá, 2007).

Bocas del Toros' situation is unfortunately not unique. Many countries have legally binding whalewatching regulations that are violated by whalewatching operators (Scarpaci et al. 2003; Corbelli 2006). In Victoria, Australia, where boat operators are licensed to whale-watch by the Department of Natural Resources and the Environment, one-third of all dolphinwatching boat approaches were determined to be illegal: operators were seen approaching very young calves (displaying the fetal-folds indicating a newly born animal), spending more than recommended time with animals, and approaching closer than proscribed distances (Scarpaci et al. 2003).

Elsewhere, whalewatching trip operators have frequently been reported disregarding whalewatching guidelines and, more generally, the well-being of the target species by closely following, or chasing, animals so that their passengers are able to get a closer look and take better pictures (e.g., Timmel et al. 2008). Because of inappropriate vessel activity in close proximity to cetaceans many animals have been struck by whalewatching vessels, leading to serious, or even deadly, injuries (Laist et al. 2001; van Waerebeek et

al. 2007; Panacetacea 2013). Much of this behavior is seen in Bocas Del Toro where whalewatching guidelines are not currently enforced by the Panamanian government or the local community (Clairborne 2010; May-Collado et al. 2012).

In Bocas Del Toro, boat operators tend to leave port at the same time, *en masse*, and as such, many boats frequently surround any given dolphin group. The majority of the boats head to "Dolphin Bay" which is regularly utilized by approximately 150 dolphins from the resident population (May-Collado et al. 2014). Panama's whalewatching guidelines require boat operators to stay at a distance of 100m from dolphins, with no more than two boats at a time. Community members have noted seeing dolphinwatching operators not complying with codes of conduct (Clairborne 2010). For example, it is reportedly common to see dolphins being circled and chased by more than 10 to 15 boats all day long (Clairborne 2010). Scientists have confirmed that, as activities are not officially monitored, these prohibitions seem to be violated on an almost daily basis (Barragán-Barrera et al. 2013; May-Collado et al. 2014).

During the "low" tourist season, as many as 37 boats have been observed surrounding a group of dolphins (May-Collado pers. comm. 2013). However, scientists have reported seeing more than 100 boats interacting with a group of dolphins during "high" tourism season (May-Collado et al. 2014). According to one senior boat captain, there are over 200 boat operators in Bocas del Toro, although this needs to be assessed. This number doesn't even consider the private residents who own boats. This implies that the potential maximum number of boats that could be engaged in whalewatching is substantial, and a cause for concern.

Previous research has made it evident that vessel activity can disturb bottlenose dolphins'

natural behavioral patterns (e.g. Au & Perryman 1982; Kruse 1991; Janik & Thompson 1996; DeNardo 1998; Williams 1999; Orams 2000; Nowacek et al. 2001; Buckstaff 2004; Scheidat et al. 2004; Stamation et al 2010; Papale et al. 2012; Parsons 2012). Yet, it is the continuous, chronic exposure to disturbance that is most likely to cause negative impacts at a population level. Such behavioral changes can increase energetic costs or prevent biologically important behaviors. Also chronic stress responses could be detrimental to the health of dolphin populations (Orams 2000; Orams 2004; Lusseau & Bejder 2007; Wright & Kuczaj 2007; Stockin & Lusseau 2008; Williams et al. 2006).

A common behavioral response to boat traffic is avoidance behavior (Buckstaff 2004; Parsons 2012). Other behavioral responses to boat traffic include: changing their swimming speed (Au and Perryman 1982; Kruse 1991; Nowacek et al. 200l); altering their swim direction (Au and Perryman 1982; Nowacek et al. 2001); increasing breathing synchrony (Hastie et al. 2003); decreasing inter-animal distance (Bejder *et al.* 1999; Nowacek el al. 2001); and exhibiting longer dive durations (Janik & Thompson 1996; Nowacek et al. 200l).

It is not only vessel exposure that can cause behavioral changes. Engine noise is another contributing factor to the response of the animals (Ebre 2002). The majority of acoustic energy from boats is produced at frequencies between 0.1 and 10 kHz (Buckstaff 2004). This boat noise range can “mask”, or acoustically obscure, dolphin whistles at frequencies between 4 and 20 kHz (Buckstaff 2004). This noise masking could prevent cetaceans from hearing calls from group members that are important for communication and social cohesion, (Erbe 2002; Buckstaff 2004). At higher speeds many boats can also produce noise at higher frequencies that could potentially cause masking problems for echolocation that is biosonar used for foraging and navigation (May-Collado 2007).

Orams (2004) explains the physiological response to short term threats: “a mammalian body rapidly mobilizes energy from storage sites (and inhabits further storage); heart rate, blood pressure, and breathing all increase in order to transport nutrients and oxygen to

muscles; reproduction is curtailed, sex drive decreases, pain is blunted, and perception sharpened" (p.23). All this increases energy cost and reduces the behaviors for reproduction. The fact is, if this type of reaction is continuous because of continuous exposure to threats over time like unregulated whalewatching, more serious health problems will occur (Orams 2004).

Previous research done on the bottlenose population in Bocas del Toro has shown that approximately every 1.5 minutes a boat passes the local researchers' boat, with the vast majority of these being whalewatching boats (May-Collado 2007; Taubitz 2007). The average number of whalewatching boats in Bocas del Toro (interacting with a group of dolphins at the same time) has been documented as typically ranging from 3 to 12 boats (May-Collado 2007), although as noted above, higher numbers have been reported. According to May-Collado (2007) and Taubitz (2007), boats drove "aggressively" and provoked a "negative response" 78% of the time. Dolphins showed more "travelling" behavior in the presence of dolphin-watching boats (Taubitz 2007). Taubitz (2007) found that dolphins in Bocas whistle repetition rates increased as dolphinwatching boats approached, and whistle rates decreased following boat encounters. Interestingly, dolphins in Bocas Del Toro also produced more frequency modulated whistles when dolphinwatching boats were present (May-Collado 2007), although the reason for this is unknown.

Methods

This study was conducted in the Bocas del Toro Archipelago from July to August 2013. Bocas del Toro is located at 9° 20' 0" N and 82° 15' 0" W, off the Caribbean coast of Panama, close to the border of Costa Rica (Windevoxhel & Heegde 2008) (Fig. 2).

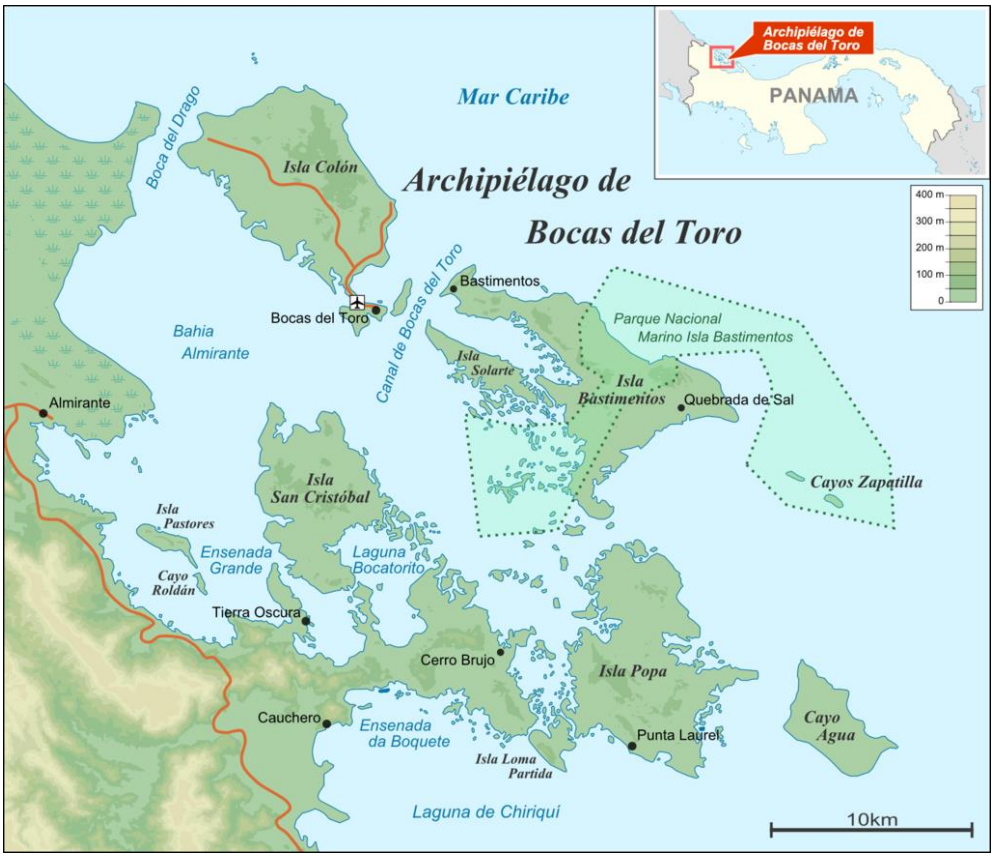

Figure 2. Bocas del Toro Archipelago (from Wikipedia 2015).

A boat-based survey was conducted to measure levels of compliance with whalewatching guidelines. Research was conducted from small boats ranging from lengths of 19 to 30 ft with a 75 hp or a 90 hp four-stroke outboard motor. If weather and accessibility permitted data was collected from 0700-1600 hrs. To minimize impact of the research vessel on the study animals, the motor was turned off when dolphins were within a radius of 100m. Surveys were conducted throughout the Archipelago (off of Isla Popa Uno, Shark Hole, Dolphin Bay (Bocatorito), Pastores, Almirante, Solarte, Loma Partida, Bocas del Drago, T. Oscura, Bahia Honda, Osa Perezoso, San Cristobal, Basimentos, Punta Caracol, Isla Peresozos). However, the majority of surveys were conducted in the location called "Dolphin Bay" by locals (which called Laguna Bocatorito on Fig. 2) due to its popularity for dolphinwatching trips (May-Collado et al. 2012).

Behavioral observations began when dolphins were sighted in the study area. At the beginning of each sighting, GPS coordinates, location name, weather and sea state were all recorded. The number of boats present and number of dolphins was recorded at the beginning of every minute throughout the entire sighting. Sightings ended when dolphins left the area or ended because of logistic reasons (which could include weather). The boats' distance to dolphins was also recorded. Every minute from the start of the encounter to the end, dolphin behaviors and boat behaviors related to compliance with the whalewatching guidelines were recorded. The vessel behaviors recorded were: the boats' approach speed; direction of approach; engine status; and type of maneuvering with respect to dolphins observed e.g., circling, following, and moving through the dolphin pod, and searching for dolphins. Additionally, if any notable events or activities were observed they were also recorded at the time of the observation. These would include any physical interaction or serious harassment conducted by whalewatching operators.

Categorizing Boats

Observed boats were categorized as whalewatching boats, canoes, sailboats, transport boats and canoes with motors. If more than one type of boat was recorded in that minute, the boat type that was assessed to have the greatest impact on dolphins (e.g., largest, loudest or closest) was the listed boat type for that minute. For instance, if a whalewatching boat (50m away from dolphins) and transport boat (100m away from dolphins) were documented together, the whalewatching boat would be the category recorded for that occurrence because it was presumed to have the greatest impact on dolphins because of its close proximity and directed activity. Any private boats were categorized by their activity, e.g. if a private boat was interacting with a dolphin group, it was categorized as whalewatching. For one incident, a sailing boat 100m or more in length was categorized as "transport" because this large vessel was transiting through the area.

Table 1. Types of vessel recorded in this study

Type of Boat Recorded	Definition
Whalewatching boats	Any boat that was participating in dolphinwatching for a company or private boat operator including sailboats
Canoe	Wooden canoe with paddles
Canoe with motor	Wooden canoe with attached motor
Transport boat	Any motorized boat (except for canoe with motor) that is traveling by
N/A	No boats present except for research boat

Method Analysis

Level of whalewatching compliancy was analyzed by evaluating 1) the distance of the boat to dolphins, 2) the number of boats with dolphins, and 3) the maneuvering behaviors of the boats. All canoes or transport boats in proximity to dolphins were removed from the compliance analysis because they were not interacting with the dolphins, and were not whalewatching.

1) Noncompliant and complaint whalewatching boats with regard to distance

Boats that were at noncompliant distances of 50m or less were categorized A=noncompliant distance and boats at compliant distances of 100m or more were categorized as B=compliant distance. Because of the difficulty of boat operators judging distances at sea, boats at distances between 50-100m were excluded - effectively boat operators were given the benefit of the doubt - and vessels categorized as definitively compliant, or noncompliant.

2) Noncompliant and compliant whalewatching boats with regard to quantity

The number of boats seen for each observation was assessed as A=noncompliant quantity for 3 or more boats seen at a given time, and B=compliant quantity for 1 or 2 boats seen at a given time.

3) Noncompliant and compliant whalewatching boats with regard to maneuvers

Boat maneuvers were evaluated according to whether they were following the Panamanian whalewatching guidelines. Maneuvers for boats at both compliant and noncompliant distances were assessed for the level of compliancy within each category. Only further analysis of the behaviors of the boats was conducted on A= noncompliant (distance of 50m or less) boats. This was done because noncompliant maneuvers are assumed to have more impact at close distances.

This study had 11 boat behaviors that were categorized as noncompliant maneuvers.

Table 2. List of whalewatching boat operators' noncompliant maneuvers in this study

Noncompliant maneuvers	
CIR	Circling dolphins
FD	Fast speed direct to dolphins
FL	Fast speed leaving
FOL	Following dolphins
HAR	Harassing dolphins
MD	Medium speed direct to dolphins
ML	Medium speed leaving
SCH	Searching for dolphins
SD	Slow speed direct to dolphins
THR	Moving through dolphin group
WTH	Within the dolphin group

Maneuvers that are categorized as compliant are ones that are required by the Panamanian whalewatching guidelines (see Table 3).

Table 3. List of whalewatching boat operators' compliant maneuvers in this study

Compliant maneuvers	
IDLE	Idle engine
OFF	Off engine
SL	Slow speed leaving
PAR	Parallel with dolphins

A final maneuvering type, "travel" was recorded but omitted from analysis because boats that were transiting were neither directly interacting with the dolphins nor were they a purely control situation.

From July to August 2013, over 13 and half hours (817 minutes) of whalewatching "occurrences" were recorded (each "occurrence" was a 1-minute recording). Noncompliant boats with respect to distance (50m or less distance from dolphins) accounted for 583-recorded minutes and 234-recorded minutes involved distance compliant boats (100m or more from dolphins).

A total of 62 dolphin survey sightings were recorded. Fifteen sightings were control sightings (no boat traffic) (#6, #10, #11, #13, #14, #18, #19, #28, #29, #32, #34, #43, #45, #55, #56). Twenty-six of the sightings had transiting boats or canoes in proximity to dolphins (#5, #7, #8, #9, #12, #16, #17, #22, #23, #24, #27, #30, #33, #35, #40 #44, #46, #47, #48, #49, #50, #51, 53, #54, #57, #58). Twenty-one sightings occurred where there were whalewatching boat interactions (Sightings #3, #4, #15, #20, #21, #25, #26, #31, #36, #37, #38, #39, #41, #42, #52, #59, #60, #61, #62, #63, #64).

The Chi-square tests of independence were conducted with a subsample of 5 minutes via the statistics program, R (64-bit version 3.1.2.: R Core Team, 2014) to examine this study's hypothesis "dolphinwatching boat operators in Bocas del Toro are not following

best whalewatching practices?" Where possible, subsampling of 5 minutes was used to offset autocorrelation and pseudoreplication).

Results

The Chi-square results showed a significant difference in observations of noncompliant and compliant boat distance from dolphin groups (X^2= 149.0832, df = 1, p-value < 2.2e-16, N=817). Figure 3 illustrates that 71% of the time boats were noncompliant (50m or less from the dolphin groups and only 29% of the time boats were complying with whalewatching regulations.

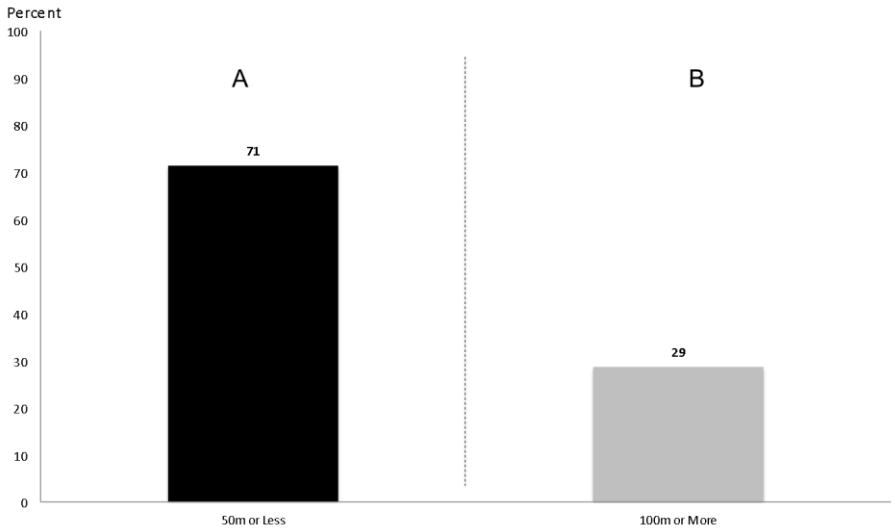

Figure 3. Proportion of boat operators not following whalewatching regulation and following whalewatching regulations. A majority of 71% of boats were A="noncompliant distance" vs. 29% of boats B="Compliant distance".

Evaluated more closely, both distance noncompliant (50m or less from dolphins) and Distance compliant (100m or more from dolphins) boats were not following proper whalewatching maneuver techniques. Figure 4 demonstrates that improper maneuvers were seen more frequent than proper whalewatching maneuvers. Noncompliant boats (in terms of distance) were observed maneuvering in violation of regulations 66% of the time (Fig. 4). Similarly, even the boats at whalewatching compliant distances were observed

maneuvering in violation of the regulations 58% of the time (Fig. 4). Only 34% of the time boats 50m or less were using proper maneuvers that might reduce harm to cetaceans (e.g. switching off engines).

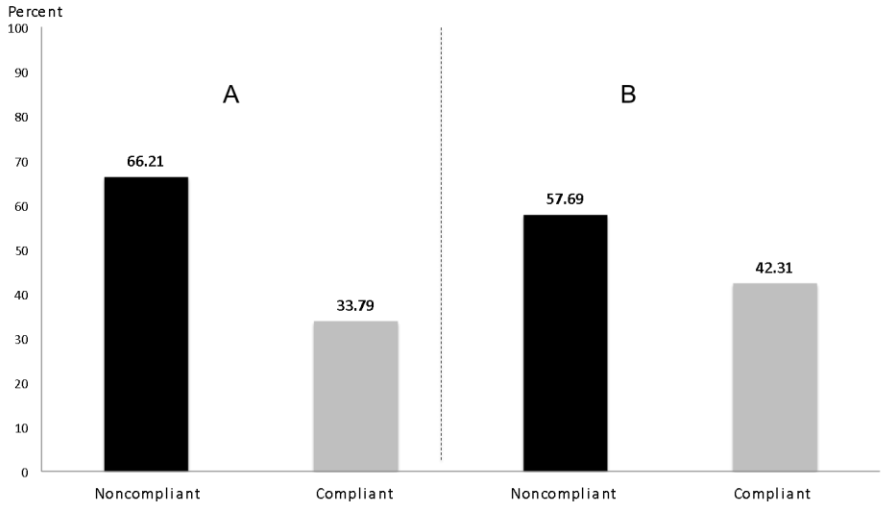

Figure 4. Proportion of noncompliant and compliant boat maneuvering for both boats at A=noncompliant boat distance and B=compliant distance. Within 817 occurrences 66% percent of A=noncompliant boat distance were improperly maneuvering, and only 34% the boats were properly maneuvering. Boats within the B=compliant distance were in violation 58% of the time, while 42% of the time the boats were proper maneuvering.

Further analysis on the maneuvers of noncompliant boats with respect to approach distance (50m or less from dolphins) showed that of 583 observed maneuvers, 197 events (34%) involved compliant maneuvering, versus 386 events (66%) that included noncompliant (aka improper) maneuvering, regardless of the approach distance itself being noncompliant (Fig. 5). Most of the violating maneuvers were “slow speed, direct approaches towards dolphins” (SD; 106 occurrences, 18% of all maneuvers, 27% of noncompliant maneuvers only), “following dolphins” (FD; 81 occurrences, 14% of all maneuvers, 21% of noncompliant maneuvers only), “searching for dolphins” (SCH; 64 occurrences, 11% of all maneuvers, 17% of noncompliant maneuvering only), and “harassing dolphins” (HAR; 49 occurrences, 8% of all maneuvers, 13% of noncompliant maneuvers only). "Idle" was the most frequent compliant maneuver observed (139 occurrences, 24% of all maneuvers, 71% of compliant maneuvering only), with other

compliant maneuvers being switching off engines when encountering dolphins (OFF; 41 occurrences, 7% of all maneuvers, 21% of proper maneuvers only), approaching parallel to dolphins (PAR; 11 occurrences, 2% of all maneuvers, 6% of compliant maneuvers only), and slowly leaving dolphin (SL; 6 occurrences, 1% of all maneuvers, 3% of compliant maneuvers only).

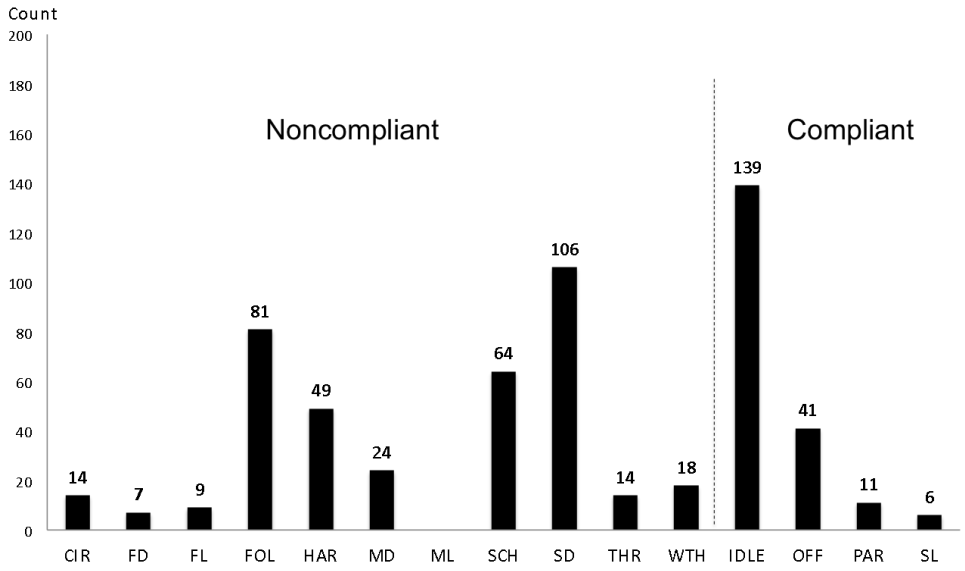

Figure 5. Total count of whalewatching boat maneuvers in 583 observations 50 meters or less from dolphins. *Maneuvers are listed from left to right: CIR=Circling, FD=Fast speed direct, FL=Fast speed leaving, FOL=Following dolphins, HAR=Harassing dolphins, MD=Medium speed direct, ML=Medium speed leaving, SCH=Searching for dolphins, THR=Driving through pod, WTH=With dolphins, IDLE=Idle engine, OFF=Engine Off, PAR=Driving parallel, SL=Slowly leaving

Over 817 sightings, 45% of the time (446 sightings) boats were in compliance with whalewatching regulations that only 1 or 2 boats should be around dolphins at one time. However, there were 371 occurrences (45% of the time) that whalewatching regulations were being violated with 3 or more boats present around dolphins simultaneously (Fig. 6a). The modes number of boats was 5 (64 total occurrences) to 6 (63 total occurrences) boats (Fig. 6b). There were 3 occurrences when 15 boats were present around dolphins (Fig. 6b).

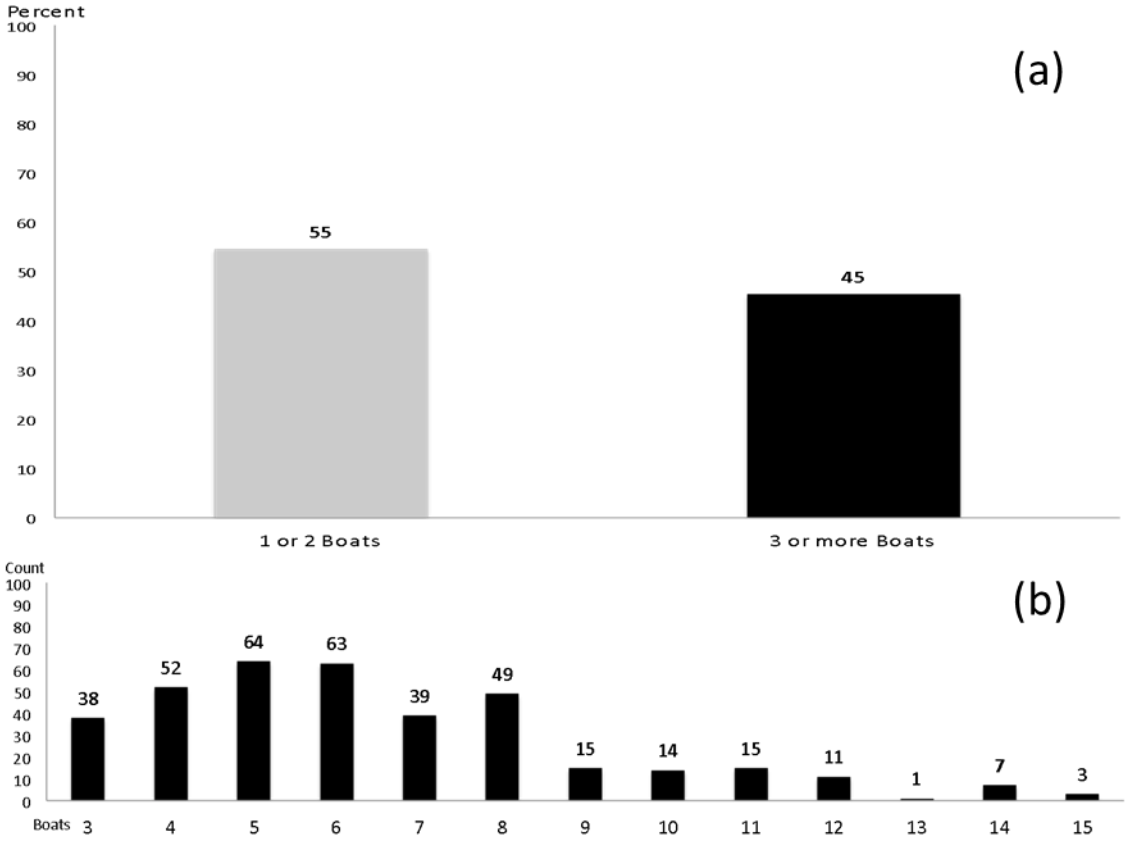

Figure 6. B=Compliant (gray) and A=noncompliant (black) whalewatching boat numbers within 50m of dolphins: (a) A comparison of the proportion of occurrences in the two categories (n=817); (b) Total number of occurrences of noncompliant whalewatching boat numbers (n=583).

Discussion

This study was conducted a year after the International Whaling Commission gave recommendation to the Panamanian Government to ensure whalewatching guideline enforcement in Bocas Del Toro in 2012. These results demonstrate that noncompliance levels were still high and that the IWC recommendations had not been heeded.

According to Kessler & Harcourt (2013), in Sydney, Australia, breaching whalewatching regulations may be a combination of misjudging distance between the cetacean and boat,

and complete disregard for the implemented whalewatching regulations. Panama's whalewatching regulations require boat operators to maintain a distance of 100m from cetaceans and a distance of 200m from other whalewatching vessels. This study illustrates that boat operators is Bocas del Toro are not following these whalewatching guidelines. Seventy-one percent of the time boat operators were 50m or less. However, in the case of Bocas del Toro, boat operators may not be breaching these guidelines because of misjudgment or disregard for the regulations. Instead boat operators in Bocas may simply have little to no knowledge of Panama's whalewatching guidelines (Sitar et al. in prep).

Results also indicate that boat operators in Bocas were not complying with whalewatching guidelines with respect to the number of boats with dolphins at any given time (Fig. 6a). Forty-five percent of the time there were 3 or more boats with dolphins, with up to 15, but most frequently 5 or 6, vessels seen with dolphins (Fig. 6b). Kessler and Harcourt (2013) and Christiansen et al. (2010) both recorded similar findings. Kessler and Harcourt (2013) recorded 2 to 12 boats with cetaceans at a given time, while Christian et al. (2010) noted 1 to 13 boats with a single dolphin group. The high number of whalewatching boats with a single groups of dolphins makes it quite likely that whalewatching in Bocas del Toro is having an impact on the local dolphins. It should be noted that this study was conducted during low tourism season in Bocas del Toro, and past studies in Bocas conducted by May-Collado et al. (2012, 2014) recorded up to 37 boats with any given group of dolphins.

Williams et al. (2002a) explain that an invasive boat approach, such as "leapfrogging" (driving parallel with cetaceans at a faster speed than the cetacean, then turning 90° in the cetacean's predicted path) induces disturbance (Williams et al. 2002a). However, invasive approaches were not the only approach that affected behavioral response. Williams et al. (2002b) demonstrated that even vessels following whalewatching

guidelines (including boat maneuvers such as slow and parallel approach) could affect cetacean movement patterns.

Like leapfrogging, many invasive behaviors were observed in this study. When boat behavior was considered for compliance, the proportion of inappropriate maneuvering was higher for close (<50m) than for more distant (>100m) approaches, although rates of noncompliant maneuvering were relatively high for both distances. The high rate of noncompliant maneuvering very close to animals (i.e. operators are being 'doubly noncompliant') could exacerbate disturbance and pose greater risk, making this a particular concern (Fig. 4). When noncompliant boat maneuvers for illegally close boats (50m or less) were examined more closely (Fig. 3.5) 91 of the occurrences (14% of maneuvers 50m or less, n=583) were boats following dolphins, 106 of the occurrences were boats moving slowly and directly towards dolphins, 49 of the occurrences were harassing incidents (8% of maneuvers 50m or less, n=583), and 64 of the occurrences were boats searching (11% of maneuvers 50m or less, n=583) around for dolphins. It is important to note that 14 events (2% of maneuvers 50m or less, n=583) of circling around dolphins were documented, 14 events (2% of maneuvers 50m or less, n=583) had boats driving through the dolphin pod, and 18 events (3% of maneuvers 50m or less, n=583) had boats within the dolphin group.

Williams et al (2002a,b) notes that leapfrogging can cause noise disturbance. Similarly, many of the noncompliant maneuvers in Fig. 3.5 required sharp changes in speed and direction. Boat speed and movement affect the intensity of noise frequency (Richardson et al. 1995). “Propeller cavitation produces much of the broadband noise from ships and boats, and propeller singing can produce strong tones at the propeller blade rate and some of its harmonics” (Richardson et al. 1995, p. 430), Therefore the invasive maneuvering recorded in this study can potentially interfere with the dolphins’ communication and impair the dolphins’ hearing (temporary or permanent deafness or “threshold shifts”) (Richardson et al. 1995; Erbe 2002). Thus, these maneuvers could potentially influence

Bocas dolphin's behavior, and could potentially worsen their chances of collision with whalewatching boats.

It is possible that Bocas boat operators think a close encounter with dolphins creates a better experience for their tourists, which might be why operators are constantly ready to be in close proximity with dolphin, and often chase and/or follow the cetaceans. However, the need to get close to the cetaceans in order to generate customer satisfaction is a misconception (Orams 2000). A survey conducted in Queensland, Australia by Orams (2000) revealed that the distance between boat and cetacean had no actual effect on consumer satisfaction. In fact, tourists were generally still satisfied with their whalewatching experience even when cetaceans were not seen (Orams 2000). Constantine (2001) found that intrusive boat maneuvers resulted in more avoidance behavior and less dolphin-human interaction. Conversely more interaction was seen when boat maneuvering was less intrusive. Constantine (2001) also found that human-dolphin interactions were more likely when dolphins had a "choice". Therefore the intrusive boat behavior in Bocas Del Toro could actually be reducing the ability of tourists to view cetaceans and thus impeding customer satisfaction.

A bottlenose dolphin-focused study conducted in Sarasota, Florida, found that boat collisions with dolphins were associated with higher than normal boating activity (Wells & Scott 1997). More collisions were recorded on holiday weekends when more boats were on the water (Wells & Scott 1997). In Sarasota, bottlenose dolphins in sheltered areas (shallow waters) are actually at greater risk of collision due to higher recreational boat density (Wells & Scott 1997). Much like Sarasota, Dolphin Bay in Bocas del Toro (the area where most of the dolphinwatching is being conducted) is a shallow area (approximately 20 m deep), with narrow mangrove channels (May-Collado & Wartzok 2008). Shallow waters are commonly used as shelter for calf rearing and feeding (Norwacek 2001). Norwacek (2001) suggested that dolphins may have once used these shallow areas as a safe haven from boat traffic. However, now that watercraft vehicles are

more able to access such shallow water areas, they are no longer safe areas for dolphin nurseries, or sheltered areas for feeding (Nowacek 2001). The calves and mothers are particularly at risk as calves are slow moving and mothers will typically remain very close (Wells & Scott 1997). Our results indicated that this might be happening in Bocas del Toro i.e., that the resident dolphins' "safe haven" is no longer a sheltered place for nursing or feeding.

This brings us to another major concern regarding the health of the dolphin population in Bocas del Toro, i.e., that they may be experiencing repeated and/or chronic stress responses from continuous exposure to unmanaged dolphinwatching with the associated potential for increased energetic costs due to physiological responses (Beale 2007; Wright et al. 2007). If dolphins are displaced from the region because of these disturbances, there could be lost opportunities for foraging or mating, or they may relocate to a less desirable habitat (Wright et al. 2007). Monitoring the long-term distribution, reproductive success and health of individual dolphins would be important future research in the area to detect if such impacts do, in fact, occur.

The findings from this study provide evidence to support previous comments by scientists on unsustainable whalewatching activity in Bocas del Toro (e.g. May-Collado et. al 2014). Boats are not following whalewatching regulations with regards to number of boats. Operators are also driving too aggressively and too closely to dolphins, which increase the chances of dolphin injury and fatalities, in addition to increasing disturbance.

Recommendations

Other studies have ascertained that tourists in the Caribbean often prefer whalewatching trips that have sustainable practices (Draheim et al. 2010; Luksenburg & Parsons 2014), and thus it would be in the operators' benefit to adhere to whalewatching guidelines and best practices. As noted above, the Panamanian Government clearly has ignored the IWC recommendation to monitor and enforce their whalewatching guidelines. Encouraging the

local community to play a greater role in monitoring and enforcing (i.e. peer-to-peer) whalewatching guidelines may therefore be a better approach. This is to say, "bottom up" management of whalewatching guidelines, instead of relying on a "top down" approach. This would require a greater level of outreach and engagement with the local community and it would require local scientists to work with community leaders to provide feedback on the effectiveness of this approach. The local community in Bocas Del Toro appears to be highly interested in marine conservation, especially dolphin protection (Sitar et al. in prep.), and thus such a bottom up approach is probably feasible.

Acknowledgements

We wish to thank The Pacific Whale Foundation, Humane Society International, Cetacean society International and the Department of Environmental Science & Policy, George Mason University for sponsoring this research and the staff of Panacetacea.

References

Au, D., & Perryman, W. (1982). Movement and speed of dolphin schools responding to an approaching ship. *Fishery Bulletin*, 80, 371-379.

Barragán-Barrera, D.C., May-Collado, L.J., Quiñones-Lebrón, S.G., & Caballero, S. (2013). Population at risk: low genetic diversity in bottlenose dolphins of Bocas del Toro, Panama. Paper presented to the Scientific Committee at the 65th Meeting of the International Whaling Commission, 3-15 June 2013, Jeju, South Korea. SC/65a/SM15. 11pp.

Beale, C.M. (2007). The behavioral ecology of disturbance responses. *International Journal of Comparative Psychology,* 20(2-3), 89-316.

Buckstaff, K.C. (2004). Effects of watercraft noise on the acoustic behavior of bottlenose dolphins, *Tursiops truncatus*, in Sarasota Bay, Florida. *Marine Mammal Science,* 20 (4), 709–725.

Carlson, C., Rose, N., Kato, H., & Williams, R. (2014). The International Whaling Commission (IWC) and whale-watching. In *Whale-watching: Sustainable Tourism and Ecological Management* (eds. J.Higham, L. Bejder & R.Williams), pp. 71- 77. Cambridge University Press, Cambridge, UK.

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. *Endangered Species Research*, 11(1), 91-99.

Claiborne, P. (2010). *Community Participation in Tourism Development and the Value of Social Capital: The case of Bastimentos, Bocas del Toro, Panamá* . Master Thesis. University of Gothenburg, Sweden.
Retrieved from: *https://gupea.ub.gu.se/bitstream/.../gupea_2077_22603_1.pdf*

Constantine, R. (2001). Increased avoidance of swimmers by wild bottlenose dolphins (*Tursiops truncatus*) due to long- term exposure to swim-with-dolphin tourism. *Marine Mammal Science*, 17, 689-702.

Corbelli, C. (2006). *An evaluation of the impact of commercial whale watching on humpback whales,* Megaptera novaengliae*, in Newfoundland and Labrador, and of the effectiveness of a voluntary code of conduct as a management strategy*. PhD Thesis, Department of Biology, Memorial University of Newfoundland.

DeNardo, C. (1998). *Investigating the role of spatial structure in killer whale* (Orcinus orca) *behaviour*. Masters Thesis. Zoology Department, University of Aberdeen, Aberdeen. 81 pp.

Draheim, M., Bonnelley, L. Bloom, T. Rose, N. & Parsons, E.C.M. (2010). Tourist attitudes towards marine mammal tourism: An example from the Dominican Republic. *Tourism in Marine Environments*, 6(4), 175-183.

Erbe, C. (2002). Underwater noise of whale-watching boats and potential effects on killer whales (*Orcinus orca*), based on an acoustic impact model. *Marine Mammal Science*, 18, 394-418.

Hardin, G. (1968). The tragedy of the commons. *Science* 162(3859), 1243-1248.

International Whaling Commission (2013). Report of the sub-committee on whalewatching. *Journal of Cetacean Research and Management*, 14(Suppl.), 1-86

International Whaling Commission (2014). General principles for whalewatching. www.iwc.int/wwguidelines Accessed 8 April 2015.

Kayes, R, (2005). *Coral Reef Tourism and Conservation in Bocas del Toro: An Analysis of Ecotourism and its Tour Guide-Based Components.* Independent Study Project (ISP) Collection. Paper 433.

Janik,V.M., & Thompson, P. M. (1996). Changes in surfacing patterns of bottlenose dolphins in response to boat traffic. *Marine Mammal Science,* 12, 597-602.

Kessler, M., & Harcourt, R. (2013).Whale watching regulation compliance trends and the implications for management off Sydney, Australia. *Marine Policy*, 42, 14-19.

Kruse, S. (1991). The interactions between killer whales and boats in Johnstone Strait, B.C. In *Dolphin Societies: Discoveries and Puzzles*, (eds. K. Pryor & K. S. Norris), pp. 149-159. University of California Press, Berkeley.

Luksenburg, J.A., & Parsons, E.C.M. (2014). Attitudes towards marine mammal conservation issues before the introduction of whale-watching: a case study in Aruba (southern Caribbean). *Aquatic Conservation,* 24, 135-146.

Lusseau, D., & Bejder, L. (2007). The long-term consequences of short-term responses to disturbance experiences from whalewatching impact assessment. *International Journal of Comparative Psychology*, 20(2), 228-236.

May-Collado, L.J. & Wartzok, D. (2008). A comparison of bottlenose dolphin whistles in the Atlantic Ocean: insights on factors promoting whistle variation. *Journal of Mammalogy*, 89, 1229-1240.

May-Collado, L. J, Agnarsson I., Palacios D., E. Taubitz, & D. Wartzok. (2007). The status of the bottlenose dolphin (*Tursiops truncatus*) population of Bocas del Toro, Panama: preliminary results based on a three year ongoing study. Fundacion Keto Internal Report IR-LJMC-KETO01- BOCAS.

May-Collado, L.J., Barragán-Barrera, D.C., Quiñones-Lebrón, S. G., & Aquino-Reynos W. (2012). Dolphin watching boats impact on habitat use and communication of bottlenose dolphins in Bocas del Toro, Panama during 2004, 2006-2010. Paper presented to the Scientific Committee at the 64th Meeting of the International Whaling Commission, 11-23 June 2012, Panama City, Panama. SC/64/WW2.

May-Collado, L.J., Quiñones-Lebrón, S.G., Barragán-Barrera, D. C., Palacios, J.D. & Gamboa-Poveda, M. (2014). The dolphin watching industry of Bocas del Toro continues impacting the resident bottlenose dolphin population. Paper presented to the Scientific Committee at the 65th Meeting of the International Whaling Commission, 12-24 May 2014, Bled, Slovenia. SC/65b/WW06.

Nowacek, S. M., Wells, R. S., & Solow, A. R. (2001). Short-term effects of boat traffic on bottlenose dolphins, *Tursiops truncatus*, in Sarasota Bay, Florida. *Marine Mammal Science,* 17(4), 673-688.

Orams, M. B. (2000). Tourists getting close to whales, is it what whale-watching is all about? *Tourism Management*, 21, 561-569.

Orams, M. (2004). Why dolphins may get ulcers: considering the impacts of cetacean-based tourism in New Zealand. *Tourism in Marine Environments*, 1(1), 17-28.

Panacetacea (2013). Bocas dolphin mortality increase to 12 animals between 2012-2013. Newsletter Issue #2 (September, 2013). http://panacetacea.org Accessed September, 2013

Papale, E., Azzolin, M., & Giacoma, C. (2011). Vessel traffic affects bottlenose dolphins (*Tursiops truncatus*) behaviour in waters surrounding Lampedus Island, south Italy. *Journal of the Marine Biological Association of the United Kindom*, 92, 1877-1885.

Parsons, E.C.M. (2012). The negative impacts of whale-watching. *Journal of Marine Biology*, 2012(807294), 1-9. (doi:10.1155/2012/807294)

Reid, R., Attwooll, J., Firestone, D. M., & McCarthy, C. (2007). Central America on a Shoestring: big trips small budgets (6th edition). London: UK. Lonely Planet.

República de Panamá Asamblea Nacional Legispan Legislación de la República de Panamá (2007). *Resolution ADM/ARAP NO. 01 of the Legislation of Panamá*. Retrieved from
http://www.panacetacea.org/uploads/6/6/8/1/6681148/resolucion_no.1_protocolo_de_avistamiento_de_cetaceos.pdf

Richardson, W. J., Greene, C. R., Malme, C. I. & Thomson, D. H. (1995). *Marine Mammals and Noise*. Academic Press, San Diego, California

Scarpaci, C., Dayanthi, N., & Corkeron, P.J. (2003). Compliance with regulation by 'swim-with-dolphins' operations in Port Phillip Bay, Victoria, Australia. *Environmental Management*, 31, 342-347.

Scheidat, M., Castro, C., Gonzalez, J., & Williams, R. (2004). Behavioural responses of humpback whales (*Megaptera novaeangliae*) to whalewatching boats near Isla de la Plata, Machalilla National Park, Ecuador. *Journal of Cetacean Research and Management*, 6, 63–68.

Stamation, K. A., Croft, D. B., Shaughnessy, P. D., Waples, K. A., & Briggs, S. V. (2010). Behavioral responses of humpback whales (*Megaptera novaeangliae*) to whale-watching vessels on the southeastern coast of Australia. *Marine Mammal Science*, 26(1), 98-122.

Stockin, K. A., Lusseau, D., Binedell, V., Wiseman, N., & Orams, M. B. (2008). Tourism affects the behavioural budget of the common dolphin Delphinus sp. in the Hauraki Gulf, New Zealand. *Marine Ecology Progress Series*, 355, 287.

Taubitz, E. (2007). *Potential effect of whale-watching engine noise on the vocal behavior of bottlenose dolphins* (Tursiops truncatus) *in Bocas del Toro, Panama and Manzanillo, Costa Rica. Diploma Thesis.* University of Rostock, Germany. 68pp.

Timmel, G., Courbis, S., Sargeant-Green, H. & Markowitz, H. (2008). Effects of human traffic on the movement patterns of Hawaiian spinner dolphins (*Stenella longirostris*) in Kealakekua Bay, Hawaii. *Aquatic Mammals*, 34, (4), 402-411.

Van Waerebeek, K., Baker, A. N., Félix F., Gedamke, J., Iñiguez, M., Sanino, G. P., Secchi, E., Sutaria, D., van Helden, A., & Wang, Y. (2007). Vessel collisions with small cetaceans worldwide and with large whales in the Southern Hemisphere, an initial assessment. *Latin American Journal of Aquatic Mammals*, 6, 43-69.

Wells, R.S., & Scott, M.D. (1997). Seasonal incidence of boat strikes on bottlenose dolphins near Sarasota, Florida. *Marine Mammal Science*, 13(3), 475-480.

WDCS (2003). *Friendly Dolphin Causes a Stir off Dorset Coast: but WDCS Calls for Responsible Behaviour by Members of the Public*. <http://www.wdcs.org/dan/news.nsf/webnews/39E6D2433E5D76D080256B98005D3777> (accessed October 3)

Williams, R. M. (1999). *Behavioural Responses of Killer Whales to Whale-watching: Opportunistic Observations and Experimental Approaches.* Masters Thesis. University of British Columbia, Canada.

Williams, R., Bain, D. E., Ford, K.K.B., & Trites, A. W. (2002a). Behavioural responses of male killer whales to a 'leapfroging' vessel. *Journal of Cetacean Research and Management*, 4, 305-310.

Williams, R., Trites, A. W., & Bain, D. E. (2002b). Behavioural responses of killer whales (*Orcinus orca*) to whale-watching boats: opportunistic observations and experimental approaches. *Journal Zoological Society of London*, 256, 255-270.

Williams, R., Lusseau, D., & Hammond, P. S. (2006). Estimating relative energetic costs of human disturbance to killer whales (*Orcinus orca*). *Biological Conservation*, 133(3), 301-311.

Windevoxhel, N., & Heegde, M. (2008). Bocas del Toro archipelago, Panama: the ecosystem approach and rapid social change. In *The Ecosystem Approach: Learning from Experience* (ed. Gill Shepard). Gland, Switzerland: IUCN x + 190pp.

Wright, A.J., Aguilar Soto, N., Baldwin, A.L., Bateson, M., Beale, C., Clark, C., Deak, T., Edwards, E.F., Fernández, A., Godinho, A., Hatch, L., Kakuschke, A., Lusseau, D., Martineau, D., Romero, L.M., Weilgart, L., Wintle, B., Notarbartolo di Sciara, G., & Martin, V. (2007). Do marine mammals experience stress related to anthropogenic noise? *International Journal of Comparative Psychology*, 20 (2– 3), 274–316.

Wright, A. J & Kuczaj, S.A. (2007). Noise-related stress and marine mammals: an introduction. *International Journal of Comparative Psychology*, 20, III-VIII.