

Exposure of humpback whales to unregulated whalewatching activities in their main reproductive area in New Caledonia

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ABSTRACT

Whale- and dolphin-watching activities are demonstrating a strong growth worldwide, raising concern of their potential impacts on cetacean populations and emphasising the need for management. Humpback whales recently have become the focus of an important tourism industry in the South Pacific, particularly in New Caledonia, where operators focus on a small population of humpback whales on their main breeding ground. Despite considerable growth since it began in 1995, the industry remains unregulated. Between 2005 and 2007, a study was conducted to assess the impact of whalewatching activities on the behaviour of humpback whales in New Caledonia. All data were collected from a land-based research station using a theodolite. Results show that 54% of all humpback whale groups sighted were exposed to whalewatching boats. Each group was watched simultaneously by an average of 2.5 boats. More than three boats were present within 300m of a group of whales 30% of the time. The length of time a group of whales was observed in the presence of boats each day was an average of one hour and 52 minutes but exceeded two hours 37% of the time. On average, each boat spent 52 minutes with the same group of whales. The closest point of approach was less than 100m for 86% of groups with a calf and 55% of non-calf groups. These results indicate that humpback whales are exposed to whalewatching boats in New Caledonia at a level exceeding the limits commonly recommended by management measures worldwide. Such exposure could be particularly problematic for mother-calf pairs, more vulnerable to threats. The strong site fidelity of individuals on this breeding ground raises concern of potential cumulative impacts. Management measures should be implemented to regulate whalewatching activities and ensure the conservation of this small, endangered population of humpback whales.

KEYWORDS: WHALEWATCHING; HUMPBACK WHALE; MANAGEMENT; CONSERVATION; PACIFIC OCEAN; SOUTHERN HEMISPHERE

INTRODUCTION

Whale- and dolphin-watching activities (hereafter referred to as whalewatching) have been expanding around the world, involving 119 countries and approximately 13 million participants each year (O'Connor *et al.*, 2009). This activity contributes substantially to the local economies of many countries, states and territories (Hoyt, 2001; O'Connor *et al.*, 2009) and plays an important role in increasing public awareness of the need for conservation of cetacean populations (IFAW *et al.*, 1997).

The increasing growth in whalewatching activities has led to concerns within the scientific community as to whether the presence of numerous boats and their operation around the animals may have an effect on their behaviour and survival. Several studies have shown that whalewatching activities can induce short-term behavioural changes in many of the species exposed (e.g. Baker and Herman, 1989; Corkeron, 1995; Scheidat *et al.*, 2004; Sousa-Lima *et al.*, 2002; Stockin *et al.*, 2008; Williams *et al.*, 2002) and therefore may represent a threat to some populations (e.g. Bejder *et al.*, 2006). Many countries have regulated approaches to whales and dolphins (Carlson, 2004) as managing the development of whalewatching and minimising the risk of adverse impacts is essential to ensure the conservation of cetacean species (IWC, 2000).

In the South Pacific Islands region, the whalewatching industry has demonstrated a remarkable growth of 45% per annum since 1998 (Economists at Large, 2008). Humpback whales (*Megaptera novaeangliae*), migrating every winter

from Antarctica to their tropical breeding grounds, attract thousands of tourists and represent an important part of this development (Economists at Large, 2008; Orams, 1999; Schaffar and Garrigue, 2007). New Caledonia is one of the South Pacific Islands where humpback whales can be observed during the austral winter. Commercial humpback whalewatching activities focus on the southern lagoon of New Caledonia, an area identified as the main breeding ground for this population (Garrigue *et al.*, 2001). Since its start in 1995, whalewatching has grown at an average annual rate of 40% and is now a well-established industry with 26 commercial tour boats (Schaffar *et al.*, 2009a). Despite this considerable growth, whalewatching activities have yet to be regulated in New Caledonia.

Humpback whales wintering in New Caledonian waters could be particularly vulnerable to this unregulated tourism industry. The species has not yet recovered from decades of whaling operations in the Southern Ocean (Clapham *et al.*, 2009) and the New Caledonian humpback whale population remains one of the smallest in the South Pacific Islands region with only 472 individuals (South Pacific Whale Research Consortium, 2006). Moreover, strong site fidelity (Garrigue *et al.*, 2002) combined with demographic and reproductive isolation (Garrigue *et al.*, 2004), suggests a risk of cumulative exposure over the years (Schaffar and Garrigue, 2006).

Given the development of whalewatching in New Caledonia and the characteristics of the humpback whale population, this activity may have reached its maximum carrying capacity. A study was therefore initiated in 2005 in

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order to assess the potential effects of recreational and commercial whalewatching boats on the behaviour of humpback whales, recommend management measures for the conservation of this population and determine carrying capacity. In this paper information is provided on the level of exposure of humpback whales to whalewatching activities in the southern lagoon of New Caledonia based on numbers of boats viewing whales, length of encounters and minimum distance of approach.

METHODS

Study site and period of research

All observations were made from Cap Ndoua, a lookout point located 189m above sea level and overlooking the area where the majority of interactions between boats and whales occur within the southern lagoon (Fig. 1). Observations were restricted to days with no rain and a wind speed less than 15 knots.

Observations were conducted in 2005, 2006 and 2007 by a team of three researchers from early morning (around 7am) to mid-afternoon (around 3pm) during the main period of presence of humpback whales in the southern lagoon (mid-July to mid-September).

Data collection

A Sokkia Set 5 theodolite was used to monitor the movement and behaviour of humpback whales in the absence and presence of boats. The theodolite was connected to a laptop computer running the tracking program Cyclopes (Kniest and Paton, 2001) and used to transform the vertical and horizontal coordinates from the theodolite readings into GPS points and to record other behavioural and fix data.

To test the maximum distance at which whales' movement and behaviour could be tracked reliably, data collected

simultaneously from the land-based station and during boat-based surveys on the same group of whales were compared. On clear days and with a wind speed less than five knots, groups could be tracked reliably up to eight nautical miles from the lookout point. Therefore, the maximum distance at which humpback whales were tracked was set at eight nautical miles (Fig. 1) but varied with weather conditions and wind speed.

Due to the small numbers of humpback whales within the New Caledonian population (estimated at 472, CV=0.18; South Pacific Whale Research Consortium, 2006) the sighting rate within the study area remains relatively low with an average of only 1.8 groups per day. These characteristics reduce the likelihood of re-sampling the same group multiple times per day (pseudo-replication) and the choice of which group to track. When more than one group was within sight of the land-based station, the group closest to shore was tracked to increase the probability of tracking the same group with boats afterwards.

Each group of whales was tracked for a minimum of 20 minutes with at least five surfacing bouts. The whales' position was fixed with the theodolite once every minute and was taken on the first whale to surface after that time elapsed. A group of whales was defined as one or more whales within 100m of each other, generally moving in the same direction in a coordinated manner (Mobley and Herman, 1985; Whitehead, 1983). Group type was recorded at the start of each tracking session and four categories were used: singleton, pair, groups of three adults or more, and mother-calf (i.e. alone or with other adult whales). A calf was defined as an animal in close proximity to another whale, visually estimated to be less than 30% of the length of the accompanying animal. All surface behaviours, such as blows, breaches, and tail slaps, were continuously recorded. Between each recording of the whales' position, the position

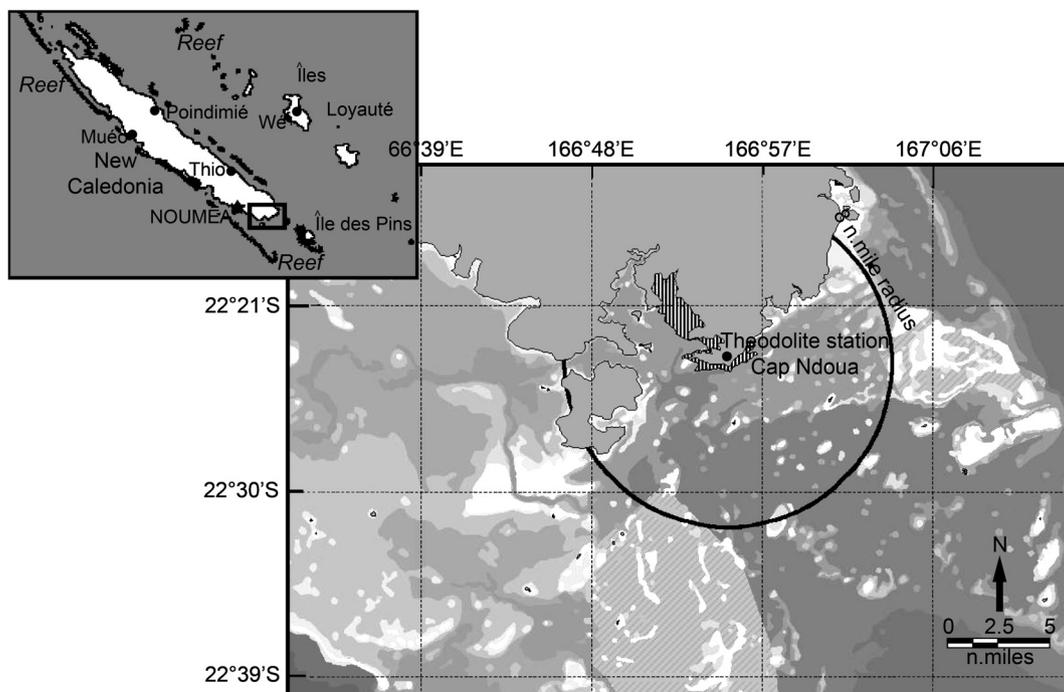


Fig. 1. Observation site and study area within a 8 n.mile radius from Cap Ndoua. The striped area represents the blind area from the shore station.

of all whalewatching boats within a 1,000m radius of the whales was also recorded. Each whalewatching boat was individually identified and recorded as either commercial or recreational. Another track was started when conditions changed, i.e. if boats arrived within 1,000m of whales that had been observed without boats up to that point, if all boats left the whales or if group composition changed (i.e. affiliation or disaffiliation of individuals).

After a track was completed, the number and identities of all boats with the group of whales was recorded every 15 minutes, while searching or tracking other groups. This information was compiled with the data obtained from tracking sessions of whales in the presence of boats in order to assess as accurately as possible the level of exposure of humpback whales to whalewatching boats. Data on the length of whalewatch encounters were also collected for some groups that could not be tracked with the theodolite.

Data analysis

The level of exposure of humpback whales to whalewatching boats was assessed using the following variables: number of boats viewing whales; length of encounters; and minimum distance of approach. These variables were calculated using all data collected on boats within 300m of a group of whales as this is the most common distance used worldwide to define the whalewatch zone (Carlson, 2004; IFAW, 2008).

The length of encounters corresponds to the time spent by each boat with the same group of whales. The cumulative time during which a group of whales was observed per day was also calculated and refers to the total amount of time a group was watched by boats. Both theodolite data and information gathered outside tracking sessions were used to assess these variables.

Only theodolite data were used to determine the distance of approach of whales by boats and the number of boats with whales. For each whale position recorded, the distance of each boat to a group was first calculated, from which the minimum distance of approach was determined. The amount of time boats were present at different distances to the animals was then calculated.

The number of boats with whales refers to the total number of whalewatch boats, either commercial or recreational, within 300m of a group of whales.

The level of exposure to whalewatching activities was compared between groups with and without a calf and between the three years of this study. The amount of time spent with whales by recreational versus commercial whalewatching boats was also compared. The mean number of boats watching whales was assessed by day of the week and time of day. Histograms were generated for each variable to assess normality before conducting an analysis of variance (ANOVA). Where *post hoc* tests were required, LSD analysis was used. A value of $p < 0.05$ was used for significance.

RESULTS

Research effort and sample size

Data were collected over three field seasons from 2005 to 2007 (Table 1). Over the 146 days of observation, 275 groups of humpback whales were sighted within the study area. Of these, 154 were tracked using the theodolite during 171.4hr

Table 1

Research effort by year showing the number of days and hours of observation in the field and the total number of hours spent tracking whales.

Year	Dates	Number of days (and hours) of observation	Number of hours tracking whales
2005	14 Jul.–4 Sep.	42 (236)	47.9
2006	18 Jul.–17 Sep.	53 (329)	58.4
2007	12 Jul.–19 Sep.	51 (308)	65.1
Total		146 (873)	171.4

Table 2

Number of humpback whale groups tracked from the shore station using the theodolite.

Year	Number of groups	Groups tracked with boats	Groups tracked without boats	Groups tracked with and without boats
2005	33	16	11	6
2006	59	13	30	16
2007	62	13	30	19
Total	154	42	71	41

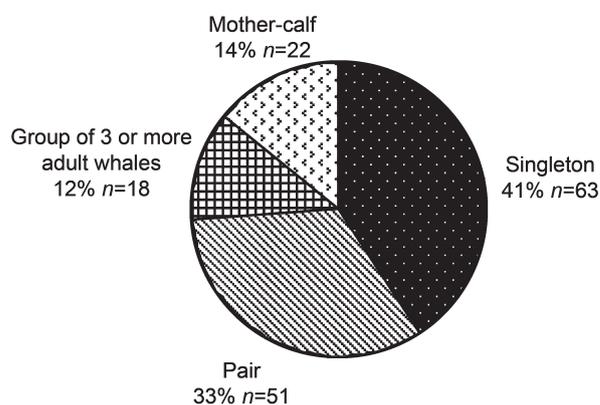


Fig. 2. Percentage of groups tracked per group type (n=154).

(Table 2). Data collected on groups that could not be tracked with the theodolite provided information on the length of encounters for another 50 groups.

Groups of whales were tracked for an average of 1.1hr (± 0.8 hr, range = 0.3 – 5.1hr, $n = 154$). The majority of groups tracked were singletons (41%, $n = 63$) and pairs (33%, $n = 51$) (Fig. 2).

Exposure to whalewatching boats

During the observations, a total of 148 groups of humpback whales were exposed to whalewatching boats, which represents 54% of all groups sighted within the study area ($n = 275$). Five hundred and fifteen occurrences of boats watching whales were observed, 31% recreational ($n = 160$) and 69% commercial ($n = 355$).

Each boat spent an average of 52min (± 42.5 min, range = 1min – 3.8hr, $n = 515$) with a group of whales. Observation time per boat exceeded 30min 31% of the time ($n = 157$) and 1hr 65% of the time ($n = 332$) (Fig. 3), with 13 occasions where boats stayed with the same group for over three hours. Boats spent more time with adult whales (54min ± 44.7 , range = 1min – 3.8hr, $n = 432$) than with groups containing a calf (42min ± 26.5 , range = 5min – 2.01hr, $n = 83$) ($F = 6.260$, $p < 0.05$). Boats spent more than 30min with mother-

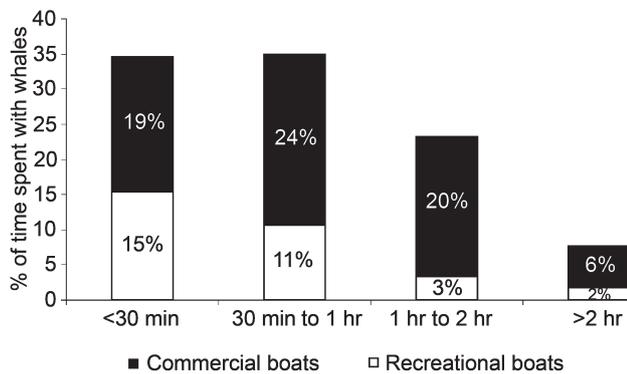


Fig. 3. Percentage of time spent with whales by commercial and recreational whalewatching boats.

calf groups 57% of the time ($n = 47$). Recreational boats spent significantly less time with whales than commercial whalewatching boats ($F = 12.726$, $p < 0.01$) (Fig. 3), with an average observation time of respectively 43 min (± 42.2 min, range = 3min – 3.8hr, $n = 160$) and 57min (± 42 min, range = 1min – 3.8hr, $n = 355$).

Each group of whales was accompanied by boats for an average cumulative time of 1hr and 52 min each day (± 1.13 hr, range = 15min – 5.8hr, $n = 131$). Whales were observed by boats for over 2hr 37% ($n = 49$) of the time, and sometimes up to over five hours a day. There were no significant differences in the cumulative observation time depending on the presence of a calf in the group ($F = 0.009$, $p > 0.05$).

Groups of humpback whales were simultaneously watched (i.e. within 300m) by an average of 2.5 boats (± 2.2 , range = 1 – 15, $n = 75$) over the length of a tracking session. Over the three field seasons, the maximum number of boats simultaneously observing a group of whales was 15. There were more than three boats with whales 30% of the time ($n = 23$) and over five boats 16% of the time ($n = 12$). The average number of boats with whales was significantly higher at weekends (3.5 ± 2.8 , range = 1 – 15, $n = 30$) than during weekdays (1.7 ± 1.03 , range = 1 – 7, $n = 45$) ($F = 177.975$, $p < 0.01$). A time specific analysis showed that the number of boats varied significantly throughout the day ($F = 30.796$, $p < 0.01$), with a peak between 10am and noon ($p < 0.01$) (Fig. 4). Boats were present in lower numbers with mother-calf groups (1.7 ± 1.3 , range = 1 – 7, $n = 15$) than with non-calf groups (2.6 ± 2.3 , range = 1 – 15, $n = 60$) ($F = 18.848$, $p < 0.01$).

Out of all groups tracked in the presence of boats ($n = 83$), the closest point of approach by boats was less than 100m

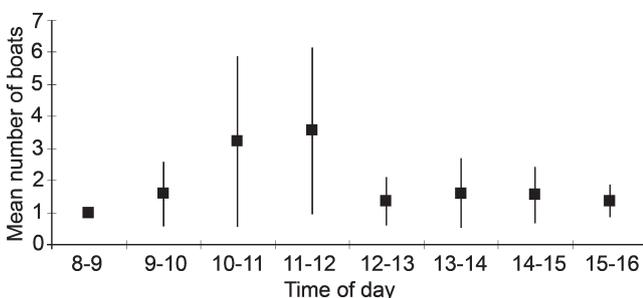


Fig. 4. Mean number of whalewatching boats within 300m of whales and standard error per time of day.

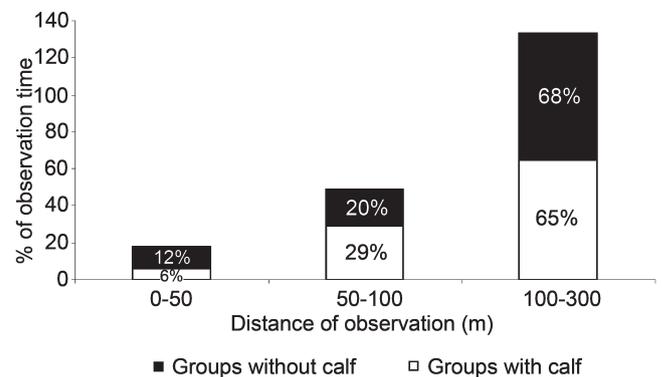


Fig. 5. Percentage of observation time with whalewatching boats present at different distances to groups with and without a calf.

for 86% of groups with a calf ($n = 13$) and 55% of non-calf groups ($n = 38$). Boats were present within 100m of non-calf groups during 32% ($n = 12.7$ hr) of observation time and 35% ($n = 3.4$ hr) for groups containing a calf (Fig. 5). Although the closest point of approach for groups with a calf was on average closer ($67.7\text{m} \pm 55.7$, range = 4.4 – 236.5m, $n = 15$) than that of groups without a calf ($137.3\text{m} \pm 139.4$, range = 2.8 – 738.6m, $n = 68$), this difference was not statistically significant ($F = 3.584$, $p > 0.05$).

There were no significant differences in the observation time per boat ($F = 2.119$, $p > 0.05$), the cumulative observation time for each group ($F = 0.298$, $p > 0.05$), the number of boats within 300m of whales ($F = 2.345$, $p > 0.05$), and in the minimum distance of approach ($F = 0.887$, $p > 0.05$) between the three years of this study.

DISCUSSION

The results of this assessment show that the small population of humpback whales wintering in the southern lagoon of New Caledonia is exposed to numerous whalewatching boats for several hours everyday. The risk of long-term deleterious effects on this population is high, especially when one considers management measures in place around the world.

An analysis of 58 whalewatching codes of conduct and regulations showed that the most common observation time allowable for boats was 30 minutes (Garrod and Fennell, 2004). During our surveys, whalewatching boats spent on average almost twice that time with the same whales. Observation time exceeded 30min 65% of the time. Restrictions on the cumulative duration of whalewatch encounters (total amount of time a group of whales is in the presence of boats within a day) are rare within the literature. Only one example has been found in the Caribbean where the cumulative observation time per group of whales is limited to 30 minutes (Carlson, 2004). Such restriction can be particularly difficult to implement and enforce as it strongly relies on communication between observers of a specific group of whales throughout the day. Due to the low number of humpback whale groups present in the whalewatch area each day and the large numbers of commercial whalewatching boats, the cumulative duration of encounters is particularly crucial in New Caledonia and often exceeds two hours.

Regarding the number of boats simultaneously watching a group of whales, almost half of the management measures

reviewed by Garrod and Fennell (2004) suggest no more than one boat at a time, 30% specified two, while 20% recommended three boats. In the Pacific Islands region, existing guidelines and regulations consistently recommend a maximum of three boats or less simultaneously watching a group of whales (IFAW *et al.*, 2008). The observations conducted in this study have shown that the number of boats with whales is regularly higher than three, especially on weekends when the demand for whalewatch trips is the highest.

The results show that boats most frequently watch whales from a distance of between 100 and 300m. The minimum distance recommended to approach a group of whales is generally between 50 and 100m in other areas (Carlson, 2004; Garrod and Fennell, 2004; IFAW *et al.*, 2008). Humpback whales in New Caledonia are approached at distances closer than 50m during 18% of the total observation time.

Specific restrictions regarding approaches of mother-calf groups often are implemented to provide extra protection to young whales, considered to be more vulnerable to threats. In many countries, watching mother-calf groups is strictly forbidden (Carlson, 2004; Garrod and Fennell, 2004). When allowed, the minimum approach distance recommended for groups with calves is often greater than for groups without a calf and most commonly is limited to 100m or more (Carlson, 2004; IFAW *et al.*, 2008). This study shows that whalewatching boats approach within 100m of groups with a calf 35% of the time. Although whalewatching boats tend to spend less time with groups with calf, observation time was over 30 minutes 57% of the time and the cumulative length of encounters was not different from other group types. Mothers and calves could be particularly vulnerable to such exposure as it may interfere with nursing or other social behaviour essential to their survival.

The number of boats with whales, the length of encounters and the distance at which mother-calf groups are approached are often beyond the limits generally recommended or enforced worldwide. Only around a hundred humpback whales visit the southern lagoon every year and the majority of individuals are exposed to whalewatching activities. The level of exposure is likely due to the large number of whalewatching boats, combined with the lack of management measures. Furthermore, the high level of exposure to whalewatching activities is probably the cause of significant behavioural changes demonstrated in the presence of boats (Schaffar *et al.*, 2009b). Although the level of individual exposure is currently unknown, the strong site fidelity of humpback whales observed in the southern lagoon of New Caledonia (Garrigue *et al.*, 2002) raises the question of the impact of cumulative exposure of a small number of animals to a high level of whalewatching activity. Minimising the level of exposure of humpback whales to whalewatching activities in the southern lagoon of New Caledonia is therefore essential.

In 2007, guidelines on how to approach and observe humpback whales were produced by New Caledonian whalewatch tour operators. For mother-calf pairs, a minimum approach distance of 100m and a maximum observation time of half an hour were recommended. It also suggested a limited number of five boats simultaneously watching the same group of whales. The results presented in

this paper show that the voluntary guidelines were often breached and did not result in a significant change in the level of exposure during that year. These guidelines therefore are unlikely to provide accurate protection to humpback whales from the impact of whalewatching activities in New Caledonia.

The results of this assessment provide valuable information that can assist the development of an informed management plan. The lack of compliance with voluntary guidelines indicates that self-regulatory measures are insufficient to ensure the conservation of humpback whales in New Caledonia, which is not an uncommon occurrence in the whalewatch industry (Constantine and Bejder, 2008). Regulations are therefore required and will need to include enforcement measures. The results of the present study also show that specific efforts should be made to limit approaches to groups containing a calf to a minimum of at least 100m. The number of boats operating in the whalewatch area appears to be a major problem and cannot be considered sustainable for the small and endangered population of humpback whales wintering in New Caledonia. As commercial whalewatching boats represent 69% of all approaches to whales, a licensing scheme limiting their number should urgently be implemented. Other measures, such as two-tiered approach distances, also need to be considered for recreational vessels. The recent listing of the southern lagoon of New Caledonia as a World Heritage site undoubtedly offers the framework to implement effective management of whalewatching and to ensure the conservation of one of the country's most emblematic species.

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