Mother and calf humpback whale responses to vessels around the Abrolhos Archipelago, Bahia. Brazil.

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ABSTRACT

As the humpback whale population spreads along the Brazilian coast, whalewatching activities are becoming more frequent in special along the coast of the state of Bahia. In order to evaluate the appropriateness of the Brazilian legislation that regulates vessel approaches to cetaceans, the behavior of humpback whale mothers and calves was studied around the Abrolhos Archipelago, an area with high concentration of tourism vessels. Mother and calf groups were observed by means of continuous sampling and tracked along with vessels using a theodolite. Three whale-vessel categories of distances were analyzed: closer than 100m (category 1), between 100 – 300m (category 2) and further than 300m (category 3). Rates of behavioral events and time spent in behavioral states of mothers and calves were compared separately in those 3 categories to observations of randomly selected mother and calf groups not involved in an interaction with a vessel (category 0). A total effort of 39h was analyzed including observations in each of the four categories. Our results showed that differences in humpback whale mother and calf behavior occurred mostly in the presence of vessels within distances of 100-300m. Mothers increased linearity and mean speed of movement, and decreased blow intervals and time spent resting. Calves exhibited less rolling, fluke-ups and others active behavioral events as well as diminished resting time. During the interaction with a vessel, the frequency of potentially important behaviors, both for mothers and calves, reduced, probably as a response to the approaching whalewatching vessels. Repeated short-term behavioral disturbances might lead to cumulative effects that may result in risks for the species conservation. Inasmuch, it is recommended that the Brazilian Legislation should include a 300-meter caution zone, where boats should reduce speed and avoid sudden changes in engine status and direction. The environmental education work with local communities along the coast must be continued and constant.

KEYWORDS: HUMPBACK WHALE; WHALEWATCHING; SHORT-TERM CHANGE; SHORE-BASED.

INTRODUCTION

For many years, Abrolhos Bank was considered the only known breeding and calving ground for humpback whales (*Megaptera novaeangliae*) in the western South Atlantic (Siciliano, 1997), however the humpback population that winters off the Brazilian coast has increased (Freitas *et al.*, 2004) and humpback whales are being encountered along the entire coast (Pizzorno *et al.*, 1998; Martins, 2004; Zerbini *et al.*, 2004; Simões, 2005; Andriolo *et al*., 2006). Nevertheless, the area surrounding the Abrolhos Archipelago is still considered unique because of the high concentration of whale groups with calves (Martins *et al.*, 2001; Morete *et al.*, 2003a).

Concomitantly with the occurrence of humpback whales along the Brazilian coast, whalewatching activities are becoming more frequent, not only around the Abrolhos Archipelago, but in other sites along the coast of the state of Bahia (Cipolotti *et al.*, 2005). Whalewatching is a particularly lucrative industry in many parts of the world, and is often seen as an economic alternative to whaling (e.g. Hoyt, 1995). However, several studies worldwide suggest that whalewatching can cause short and long-term reactions on humpback populations. Short-term reactions would be alterations on respiration, diving and swimming patterns, and/or exhibitions of particular aerial behaviors (breaching, head slap) correlated with vessel numbers, proximity, speed and direction changes, depending on the composition of the group of whales (e.g. Baker *et al.,* 1982, 1983; Bauer, 1986). Longer-term reactions such as mother and calf pairs becoming proportionately less frequent close to shore while recreational boating was increasing were suggested by Glockner-Ferrari and Ferrari (1985, 1990) and Salden (1988). However, Hawaii's humpback population seems to be increasing despite continuous exposure to human

activities (Bauer *et al*., 1993) and the population remain using Cape Cod, Massachusetts/USA as an annual feeding ground, despite exposure to many kinds of vessels (Clapham *et al*., 1993).

Scheidat *et al*. (2004) suggest that mother-calf pairs may be specially vulnerable to whalewatching disturbance, since some potential avoidance responses (of increased swim speed and longer dives, for example) may be beyond the physiological limits of the calf, and because calves may have less opportunity to nurse if the mother is forced to increase her speed or change her behavior from resting to swimming. Lien (2001) suggests that mothers and calves groups are especially vulnerable to human presence, and so they should receive exceptional protection by regulations.

Baker and Herman (1989) report that most changes on the behavior of humpback whales on the Alaska feeding ground were caused by vessels within 400m from a group. However, behavior could be affected by vessels up to 4km distant. Watkins (1986) shows that whales can have negative reactions (i.e. changes from activity to inactivity, usually suspending vocal activity, startle responses including sharply turning away or diving quickly, persistent movement away from the sources of stimuli) when within 100m of sounds sources (sudden and loud sounds such as engine starting, ships' close approaches, propeller cavitation during reverse or sharp turns). Most of whalewatching guidelines and/or legislation worldwide suggests 300m radius from a whale group as a caution area, where speed of the vessel should be decreased and the closest approach of a vessel towards a whale group is normally 100m. The Brazilian legislation (117/1996) concerning whalewatching activities demands that boats cannot go closer than 100m of a whale group, but does not consider any caution zone before this minimum distance. In face of that, the objective of this study is to evaluate the responses of mother and calf groups to vessels in three distances categories, based on 100m and 300m. Three vessel–whale distance categories were analyzed: vessel present further than 300m, vessel within 100 to 300m, and finally vessels closer than 100m.

The behavior of humpback whale mothers and calves were studied around the Abrolhos Archipelago, an area of high concentration of tourist vessels, in order to evaluate the need to improve the Brazilian legislation.

MATERIALS AND METHODS

The Abrolhos Bank (16º40'S to 19º30'S, 37º25'W to 39º45'W) is an extension of the continental shelf on the east coast of Brazil. The Bank is characterized by water that is both warm (winter average temperature = 24^{o}C) and shallow (average depth ≈ 20m), as well as by an extensive coral reef system. These features are typically associated with breeding grounds for humpback whales in other locations in the globe (e.g. Whitehead, 1981; Whitehead and Moore, 1982; Clapham, 1996). The shore-based station (17°57'44''S, 38°42'22''W) was located 37.8m above highest sea level, on the top of the western portion of the Santa Barbara Island, in the Abrolhos Archipelago. The study area encompasses a radius of 9.3km around the shore station (Fig.1), however to reduce measurement error of the whale's position, intrinsic to theodolite tracking (see Würsig *et al.*, 1991), only those whale and boat interactions that occurred within 3.5km radius of the shore station were considered for this study.

Field Observations

Every morning, weather permitting, a one-hour scan was conducted. After the scan a group of humpback whales would be chosen (normally closer groups) for a continuous sampling behavioral observation (Mann, 1999), which involved collection of behavioral data on a whale or group of whales containing a maximum of 2 adults and one calf, as recommend by Altmann (1974) for reliable data. Sampling continued until the group either moved out of the study area, or until sighting conditions (rain or Beaufort State> 4 and glare) reduced observation quality. Observations of mother-calf groups approached by vessels were collected opportunistically (i.e. when the group under observation was approached by a tourist vessel, or in some instances when the Humpback Whale Institute research vessel was in the vicinity and contacted by radio asking them to approach the group). These data were collected from 1998 to 2003, during the months of July to November, using a Sokkia DT5 30-power digital theodolite and Tasco 7x50 binoculars. Position of an object relative to the shore-based station was obtained by measuring the angles of depression or vertical deviation and angles of horizontal deviation to the object. This method, developed by R.S. Payne, allows one to follow the movements of whales and boats in detail (Tyack, 1981).

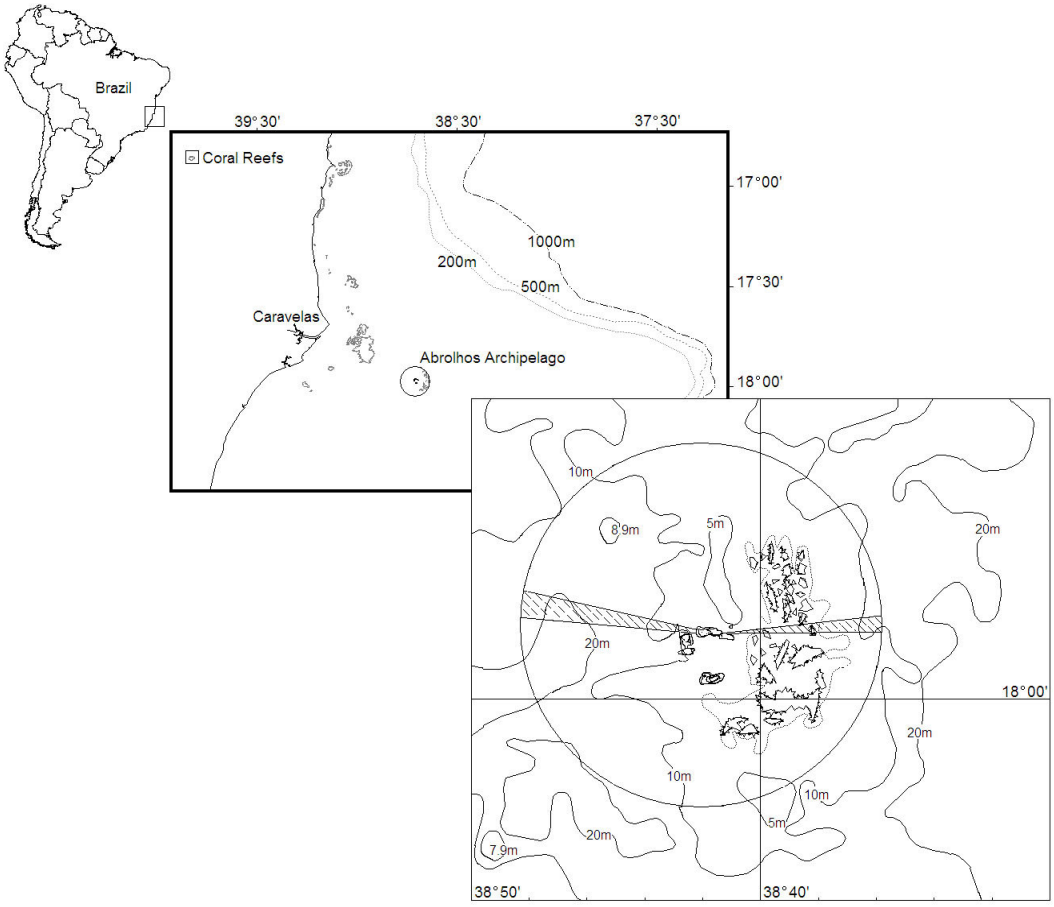

Figure 1. The study area encompasses 9.3km (5 nautical miles) radius excluding the two blind areas (to east and west) from the shore-based station at Santa Barbara Island in the Abrolhos Archipelago, east coast of Brazil.

The shore-based station team consisted of 3 people, the theodolite operator, who was the principal observer, the binoculars observer, and the computer operator. The theodolite observer would tell all whale behaviors (behavioral events and states, as described by Altmann (1974) to the computer operator, who entered the data real-time on a Macintosh Powerbook computer running the time–synchronized data-collection program Aardvark (Mills, 1996) designed for shore-based cetacean studies (*e.g.* Frankel *et al.*, 1995; Frankel and Clark, 1998). The theodolite operator was also responsible for giving the vocal command for the computer operator to record the theodolite readings (position) when the target whale or vessel was under the theodolite aim. The theodolite operator would take positions of the vessel as much as possible without compromising the observation of the whale and would take a mean of 1 position of the whale for each 1.5 minute of observation. The binoculars observer would serve as a "back-up" observer, as the binoculars have a broader range of view than the theodolite, this observer would alert the principal observer of the approach of vessels, other whale groups in the vicinity, and would tell if the principal observed (theodolite operator) missed any behavioral event.

Tide variations were entered in Aardvark hourly for correction of the eyepiece height of the theodolite above the surface of the water. Aardvark statistics output were used to estimate whale mean speed and headings in each distance category.

Definitions

A calf was defined as an animal in close proximity to an adult whale, estimated to be less than 50% of the length of the accompanying animal (Chittleborough, 1965), and presumably born during the current season. A whale was considered to be a mother when had a calf by her side. The variables used for behavioral events and states are listed and described in Table 1.

Table 1

Variables including behavioral events and states analyzed to evaluate the behavior of mothers and calves in the presence of vessel in three distances categories and in the absence of vessel.

Variables	Definitions
Linearity *	calculated by dividing the distance between the first and last position of the whale by the cumulative distance covered between all recorded positions
Mean Speed*	total distance covered divided by total time of observation
Reorientation rate*	absolute sum of the all heading changes divided by total time of observation
Blow interval*	elapse time between blows
Blow*	exhalation above the surface of the water
No blow*	surfacing with no evidence of exhalation
fluke up	submerging, lifting the flukes so that the ventral side of the fluke can be exposed
active	including breaches, pectoral fin slap, tail and peduncle slap, tail slashes, tail breach and head slap
rolling **	including exposition of pectoral fins, movement showing the ventral part of the body, exposition of half of the fluke and belly-up
lap **	when the calf go on top of the mother rostrum while the mother is resting, and almost its whole body can be observed out of the water
head exposition **	when calf move head above the surface at an angle less than 60º
spyhop **	lifting the head vertically above the surface of the water (90º angle)
Tail-up*	Behavioral state: maintaining fluke above the water for some period - see Morete *et al.,* 2003b
Swimming	Behavioral state: movement in a fixed direction when the whale shows the dorsal part of the body intermittently sometimes interspersed by diving
Resting	Behavioral State: floating motionless, lying at the surface exposing the dorsal part of the body
Milling **	Behavioral State: as swimming, however varying direction, within a small area - for calf also when swims circling the mother

* variables calculated just for mothers, ** and just for calves

Analyses

In order to evaluate the behavior of mothers and calves in the presence of vessel, three distances categories were created, the presence of vessel closer than 100m (category 1), between 100 – 300m (category 2) and further than 300m[1] (category 3). Some whale groups were approached and re-approached by whalewatching or research vessels within the same continuous sampling, for example, a boat entered a 300m radius from a whale, spent some time with the group, left this 300m radius, and re-approached. In these cases only one period of the sampling in each distance category was considered for the analyses. In other words, for each continuous sampling only one set of data from each distance category was included. Due to the opportunistic conditions of this study, not all observations contained the three distances categories. Some observations of interactions started when the boats were already closer than 300m from the whale group, and less observations of whales were done in category 1. This would be expected because in Brazilian waters, tourism boats theoretically cannot approach a whale closer than 100m (ordinance 117/1996), in fact, all observations made in category 1 were of vessels related to research. Also this ordinance stipulates that tourism boats cannot stay longer than 30min watching a group, resulting in short periods of observations in categories 1 and 2. These shorter interactions (less than 10min in each category) were excluded in order to reduce bias. Fifteen continuous sampling of mother and calf groups that were not approached by vessels were chosen randomly to serve as control, this set of data entered the analysis as category 0.

The variables analyzed for the mothers and calves are listed in Table 1. For the calves, blow rate was not taken into consideration because of the potential error of counts due to the small size of the blow, which easily could be missed by the observer if the calf was "behind" the mother (in relation to the theodolite observer), or if glare or wind were strong. Calves do not perform tail-up behavior (Morete *et al*., 2003b) so that was not included also. The behavioral state "milling" was not considered for the mothers because indirectly the software Aardvark gives a milling index (linearity). However, calves were frequently observed swimming around the mother, and we decided to use "milling" to describe this behavior. For behavioral events we calculated the rate of occurrence by dividing number of occurrence by total time of the continuous sampling in the respective distance category. For behavioral states, we calculated the proportion of time the whale spent in each state.

[1] 300m before arriving at the group and not leaving the group after interaction.

Data from the 3 distance categories for mother and calf behaviors (separately) were compared to data from the category 0, using a non parametric Mann-Whitney test for two independent samples. All statistical analyses were run in the software STATISTICA 6.0 (StatSoft, Inc., 2001)

RESULTS

Because of the opportunistic nature of data collection, a balanced design was impossible to achieve. Excluding other humpback groups categories, groups observed further than 3.5 km from the shore station, excluding periods of the sampling where boats re-approached the same group, and excluding observations of known individual whales that had already been part of the dataset, we analyzed 23 mother-calf groups observations, summing 17.2h of continuous observations of whales in the presence of vessels. Among these, 1.6h in category 1; 4.26h in category 2 and 11.33h in category 3. A total of 22.1h of observations of 15 mother and calf groups was used as control for the analyses. In all 23 whale-vessel interactions never more than 1 boat was present.

Mean values of rate of occurrence of behavioral events and states for mother and calf are listed in Table 2. The comparison of all variables for mothers, between category 0 and category 1, and category 0 and category 3 resulted in no statistical difference. However, the mean speed in the presence of vessels within 100m (3.98km/h) was twice as fast when compared to the control (1.99km/h). Only between category 0 (n = 15) and category 2 (n = 14) Mann-Whitney test resulted in statistical significant differences in linearity, mean speed, blow interval and resting state (Table 3). When compared to the absence of boats, mother tended to move in a more straight forward manner and faster while vessels were between 100 to 300m away (category 2). Additionally, mother´s blow intervals were smaller in the presence of vessels (100-300m) leading to an increase blow rate, although the latter, not statistically different from when boats were absent. The proportion of time spent in resting behavioral state decreased in 54%.

The comparison of all variables for calves between category 0 and category 3 resulted in no significant statistical difference; however we did find a significant difference among category 0 and category 1 and between category 0 and category 2 (Table 3). In the presence of boats within a radius of 300m around the calf (both, category 1 and category 2), the number of rolling events decreased. When boats were between 100 and 300m from the calves they exhibited less active events, less fluke-ups and reduced the time spent in resting in about 64%. When boats were closer than 100m, calves decrease the amount of time in milling. Although the event lap was not significantly different between category 0 and category 1, it is important to note that it did not occur while boats were within 100m of the group (Table 2).

DISCUSSION

Shore-base research platforms for studying cetacean behavior, especially when the objective is to evaluate whale responses to human activities, has been used worldwide (e.g. Bauer, 1986; Frankel *et al*., 1995; Frankel and Clark, 1998; Heckel, 2001; Willian *et al.,* 2002; Scheidat *et al.,* 2004) because they offer the advantage of being non-intrusive, when compared to research vessels that can influence the response to be measured.

Many studies have shown that responses of humpback whales to whalewatching vessels can occur at distances further than the 300m (stipulated for this research). Bauer (1986) shows that several behaviors appear to be affected by the presence of the vessel within 500m and/or between 500 to 1000m; Baker and Herman (1989) observed that humpback whale behavior on the Alaskan feeding ground could be affected by vessels up to 4km distant, but most changes were caused to vessels within 400m.

Motivated by whalewatching guidelines and legislation around the world and especially by the Brazilian legislation, which stipulates 100m as the minimum distance of a whalewatching vessel to a group of whale, we focused our study in the presence of vessels further than 300m, between 300 -100m and within 100m.

Corkeron (1995) found significant differences in some humpback behaviors when exposed to boats within 300m. Our results mainly showed differences of humpback whale mother and calf behavior in the presence of vessels within a distance of 300 to 100m, when compared to the control situation (continuous sampling with no whale-vessel interaction). Mother and calf groups increased mean speed and presented more direct displacement, and the mothers decreased blow intervals. The increase of speed in the presence of boats has been observed in others studies with humpback whales (e.g. Bauer, 1986; Au and Green, 2000; Scheidat *et al*., 2004). Bauer (1986) and Baker *et al*. (1982) found that the closer the vessel the smaller the mean blow interval and Baker (1988) states that within 400m whales responded to close proximity of vessels by also decreasing blow intervals, as it was observed for the mothers in the category 2 of this study. Additionally, we observed that mothers and

Table 2

Mean values and standard deviation (SD) of rates of occurrence of behavioral events, proportion of time in behavioral states of mothers and calves humpback whale in the absence of vessels (Cat 0) and in the presence of vessels in three categories of distance: category 1(Cat 1), category 2 (Cat 2) and category 3 (Cat 3).

	Cat 0 (no vessel) n = 15		Cat 1 (0-100m) n = 6		Cat 2 (100-300m) n = 14		Cat 3 (+300m) n = 14	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
				MOTHER				
Linearity	0.66	0.23	0.79	0.20	0.83	0.17	0.63	0.26
Mean Speed (km/h)	1.99	1.65	3.98	2.71	4.18	2.83	2.38	1.39
Reorie. Rate	18.68	11.94	29.8	31.98	15.91	15.29	22.69	21.50
Blow Interval (min)	1.70	0.68	1.54	0.31	1.21	0.63	1.47	0.67
Blow / h	38.59	11.85	30.82	10.94	49.84	21.63	42.11	13.77
No blow / h	7.24	5.17	14.13	21.21	13.69	13.21	8.28	9.47
fluke up / h	0.53	0.87	0	0	9.05	15.88	1.30	1.99
active / h	0.89	1.52	0.71	1.74	0.95	1.95	0.30	0.54
Tail-up duration (min)	7.25	0.38	4.58	1.84	8.17	3.92	6.99	3.42
% Tail-up	61.09	0.27	51.77	21.37	40.53	19.07	45.83	21.08
% Swimming	64.83	35.60	57.45	49.38	70.13	35.43	47.42	36.40
% Resting	27.02	27.77	16.67	22.21	12.49	21.29	32.94	30.67
				CALF				
fluke up / h	1.06	2.10	0.71	1.74	0.00	0.00	0.53	1.21
rolling / h	7.72	13.44	0.71	1.74	3.65	12.54	9.15	13.47
active / h	8.15	19.10	4.27	10.45	0.15	0.55	4.16	8.19
lap / h	0.76	1.44	0.00	0.00	0.68	1.80	1.08	1.86
head exposition / h	1.45	3.43	0.71	1.74	0.76	2.24	2.17	4.83
spyhop / h	0.09	0.20	0.00	0.00	0.00	0.00	0.54	1.41
% Swimming	53.04	36.43	54.40	50.87	70.13	35.44	42.39	35.46
% Resting	15.20	19.56	40.33	45.46	5.50	14.07	18.41	18.34
% Milling	31.76	32.81	5.26	12.89	24.37	28.64	39.20	27.70

Table 3.

Values of Mann-Whitney test (U) and respective *p* value of rates of occurrence of behavioral events, proportion of time in behavioral states of mothers and calves humpback whale in the absence of vessels (Cat 0) and in the presence of vessels in three categories of distances: category 1(Cat 1), category 2 (Cat 2) and category 3 (Cat 3). *p* significant at level 0.05.

	Cat 0 and Cat 1		Cat 0 and Cat 2		Cat 0 and Cat 3	
Variables	U	*p*	U	*p*	U	*p*
			MOTHER			
Linearity	30	0.242	55	0.029	99	0.793
Mean Speed (km/h)	20	0.051	57	0.036	84	0.359
Reorie. Rate	35	0.436	81	0.295	98	0.759
Blow Interval (min)	43	0.876	50	0.016	78	0.238
Blow / h	25	0.119	76	0.206	92	0.570
No blow / h	32	0.310	82	0.315	91	0.540
fluke up / h	27	0.078	84	0.305	97.5	0.707
active / h	36.5	0.430	92.5	0.506	88	0.381
Tail-up duration (min)	0	0.083	4	0.505	5	0.738
% Tail-up	2	0.563	2	0.182	4	0.504
% Swimming	44	0.937	84	0.354	73	0.161
% Resting	31	0.272	59	0.040	87.5	0.444
			CALF			
fluke up / h	31.5	0.24	49	0.00	76.5	0.15
rolling / h	16.5	0.02	41	0.00	104	0.96
active / h	29	0.18	47	0.00	94	0.61
lap / h	27	0.08	82	0.20	102.5	0.90
head exposition / h	33	0.29	75	0.11	95	0.62
spyhop / h	36	0.25	84	0.08	100	0.76
% Swimming	43.5	0.91	75.5	0.19	86.5	0.42
% Resting	37.5	0.55	62.5	0.05	81	0.29
% Milling	16.5	0.02	85.5	0.38	82	0.31

calves reduce time spent resting . Besides, calves significantly reduced activities above the surface (i.e. fluke-up, rolling and other active behavioral events).

The results point to significant changes in humpback whale mother-calf pairs in the presence of vessels, and we may think of them as negative effects. The observed absence of active behavioral events (e.g. breaches, tail, peduncle and pectoral slashes) by the mothers even in category 0, may function as a energy saving measure to due the high cost of lactation (Lockyer, 1981) and the virtual absence of feeding during the winter season. In the other hand, calves could benefit from vigorous activity in the form of play (Thomas and Taber, 1984), exhibiting active behavioral events leading to development of motor skills and coordination. While mothers rested, it was frequently observed calves swimming in circles around them (milling), and rolling interspersed by dives, what we believe could be related to nursing activity. With the approach of a vessel, those important behaviors for mothers and calves (resting and presumably suckling), reduced, probably as a response to the adopted approach procedure of whalewatching vessels. Normally after the captain had spotted the whale group for the first time and until the final approach, the boat would change speed and direction several times repeatedly to keep following the whale group as close as 100m. Watkins (1986) discussed that whales responded negatively to sudden and loud sounds from nearby sources, such as from an engine starting, propeller cavitation during reverse or sharp turns. Nonetheless, the sounds of an engine that had been running at a particularly rate for some time generally did not cause a reaction (Watkins, 1986). In fact, although whalewatching vessels most of the time do maintain the 100m minimum distance stipulated by the Brazilian legislation, they switch engine status while the group is underwater, cross the whales' path, and probably generating the sounds discussed by Watkins (1986) by increasing and decreasing speed continuously.

We would then expect that mother and calf groups would react in the same manner to vessels closer than 100m. However, except for the percentage of time spent in milling and the rate of occurrence of rolling by calves, (significantly lower when compared to the control condition), no other alterations were statistically significant. The absence of the occurrence of lap behavior by calves and the double displacement speed by the mothers while in the presence of vessel within 100m called our attention though and we believe that the low number of samples in category 1 may have compromised the significance level of our results. Possibly, the lack of significant difference in this instance was due to a type II statistical error. But also, all six cases of vessel present within 100m of a mother and calf analyzed in this study were of boats related to research, which were done at closer distances to the group than whalewatching vessels, however avoiding abrupt changes in direction and speed, or even keeping the engine in idle most of the time, what would considerably reduce or eliminate the noise source (Au and Green, 2000).

Whale responses to vessels approaching but still further than 300m, where not different from the behavior of control whale groups (category 0). Assuming that vessels navigate at a mean speed of 15km/h, it would take them about 4min to cover 1km distance, so the duration of time whales were exposed to the vessel in this study was much shorter when compared to the whole period of the observation. The mean time of continuous sampling in category 3 was 48.6min, diluting any behavioral changes that might occur further than 300m, as observed by some studies (e.g. Bauer, 1986; Baker and Herman, 1989; Green and Green, 1990). Nevertheless we believe that at least visually it is not possible to attribute a given reaction from a humpback whale to the presence of a boat that is not nearby, because others factors unrelated to the vessel not under the view/control of the observers, may influence that whale group.

Short-term reactions to whalewatching vessels are well documented in the literature and once again was observed here. However, the ultimate question of what may be the long term effects of whalewatching activity is still to be answered. Normal behavior by mothers and calves were altered in the presence of a vessel and that may interfere in their energetic demands. Repeated short-term behavioral changes such as these may lead to cumulative effects that might prevent animals from carrying out normal life processes. If disruption occurs to a particular segment, or to a significant number of individuals within a population, it follows that conservation of the population may be at risk (Lien, 2001). The whalewatching activity is spreading along the coast of Brazil (Cipolotti *et al.*, 2005), in regions inside and outside protected areas. Although we do not have information about the amount of the whale population that is being affected, we do know that these interactions occur in a great part of its distribution and certainly not all the people conducting this activity have knowledge and/or consciousness about the Brazilian legislation regulations.

Whether the short-term behavioral changes described here are accompanied by a long term avoidance of the Abrolhos Archipelago region as a breeding site has not been verified yet. Abundance estimates in the area show that the population is increasing (Freitas *et al*., 2004; Andriolo *et al*., 2006). Indexes of abundance around the shore-station have shown that sightings of whales per scan increased, especially from 2002 to 2004 based on a 7-year study from 1998 to 2004 (Morete *et al.,* unpublished data).

However, in long-lived, slow-breeding species, the long-term effects of reduced resting behavior on fitness, individual reproductive success, and hence, population size, could take a long time to be detect (Wilson *et al*., 1999; Thompson *et al.,* 2000) and cannot be observed until they have occurred (Tyack *et al.,* 2004).

In face of that, it is recommended that the Brazilian Legislation, as well as places where guidelines do not mention it, should contain an item about a 300m caution zone, where boats should reduce speed, avoid sudden changes in direction and speed (i.e. noise level), and approach and leave whales cautiously and slowly. The Brazilian whalewatching legislation should be respected by whalewatching vessels, and for that, extensive environmental education work with local communities along the coast must be continued and constant, adding training of boat captains and effective reinforcement of the guidelines should be done by the appropriate Brazilian authorities.

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