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Distribution and relative abundance of large whales in a former whaling ground off eastern South America

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ABSTRACT. Ship-based sighting surveys for cetaceans were conducted in the former whaling ground off the northeastern coast of Brazil. The cruises took place in winter and spring of 1998-2001 with the objectives of investigating current distribution and abundance of cetaceans, particularly large whale species taken during whaling. In 1998 the survey were conducted between the parallels 5°30'W and 9°S and the 200 m isobath and the meridian 033°W. A total of about 3,100 nm were surveyed between 1998 and 2001 Surveys were conducted using line transect methods from about 5-10°S, and from the coast to 33°W. A total of 151 sightings (203 individuals) of large whales were recorded on effort. The Antarctic minke whale – *Balaenoptera bonaerensis* (Burmeister, 1867) was the most frequently sighted species (97 groups/132 individuals; Sighting Rate [SR] = 0.031 groups/nm), being recorded only in offshore waters. Density gradually increased from August to October. Minke whales were distributed throughout the area, both to the north and the south of former whaling ground. Sighting data indicate this is the most abundant species, particularly in the area beyond the continental shelf break. Breeding behavior was observed for Antarctic minke whales, but few groups containing calves were recorded (4.3% of the groups sighted on effort). Three other large whale species were recorded in low numbers: the Bryde's whale – *Balaenoptera edeni* (Anderson, 1879)[1], the sei whale, *B. borealis* (Lesson, 1828), and the sperm, *Physeter macrocephalus* (Linnaeus, 1758). Sei, Bryde and sperm whales were regularly caught during whaling operations, but are rare in the area, suggesting they were depleted by whaling and have yet to recover to their pre-explotation abundance. In contrast, minke whales are abundant in this area, suggesting that either they were not substantially depleted, or that they have recovered rapidly. Blue whale, *Balaenoptera musculus* (Linnaeus, 1758), and fin whale, *B. physalus* (Linnaeus, 1758), not recorded on our surveys, have always been extremely rare in the area.

KEY WORDS. Bryde's whale; minke whale; sei whale; sperm whale; South Atlantic.

The northeastern Brazilian coast was a major whaling ground off the eastern coast of South America (IWC management area II – Donovan 1991) in the 20th century. One land station operated in Costinha, Paraíba State (PB) (6º57'S, 34º51'W, Fig. 1), during 1904-1914 and 1924-1985 (e.g. Williamson 1975, da Rocha 1983). Catch data for all of these years except for 1904-1910 and 1929-1947 (data from the Bureau of Whaling Statistics [BIWS] – Paiva 1961, Williamson 1975). One or two catcher boats and, in some years, one towing boat operated at distances of about 30 to 140 km from the coast, between 6º and 8º10'S

[1] The taxonomic status of the Bryde's whales is unresolved and it is not clear whether one or more species exists (e.g. Wada *et al.* 2003, Kato & Perrin 2009). In this paper, *B. edeni* is adopted as the specific name because this is the one currently in use by the International Whaling Commission. However, we recognized the urgent need for further studies to clarify the taxonomy and population structure of Bryde's whales in the western South Atlantic Ocean.

(Williamson 1975, da Rocha 1980, Singarajah 1983). The whaling season lasted from June to October-December, depending on the target species (Paiva & Grangeiro 1965, 1970, Williamson 1975).

Eight species of large whales were recorded off Northeastern Brazil (e.g. Paiva & Grangeiro 1965, Williamson 1975, da Rocha & Braga 1982, Zerbini *et al.* 1997, Andriolo *et al.* 2006, Andriolo *et al.* 2010). The sperm whale, *Physeter macrocephalus* Linnaeus, 1758, has been observed throughout the year (e.g., Ramos *et al.* 2001), but migratory baleen whales occur during winter and spring. As observed for other whaling grounds, whaling operations off Costinha took the easy-to-kill and larger species first. Humpback whales, *Megaptera novaeangliae* (Borowski, 1781), were the primary target when whaling started. At least 1,342 whales, from this species, were caught before 1928 (Williamson 1975), showing relative high density of the species in the area. In addition, 170 individuals were captured from 1948 to 1963, a period in which this species had been depleted (Williamson 1975). Catches of sei/Bryde's[2] whales – *Balaenoptera borealis* Lesson, 1828 and *B. edeni* Anderson, 1879 – probably began after the decline of the humpback whale stock, but it is not clear when exploitation started as no records were kept. Sei/Bryde's whales were abundant off Costinha and dominated the whale harvest from 1947 through 1965. Data indicated that about 3,500 sei and 360 Bryde's whales were taken off northeastern Brazil from 1948 to 1977. Antarctic minke whales, *Balaenoptera bonaerensis* Burmeister, 1867, and dwarf minke whale, *Balaenoptera acutorostrata* Lacépède, 1804, were the last species to be captured. Some individuals were occasionally taken in 1949 and 1959 but only after 1963 the species started to be consistently exploited. Minke whales became the main target of the whaling industry in 1966, after the depletion of the sei/Bryde whale stocks. Nearly 14,300 individuals were captured until the end of whaling activities in 1985. The bulk of the catches corresponded to Antarctic minke whales (*B. bonaerensis*). The capture of only three dwarf minke whales (*B. acutorostrata*) has been confirmed (*e.g.* da Rocha & Braga 1982) among nearly 4,300 minke whales taken between 1980 and 1985. Sperm whales were captured in relatively small numbers off Costinha. A total of 686 individuals were taken there from 1953 to 1980. Blue whale, *Balaenoptera musculus* (Linnaeus, 1758), and fin whale, *B. physalus* (Linnaeus, 1758), were very rare in the whaling statistics. Only one individual of the former was captured in 1948 and three of the latter, one each in 1956, 1958 and 1972 (Williamson 1975, Zerbini *et al.* 1997). Table I present summarized data of whale catches in different years at Costinha, Paraíba, Brazil.

Whaling activities at Costinha were interrupted with the implementation of the global moratorium on commercial whaling after the 1985 season. Since then, research effort in the former whaling ground area has been focused on stranded animals or opportunistic sightings from shore (*e.g.* Lucena *et al.* 1998). Therefore, the status and possible recovery of whale stocks had remained unknown in this region. In view of that, the Brazilian Agency for the Environment (IBAMA), the Ministry of the Environment (MMA) and the Brazilian Navy (Inter-Ministry Commission for Marine Resources [CIRM] and the Department of Hydrography and Navigation [DHN]) sponsored cetacean sighting cruises off the Northeastern coast of Brazil from 1998 to 2001. These surveys had the primary goal of verifying the distribution and abundance of large whales off Brazil.

MATERIAL AND METHODS

The cruises were planned to take place in the peak of abundance of whales off Costinha. According to whaling data, sei/Bryde's were present in the region from June to November with peaks from July to September (Paiva & Grangeiro 1965, 1970). Minke whales were present from June to December with peaks in September, October and November (Williamson 1975). Three different vessels were used, but they have fairly similar lengths, operating speeds and platform viewing heights. Table II summarizes ship specifications and survey period.

In 1998 the survey were conducted between the parallels 5°30'W and 9°S and the 20 m isobath and the meridian 033°W (at approximately 90 miles of distance from the coast). This region contained the area where catcher boats operating from Costinha took whales during the whaling period. In 1999, the survey was expanded to the north (up to 5°S) and to the south (up to 10°S). Limits of the offshore block were the same as the 1999 survey with the difference that transects were not placed over the continental shelf (depth contour < 200 m). The coastal block was limited by the shelf break and the parallels 5 and 12ºS. In this work, only the offshore block data is analysed. More information on results for the coastal block is reported in Zerbini *et al.* (2004). In 2001 the survey were conducted offshore between the parallels 5 and 10ºS (Fig. 1).

A total of about 3,100 nm were surveyed between 1998 and 2001 (Tab. II) with average daily survey effort of 70.1 to 103.6 nm/day. Effort was stratified by depth intervals (Tab. III) in order to verify distribution and sighting rate at different depths for large whales.

During the surveys, sea state conditions varied between Beaufort 2 and 6, but ranged from 2 to 5 while the observers were 'on effort'. Sea surface temperature ranged from 26 to 27.5°C.

The cruises were divided in two phases. The first corresponded to a training period and lasted one to two days while the second was the effective survey. During the first phase, each observer was trained to read the reticles in the binocular lenses

[2] Sei and Bryde's whales appear as 'sei whales' in Brazilian whaling statistics up to 1967. According to Williamson (1975), the two species were recorded separately in subsequent years and the former corresponded to around 90% of the catches.

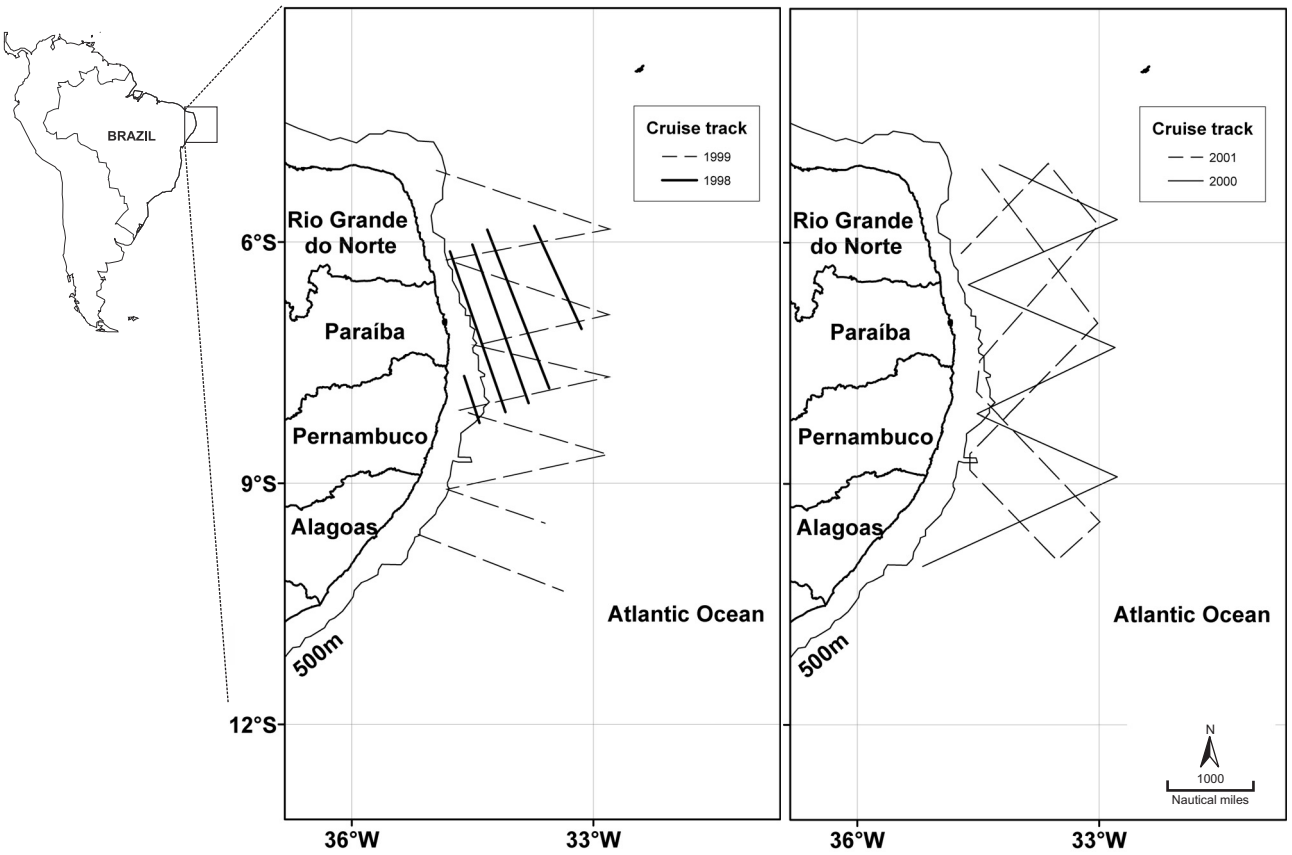


Figure 1. Cruise track design of sighting surveys conducted off northeastern Brazil between 1998 and 2001 by the Minke Whale Project (IBAMA).

Table I. Catches (5-year intervals) of different whale species at Costinha, Paraíba, Brazil. Data from the Bureau of Whaling Statistics (BIWS) – International Whaling Commission.

	1948-55	1956-60	1961-65	1966-70	1971-75	1976-80	1981-85	Total
Right	1							1
Blue	1							1
Fin	1				1			2
Humpback	104	37	29	0	0			170
Sperm	3	18	33	234	279	115	0	682
Sei/Bryde	875	1223	1435	279	38	8	0	3858
Minke	10	0	113	2614	4056	4107	3426	14326
Total	995	1278	1610	3127	4374	4230	3426	19040

and to estimate radial angles with angle boards. In addition, reticle readings and angle estimates were calibrated among observers using true sightings, boats and floating objects as targets. A complete simulation of the searching methods used in the following days was also carried out.

Data was collected following the standard line transect methodology as described by Burnham *et al.* (1980), Hiby & Hammond (1989) and Buckland *et al.* (1993). Cetaceans were continuously searched from 05:30 to 17:00 h during 1998-2000 surveys, and from 05:00 to 17:00 h during 2001 survey (*i.e.* about half an hour after sunrise and before sunset). In 1998 six scientists rotated through four observation positions in order to record sighting data. A full observation period lasted two hours (30 minutes in each position) and was followed by a one-hour rest

Table II. Specifications of the ships and the period of the surveys for large whales off Northeastern Brazil.

Specifications	1998 Survey	1999 and 2000 Surveys	2001Survey
Ship	Rbam 'Alte Guilhem'	NF 'Alte Graça Aranha'	NH 'Sirius'
Size	63 m	75 m	77.9 m
Observation platform height	10 m	12.3 m	9.95 m
Searching speed	9-10 knots	9.5-11 knots	11 knots
Period of the survey	23 Sep – 05 Oct	1999: 06 Sep – 27 Sep 2000': 14 Aug – 2 Sep	10 – 18 Oct
Area covered	25,187 nm^2	38,237 and 30,066 nm^2	31,549.86 nm^2

Table III. Searching effort (nm) stratified by depth intervals during the sighting survey conducted off Northeastern Brazil. Sighting rate (number of groups seen/nautical mile) of minke whales at different depths during the surveys conducted in 1998, 1999, 2000 and 2001 off the Northeastern Brazil.

Year	200-999 m	1000-1999 m	2000-2999 m	3000-3999 m	>4000 m	Total
1998	107.7	98.0	121.6	164.3	270.7	762.3
1999	89.1	62.5	188.0	213.5	416.0	969.1
2000	20.3	78.1	72.0	113.2	207.3	490.9
2001	53.0	60.0	94.0	73.5	502.5	783.0
Total	270.1	298.6	475.6	564.5	1,396.50	3005.3
Sightings –1998	5	5	6	4	8	28
Sightings –1999	5	0	7	7	4	23
Sightings –2000	1	1	1	3	3	9
Sightings –2001	4	3	4	4	19	34
Sighting rate	0.056	0.03	0.038	0.032	0.024	

period for each observer. One scientist at port and another at starboard searched from 0° (the bow) to 90° while other two observers were primarily focused on the trackline, covering about 10° at the port or starboard with the trackline as reference. If the port or the trackline observers made a sighting, the starboard acted as data recorder. If the latter made the sighting the port observer was the data recorder. In the following years eight or nine scientists were on board, so an independent data recorder position was added to take the notes about the observations. The rotation was established as two hours and a half of work versus two hours resting. Observer rotation is important to keep the effort homogeneity and to reduce tiredness (Hiby & Hammond 1989, Buckland *et al*. 2001).

The team of observers was randomly selected for each day of survey. Cetaceans were searched by naked eye or using binoculars. Search was abandoned when the weather and visibility conditions were poor and sea-state was Beaufort 5 or above. Whenever necessary, the ship diverted from the track to confirm species identity and group size and then returned to the trackline following a convergent course to avoid any stop/start effect (Kishino & Kasamatsu 1987).

Sightings made while the observer's team was working were considered "on effort" while those recorded by the ship's crew, during training days, during the night or during off-watch periods were considered "off effort". Each observer carried 7 x 50 scale binoculars and an angle board. Immediately after a sighting was detected, the number of reticles between the horizon and the animals and the radial angle between them and the ship's track were recorded in a standard data form. In addition, the following information was collected for each sighting: date, time observed, position (latitude and longitude) of the ship by the time the group was first observed, species, estimated number of individuals, presence of calves, status of the sighting ("on" or "off effort"), position of the observer who made the sighting, behavioral observations, and film and frame numbers of photographs taken. In addition, environmental variables such as cloud cover, wind strength and direction, sea state (Beaufort scale) and sea surface temperature were also recorded during the survey period. Cetaceans were identified to the lowest taxonomic level possible according to field guides and scientific literature (Leatherwood *et al*. 1982, Leatherwood & Reeves 1983, Perrin *et al*. 1987, Jefferson *et al*. 1993).

RESULTS

A total of 212 sightings of large whales were recorded (Tab. IV), being 151 'on effort' and 44 'off effort'. Nearly 32% of the sightings were not identified to species level. In order of decreasing frequency of groups seen, the most common species were: minke whales, sperm whales, Bryde's whales and sei whales. The distribution of large whale sightings off northeastern Brazil is presented in figures 2-4.

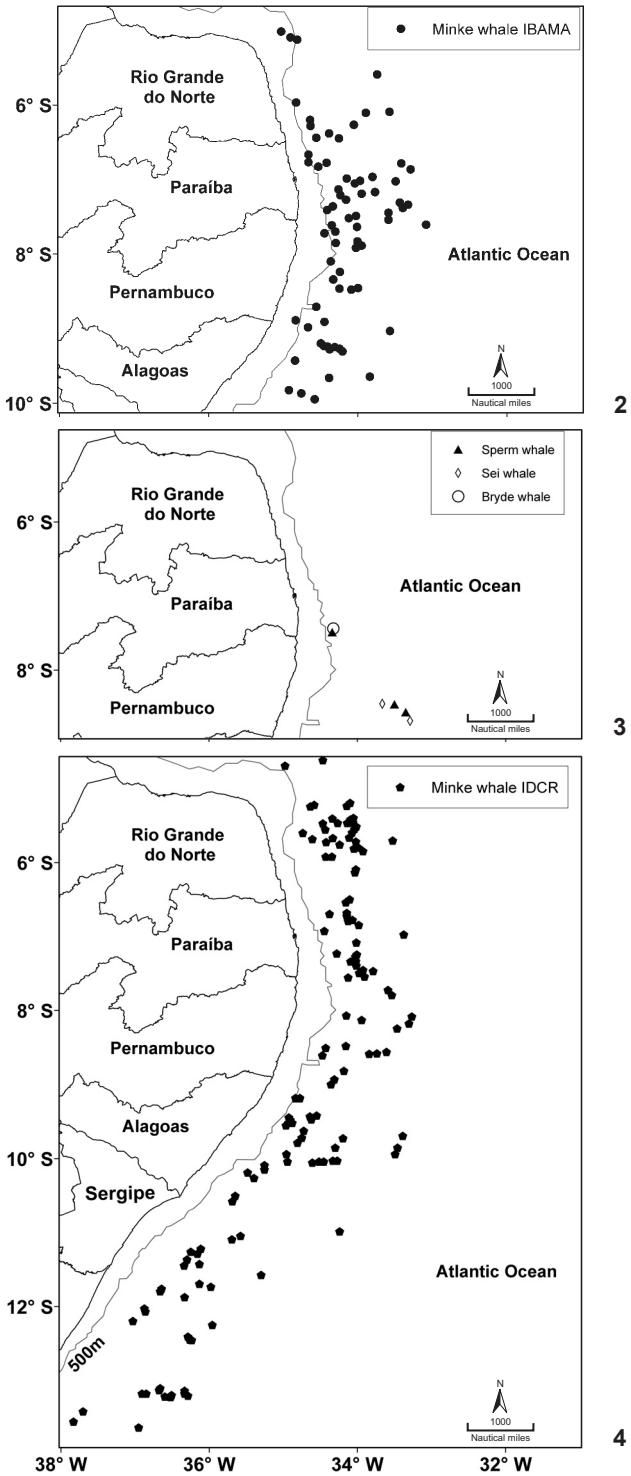
Minke whales were the most common species sighted, representing 55.2% (n = 117) of the total number of sightings (n = 195) and 64.2% of the groups recorded 'on effort' (Tab. IV). Overall sighting rate for this species was 0.031 groups/nm. A total of 30% of the minke whale sightings were identified with certainty as Antarctic minke whales. One dwarf minke whale sighting was recorded in relatively shallow waters (45 m), but none were seen in deeper waters (>200 m). For this reason, the information reported here is assumed to correspond to *B. bonaerensis*. This species was recorded in waters varying from 200 to 4675 m, but was primarily distributed over and beyond the continental slope (Figs 2-4). Only three out of 97 sightings were recorded over the shelf. Most sightings were observed in areas where depth was greater than 1000 m. Sighting rate was higher between the 200 and 999 m depth interval (Tab. III).

A total of 117 minke whales were seen in groups containing from one to six individuals (mean = 1.32). Calves of the season, defined as individuals measuring about half of the size of the larger individual in the group, were observed five times in groups of two (1) and three (4) whales. This corresponds to only 4.3% of all sightings. Behavior interpreted as a mating was observed twice. On 27 September 1998 a group of three individuals (including a calf) was detected about 500m away from the boat. As the ship approached the whales, one individual, could be seen in a 'belly-up' position, exposing its reproductive organs. On 21 August 2000 a group of six minke whales were seen also in a breeding-like behavior. At least two individuals of the group were swimming close to each other, near the surface, in a 'belly-to-belly' position. This group was surrounded by a group of about 40 bottlenose dolphins, *Tursiops truncatus* (Montagu, 1821), and a group of 12 short-finned pilot whales, *Globicephala macrorhynchus* Gray, 1846.

Minke whales were uniformly distributed to the north and to the south of the area they were regularly taken during whaling. No detectable latitudinal differences in density were observed.

The sighting rate of minke whale groups gradually increased from August to October (Fig. 5).

Three confirmed sightings of Bryde's whales were observed during the three cruises. In 1998 two groups were observed during the training phase of the survey. Both contained only one individual and were observed over the continental slope in waters of 800 m in depth. In 1999 one sighting 'on effort' was recorded, with two whales being registered in oceanic waters (depth = 2900 m). Overall sighting rate for this species was 0.0003 groups/nm.



Figures 2-4. Distribution of large whales off northeastern Brazil between 1998 and 2001 by the Minke Whale Project (IBAMA) (2-3) and data of IDCR cruise in 1981 (4). The gray line following the coast line is the 500m isobath.

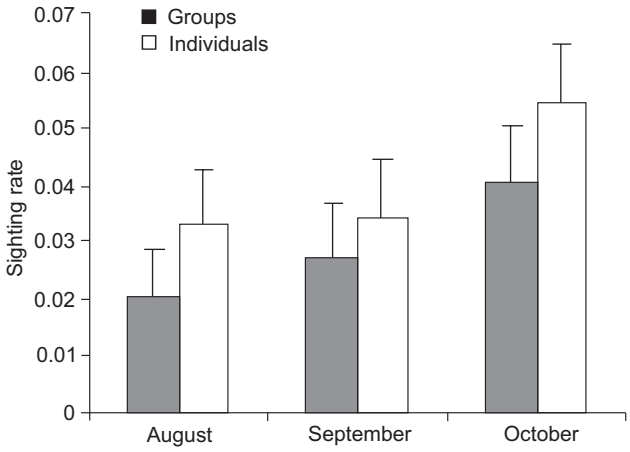


Figure 5. Seasonal variation in sighting rate (groups/nm and individuals/nm) of minke whales off northeastern Brazil.

Sperm whales were also sighted only in offshore waters, in depths greater than 2000 m. One individual was recorded 'off effort' in 1998, two groups of 6 and 8-10 whales were observed 'on effort' in 1999 and a group of five were recorded 'on effort' in 2001. Encounter rate for this species was also small (SR = 0.0009 groups/nm).

Only two sei whales were seen (in 2000) during this study. One individual was recorded "off effort" (depth = 3200 m) and another "on effort" (depth = 4100 m). Sighting rate for this species was 0.0003 groups/nm.

DISCUSSION

Five out of eight species of large whales captured during whaling operations off Costinha were recorded in the present surveys. Information on one of them, the humpback whale, is discussed elsewhere (Zerbini *et al.* 2004). Whaling records correspond to the main source of information on distribution and relative abundance of large whales for comparison with the data collected in the present sighting surveys. In addition, whale sightings collected during a minke whale marking and assessment cruise of the International Whaling Commission/International Decade of Cetacean Research (IWC/IDCR) program conducted off northeastern Brazil in November/December 1981 provide insights on the distribution of whales in the area.

A direct comparison of sighting and catch rates can not be performed for a number of reasons. There are differences in searching effort between catcher boats and sighting boats, there were seasonal and temporal differences in searching for different target species, not all the whales sighted were caught. Therefore, for some species, it is difficult to evaluate their status based on their past and present patterns of occurrence and indices of abundance. However, for other species (*e.g.* sei whale, see below) differences are clear.

The two species of Southern Hemisphere minke whales occur off the coast of Brazil (*e.g.* Williamson 1975, da Rocha & Braga 1982, Singarajah 1983, Zerbini *et al.* 1996, 1997). While Antarctic minke whales were regularly taken during whaling operations off Costinha, only three individuals of the smaller dwarf minke whale were confirmed in the catches (da Rocha & Braga 1982). Because size selection by whalers could cause the latter to be underrepresented, one of the objectives of this study was to assess the proportion of the two species in the area. Approximately 30% of the minke whales were identified to species level in the present cruises, but only one individual was identified as a dwarf minke whale, confirming that the species is rare in off shore region, at least during the period the surveys took place. Because the peak of occurrence of dwarf minke whales was observed earlier in the season in other areas (see Best 1985 for the coast of Africa) it is possible that more individuals would have been sighted if surveys were conducted earlier off the Northeastern coast of Brazil.

Antarctic minke whales were primarily observed in offshore waters, beyond the continental slope. Individuals were regularly found along the whole study area with little latitudinal differences in sighting rate. During the whaling period, whales were caught in a relatively small geographic area (limited by the 6º and 8º10'S parallels and up to 140 km offshore (*e.g.* Williamson 1975, da Rocha 1983). Information on the distribution and relative density outside this area was limited. Williamson (1975), based on information from the whaling station, stated that some whales were found up to the easternmost corner of the South American continent (5ºS) but no information for regions to the south of the former whaling ground has been provided. Sighting data from recent surveys suggests that minke whales are regularly found to the north and to the south of the whaling ground. A sighting and marking cruise conducted in 1981 by the International Whaling Commission (SUDEPE, Brazil, Progress Report, 1983, unpublished data), regularly recorded minke whales as far south as 15ºS along the northeastern Brazilian coast (see figures 2-4). The same pattern is seen in results from this study, although the survey area did not extend beyond 12°S. Williamson (1975) also mentioned that minke whales tended to concentrate at about 50-60 km offshore, over the continental slope (average depth = 2500 m), and that density decreased further offshore. The survey area of the present study extended up to about 160 km of distance from the coast. Sighting rates were relatively small over the shelf but increased between 200 and 1000 m, decreasing in deeper areas. This concurs with Williamson's (1975) findings. Effort data were not available for the IWC/IDCR cruise and therefore an evaluation of sighting rates per depth interval could not be performed. However, a visual inspection of figures 2-4 suggests that sightings were also concentrated in the area beyond the continental slope during the IWC/IDCR cruise (note high number of sightings between 34° and 35º20'W).

Table IV. Large whales sightings, sighting rates (SR groups or individuals/nm) and average group sizes observed during the cruises conducted off northeastern Brazil (Off Effort – Off; On Effort – On).

Species	Groups Off	Ind. Off	Groups On	Ind. On	SR (groups)	SR (ind.)	Total of groups	# of ind.	Average group size
1998									
Minke whale	8	11	30	41	0.0360	0.0490	38	52	1.37
Bryde's whale	2	2	–	–	–	–	2	2	1.00
Sperm whale	1	1	–	–	–	–	1	1	1.00
Unidentified large whale	6	6	9	9	0.0110	0.0110	15	15	1.00
1999									
Minke whale	6	6	23	28	0.0220	0.0270	29	34	1.17
Bryde's whale	–	–	1	2	0.0010	0.0020	1	2	2.00
Sperm whale	–	–	2	14	0.0020	0.0140	2	14	7.00
Unidentified large whale	11	12	17	17	0.0170	0.0170	28	29	1.00
2000									
Minke whale	1	1	9	16	0.0180	0.0330	10	17	1.70
Sei whale	1	1	1	1	0.0020	0.0020	2	2	1.00
Unidentified large whale	–	–	5	5	0.0100	0.0100	5	5	1.00
2001									
Minke whale	5	5	35	47	0.0430	0.0570	40	52	1.30
Sperm whale	–	–	1	5	0.0010	0.0060	1	5	5.00
Unidentified large whale	3	3	18	18	0.0220	0.0220	21	21	1.00
1998-2001									
Minke whale	20	23	97	132	0.0310	0.0420	117	155	1.32
Bryde's whale	2	2	1	2	0.0003	0.0006	3	4	1.33
Sperm whale	1	1	3	19	0.0009	0.0060	4	20	5.00
Sei whale	1	1	1	1	0.0003	0.0003	2	2	1.00
Unidentified large whale	20	21	49	49	0.0150	0.0150	69	70	1.01
Total	44	48	151	203	0.0480	0.0640	212	251	1.18

The relatively high encounter rate of minke whales (SR = 0.031) suggests that this species is far more abundant than any other large whale species off northeastern Brazil. This was expected considering that minke whale density indices had not decreased in the area during whaling (da Rocha 1983, Ohsumi & Myashita 1987) and it is well known that other species have been severely depleted by whaling (Clapham *et al.* 1999, Perry *et al.* 1999, Branch *et al.* 2004.

The NE coast of Brazil has long been considered a breeding ground for minke whales (Williamson 1975, Horwood 1990). Examination of reproductive organs of whales processed in Costinha showed that both males and females were reproductively active off Brazil (Williamson 1975, da Rocha & Braga 1982, Lucena 2006). Despite that, minke whale calves are not easily observed, which is unusual for an area considered a breeding ground. This is consistent with the fact that a small number of fetuses were recovered during whaling (e.g. Horwood 1990). A possible explanation for the lack of calf sightings in this study is that lactating females may show spatial segregation from mating whales (Horwood 1990).

Sei and Bryde's whales dominated whale catches off Brazil from 1951 to 1965 and were captured until 1977 (Williamson 1975, Horwood 1987). They were not distinguished in the whaling statistics up to 1963 when, sei whales comprised 90% of the catches (Williamson 1975). Assuming that this proportion was constant during the whole sei/Bryde's whaling period, sei whales must have been abundant and Bryde's whales relatively uncommon off Northeast Brazil. Although the present cruises were carried out during the peak of abundance of sei and Bryde's whales (see Paiva & Grangeiro 1965, 1970), current sighting rate of both

species was very low. Williamson (1975) described the 'virgin relative abundance' of sei and Bryde's whales as 'common' and 'occasional', respectively. This author estimated that about 350 Bryde's whales were taken at Costinha during 27 years (1947-1974) what suggest that the species was never abundant. The current sighting rates for this species therefore indicate low abundance for both species off northeastern Brazil. Because Bryde's whales seem to have been rare in this region, it is difficult to make inferences about the current status of this species from a comparison of relatively low historical catches and current sighting rates. On the other hand, the current low abundance of sei whales off NE Brazil contrasts with high catches observed in the mid 1960s. Williamson (1975) estimated that about 3600 sei whales were taken from 1947 to 1974, with more than 400 whales being killed in some years (*e.g.* 1960-1961). Catches dropped abruptly in the early 1960's, clearly indicating the depletion of the sei whale population in the region. The low numbers observed in the former whaling ground off NE Brazil during this study suggests that this population has not yet recovered.

A total of 686 sperm whales were captured off northeastern Brazil from 1952 to 1980, suggesting that the species was regularly found in the area. Williamson (1975) reported that the status of sperm whales was 'common' in 1974. According to whalers, sperm whales were not taken if other large whale species were in the area (R.L. Brownell Jr, pers. comm.) Sighting rates reported in this suggest the species is not common off northeastern Brazil.

Blue or fin whales were not sighted in the present study. Historical records suggest that these species were never common off northeastern Brazil. Whaling statistics indicate that only two blue and three fin whales were killed off Costinha (Williamson 1975). In addition, only two sightings of the former and nine of the latter were recorded collected during whaling operations from 1979 and 1985. Branch *et al.* (2007) reports that one of two Brazilian catches is questionable because it was reported as either a "blue or bowhead" in the IWC database, neither of which is likely. Also, da Rocha (1983) reports three blue whale sightings from Costinha in 1969, 1979, 1980.

Mackintosh (1965) observed that blue and fin whales primarily remain south of 20ºS and therefore only a few individuals may reach low latitudes. In addition, Branch *et al.* (2007) showed that blue whale are extremely rare in the western South Atlantic.

By registering the presence and relative abundance of different whale's population at the Brazilian coast, this study provide valuable information to elaborate conservation strategies according with the coastal development and the need of new protected areas.

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