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An assessment of the migratory flow of *Megaptera novaeangliae* along the southwest coast of Madagascar

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Summary

Humpback whales (*Megaptera novaeangliae*) migrate from southern latitudes to warmer tropical waters to breed.

In Madagascar

Migratory populations have been well documented off the east coast of Madagascar in Antongil Bay and around Ile de St Marie. Studies have also been conducted in the Comoros Islands, north west of Madagascar. To date no surveys have been conducted on the west coast of Madagascar and little is known about the individuals migrating through the Mozambique Channel. This study assesses the migratory flow of *M. novaeangliae* along the south west coast of Madagascar.

Key findings

The key findings of this study show:

(i) Movement of whales was documented along the south west coast of Madagascar between June and October

(ii) It is likely that the northwards migration begins earlier than June and future monitoring projects should begin in May

(iii) Large numbers of whales travel north along the coast between June and August

(iv) There is a significant decrease in the number of individuals travelling north in September and October

(v) The number of whales travelling south increases towards the end of the season

Table of Contents

List of Figures

Introduction

Humpback whale biology

The humpback whale is a member of the Mysticete or baleen whale family, comprising 11 documented species (Mead & Brownell 1993). The Mysticete species are characterised by the baleen plate which filters large volumes of incoming seawater to remove small prey such as krill. They are found in a wide range of coastal, shelf and pelagic habitats and feed off a variety of prey.

Humpbacks are probably the most studied species of baleen whale due to their coastal distribution, and ease of identification between individuals from natural markings on the underside of the fluke (Katona & Whitehead 1981). Humpbacks, like most species of baleen whale, show seasonal migration patterns, moving between summer feeding grounds in temperate or high latitudes, and winter breeding areas in warmer tropical waters (Kellogg 1929; Mackintosh 1942). Females migrate to high latitudes to give birth or conceive. Females usually breed every two or three years and have a gestation period of 11.5 months, although some cases of post-partal conception have been noted (Clapham 2003). Females migrate to warm, tropical waters as these are considered optimum conditions for birthing, and mother-calf groups show a strong preference for shallower waters, and maintain this preference in most conditions (Ersts & Rosenbaum 2003). It is not known how long individual whales remain in these warmer tropical waters. Long term studies around the islands of Hawaii have produced estimates of residence in the region through resighting studies of migrating humpbacks. The majority of whales had a resighting interval of less than two weeks suggesting that whales do not remain for long periods, and no juveniles had a resighting interval of more than four weeks (Craig *et al.* 2001). Shortly after birth it is likely that mothers are eager to start the return migration as the food reserves in their blubber begin to run low and they will have lost up to one third of their body weight (Leatherwood & Reeves 1983).

The most recent population estimates (IWC 1997; 1998) for southern hemisphere humpback whale stocks are approximately 42,000. However, this figure is incomplete, as there has been very limited research conducted on whale populations north of 60S. Estimates for humpback whale stocks in the southern hemisphere have been mainly based on studies around Australia where funding is available to monitor migrating individuals migrating past. There has been little research in the coastal areas of developing countries in the region as funding is limited and often dependent on international non-governmental organisations (NGOs). The International Whaling Commission (IWC) is currently working on an 'in-depth evaluation of the status of all whales stocks in the light of management objectives and procedures' (IWC website). This will include studies of current stock size and recent population trends to determine the sustainability of populations. Populations were severely impacted by whaling fleets during 18th and 19th centuries in response to the increasing demand for whale oil, and in particular in the early 20th century following the development of factory ships. Although present evidence suggests humpback populations are not critically endangered, historic evidence of heavy exploitation means populations may be under threat (Clapham *et al.* 1999).

Humpback whales around Madagascar

The IWC has divided the Southern Hemisphere humpback whale populations into seven wintering regions (A-G) based on tropical distribution. Madagascar falls within Region C, the South Western Indian Ocean, which has been further divided into three sub regions based on wintering preference (Best *et al.* 1998; Rosenbaum *et al.* 1997):

(i) C1: wintering off the east coast of South Africa to Mozambique

(ii) C2: a group that potentially migrates up the Mozambique Channel to winter grounds in the Comoros Islands
(iii) C3: wintering in the coastal waters of Madagascar.

The C3 sub region has been studied predominantly through an identified breeding area off the east coast of Madagascar around Ile Sainte Marie and particularly Antongil Bay in the north of Madagascar. Antongil Bay was historically discovered as an important location for humpbacks from documented concentrations of American whaling ships (Starbuck 1878). Recently it has been identified as a wintering area where large numbers of humpback whales congregate during the austral winter (Rosenbaum *et al.* 1997). Since 1996 the Centre for Biodiversity and Conservation (CBC) project has been working in partnership with the Wildlife Conservation Society (WCS) in Antongil Bay. This long term monitoring project has led to the formation of the Indo-South Atlantic Consortium on humpback whales (ISACH). This is a regional initiative by local scientists and environmental supporters to 'coordinate research and conservation efforts for humpback whales in the Southwest Indian and Southern Atlantic Oceans' (CBC website). The C3 stock population size has been estimated to be somewhere between 3,000 and 6,000 following both genetic and photo identification studies (Cerchio *et al.* 2006).

Other areas of Madagascar are noted to have a high abundance of migrating whales, in particular the region around Fort Dauphin in the south. Blue whales have been documented showing feeding behaviour on the Madagascar plateau, south of the island (between 25° and 35°S, 40° and 45°E), and humpbacks are likely to target a similar prey. High quantities of euphausiids have been documented in waters off the southern tip of Madagascar and attributed to localised upwelling (Best *et al.* 2003). Until recently scientists globally were unaware that humpbacks fed at any point during the migratory period, but recent activity in Bermuda suggests whales passing through the area are feeding off krill (*pers. comm.* Andrew Stevenson). This could explain the prolonged presence of whales in the Fort Dauphin area where prey species are abundant. Anecdotal evidence from tourist sightings suggests there may be scope for a small study in the area around Fort Dauphin, but the focus has so far remained on Antongil Bay due to the limited funding currently available for cetacean research in the waters around Madagascar.

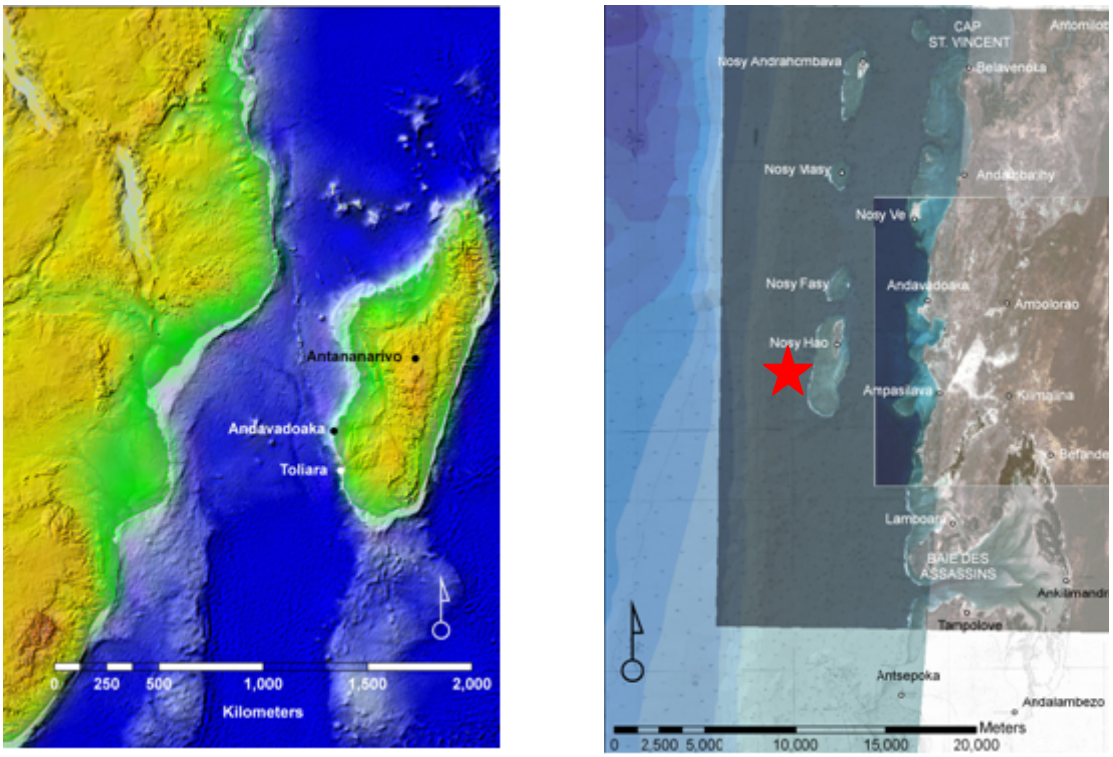
The focused research on the east coast has produced population estimates for whales visiting the area, but little is known about the movement of whales along the west coast of Madagascar, and no previous studies have been conducted. This study aims to provide a general overview of the flow of the humpback whale migration along the west coast of Madagascar on which further, more in depth studies can be based. Blue Ventures Conservation, a UK based NGO has been working in the region since 2002. Blue Ventures' research is focussed in the village of Andavadoaka, a small Vezo fishing village with a population of approximately 1,200. It is not known whether the whales passing Andavadoaka will be members of stock C2 or C3. Genetic and photo identification studies of whales sighted from the west coast would add clarity to whale movement around Madagascar.

Methods

Study Area

The field site is based on the south west coast of Madagascar 50km South of Morombe and 150km North of Toliara. Nosy Hao, a small barrier island 5km off the mainland provides a 360 degree view of the Mozambique Channel. A barrier reef surrounds the island approximately 1km offshore and all sightings occurred outside this.

Figure 1. Map of the study area



Surveys

Research activities were conducted on a small barrier island from a purpose built 5m high whale watching platform. The platform was constructed in August 2006 from local wood supplies on the south western tip of Nosy Hao. Preliminary surveys were conducted in 2006 to examine the suitability of the platform and success of sighting whales from the platform.

From this limited dataset a more in depth study was developed in 2007, with tri-weekly trips to the platform organised for the duration of the known migratory period of humpback whales. Figure 2 shows the survey intensity for each month of the study following the first incidental sighting from the main field site on June 16th 2007 in Andavadoaka. Surveying was stopped after 15 survey trips in November and December produced just one sighting.

A team of two trained observers was sent for two hour observation periods with 8 x 40 magnification binoculars, ID sheets and recording materials. Standard scan sampling techniques and visual observations (naked eye) were used to scan for cetaceans in favourable weather conditions (Beaufort sea state ≤4, swell height ≤2m). Observers were able to scan a 180° sector to the west of Nosy Hao from approximately 7m above sea level.

On arrival at the platform weather conditions were noted. Time, activity, number of individuals and direction of travel was noted on sighting of cetaceans.

Incidental Sightings

Sightings were also documented when they occurred outside of the survey hours and from locations other than the whale platform. These are classified as incidental sightings. Simple environmental data was recorded if possible as well as details of sighting location, group size and activity if the observer could remember this information.

Figure 2. Survey intensity by month

Month	Number of 2 hour surveys
June	4
July	12
August	15
September	13
October	13
November	13
December	2
Grand Total	72

Figure 3. Photograph of the whale watching platform constructed on Nosy Hao

Results

Tri-weekly surveys from 21st June to 5th December 2007 produced 97 sightings of 130 humpback whale individuals (and 1 unidentified species) from 72 survey trips and over 22 hours of survey effort. Solitary individuals and pairs were the most frequent group composition, 52% and 19% of the observed groups (n = 97), respectively, assuming that observers are successful in assessing group size.

Figure 4 shows the frequency of whale sightings during the survey period. The graph shows that August was the peak month for whale sightings.

Figure 4. Whale sightings from the platform throughout the survey period

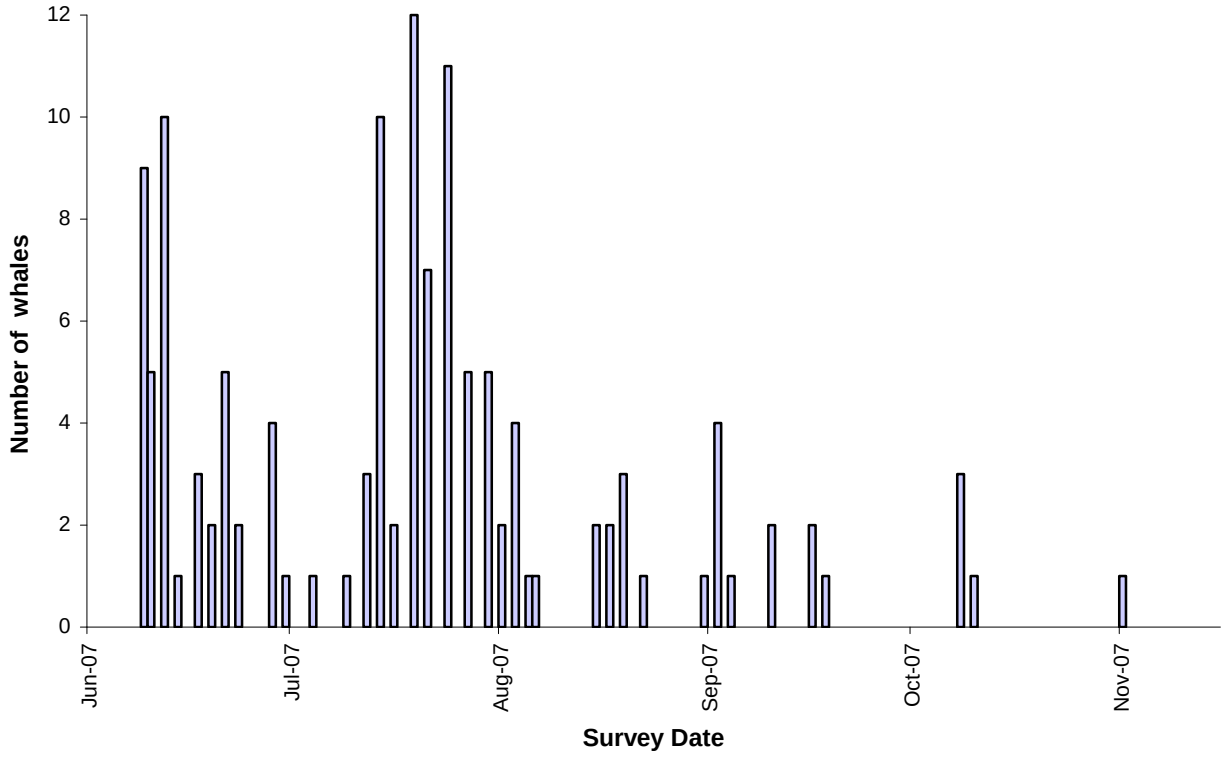


Figure 5 factors survey effort into the monthly sighting frequencies to produce sightings figures per survey hour per month. This shows that June and July both have a high frequency of whale sightings despite the low survey effort in June: 9 hours of surveys in June produced 10 sightings, over 24 hours of surveying in July resulted in 27 sightings, but the figure for the number of whales sighted per hour was actually slightly higher in June (1.6 and 1.2 whales per hour respectively)

Figure 5. Whale sightings from the platform adjusted for survey effort

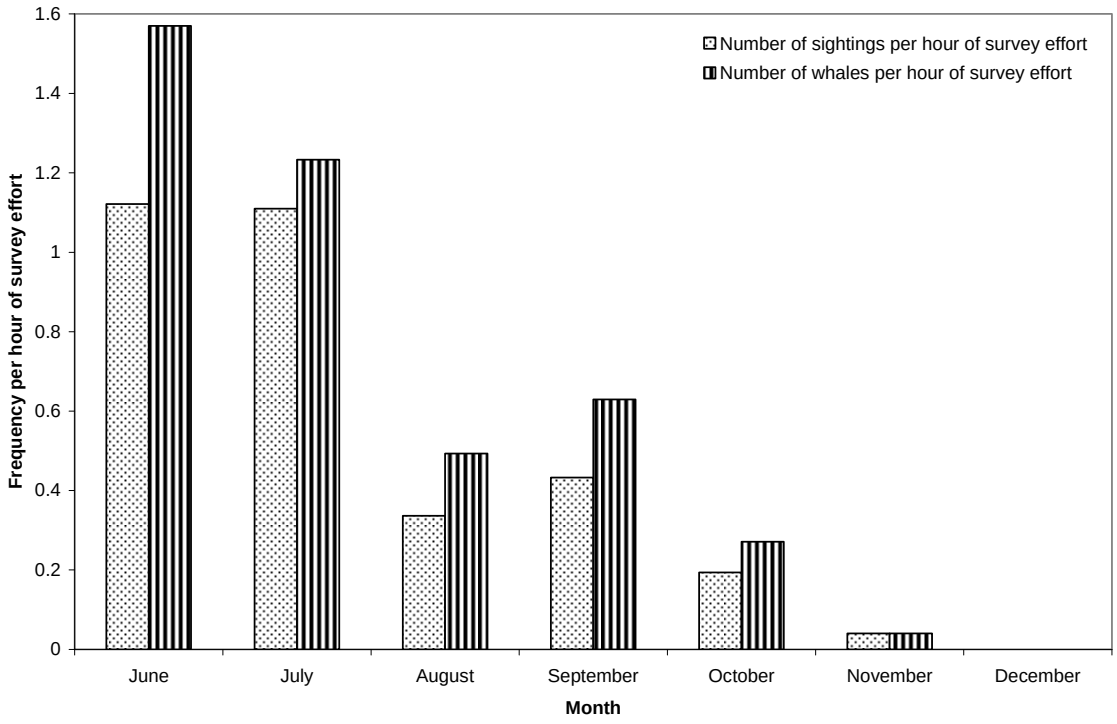


Figure 6 details the incidental sightings recorded during the survey period. There were 20 incidental sightings noted between 16th June and 20th October. 35% (n = 8) of these occurred in the vicinity of Nosy Andranombala, a small offshore island approximately 15km North of Nosy Hao.

Figure 6. Incidental sightings during the survey season

DATE	PLATFORM	Location	# group
16/06/2007	Land. Nosy Cao	Just West of Andavadoaka rock	2
24/06/2007	Boat. Tsontso	North of Andrivamike dive site	1
08/07/2007	Land. Phone rock	S of nosy Ve	1
09/07/2007	Boat. Alo Alo, Madablu	Sighted whilst divers were at 007	1
17/07/2007	Land. Phone rock	In between Nosy Ve and Nosy Hao	2
02/08/2007	Boat. Tsontso	At Valleys dive site while divers where down	1
03/08/2007	Boat. Alo Alo	Between Andava and Andranombala.	1
04/08/2007	Boat. Alo Alo	Nr Andranombala	3+
05/08/2007	Land. Andavadoaka Beach	On horizon straight out from Andava Beach.	1
06/08/2007	Land. Volunteer huts	Off Halfmoon beach just past Andava rock	1
21/08/2007	Boat. Pirogue	NE of Nosy Hao	2
24/08/2007	Land. Restaurant upstairs	In lagoon, quite nr breakers	2
11/09/2007	Boat. Motorised pirogue	Seen on the way to Andragnombala	2
21/09/2007	Land. Andragnombala	Seen from the N end of Andragnombala	3
25/09/2007	Boat. Dive Boat	Off N end of Nosy Hao	2
06/10/2007	Land. Andragnombala	Off SE side of Andragnombala.	1
08/10/2007	Boat. Tsontso	Just E of Nosy Fast	1
20/10/2007	Boat. Alo Alo	SE Andragnombala nr dive site ANDR60	2
20/10/2007	Land. Andragnombala	NW Andragnombala	1
20/10/2007	Land. Andragnombala	W of Andragnombala	3

Figure 7: Direction of travel of whales sighted

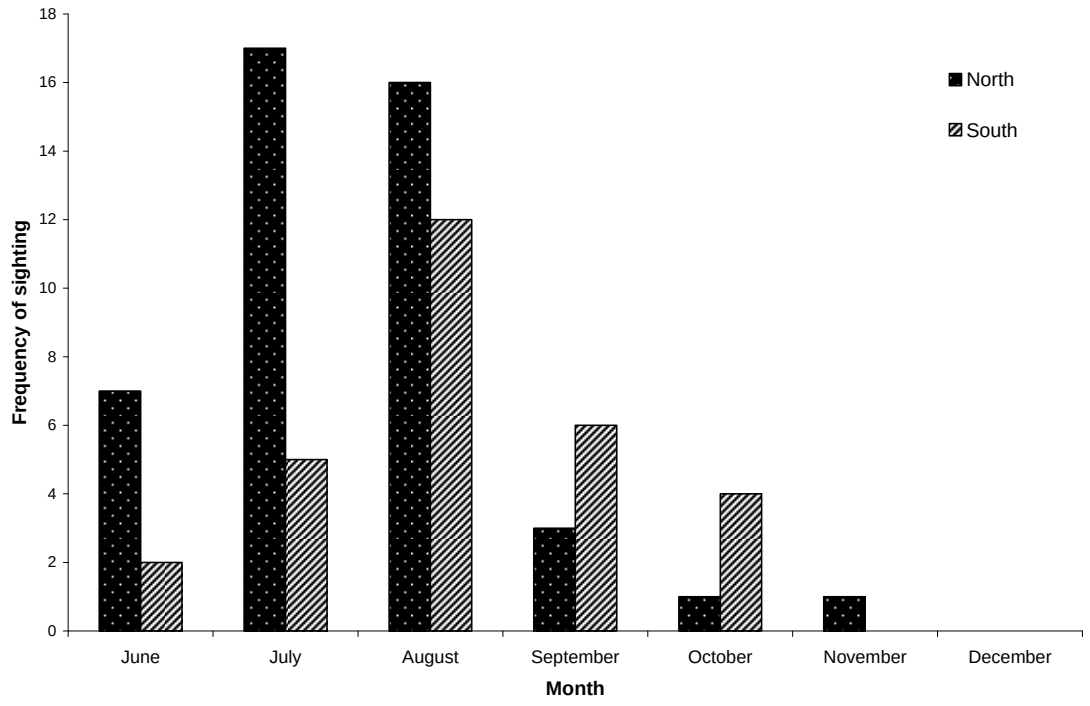
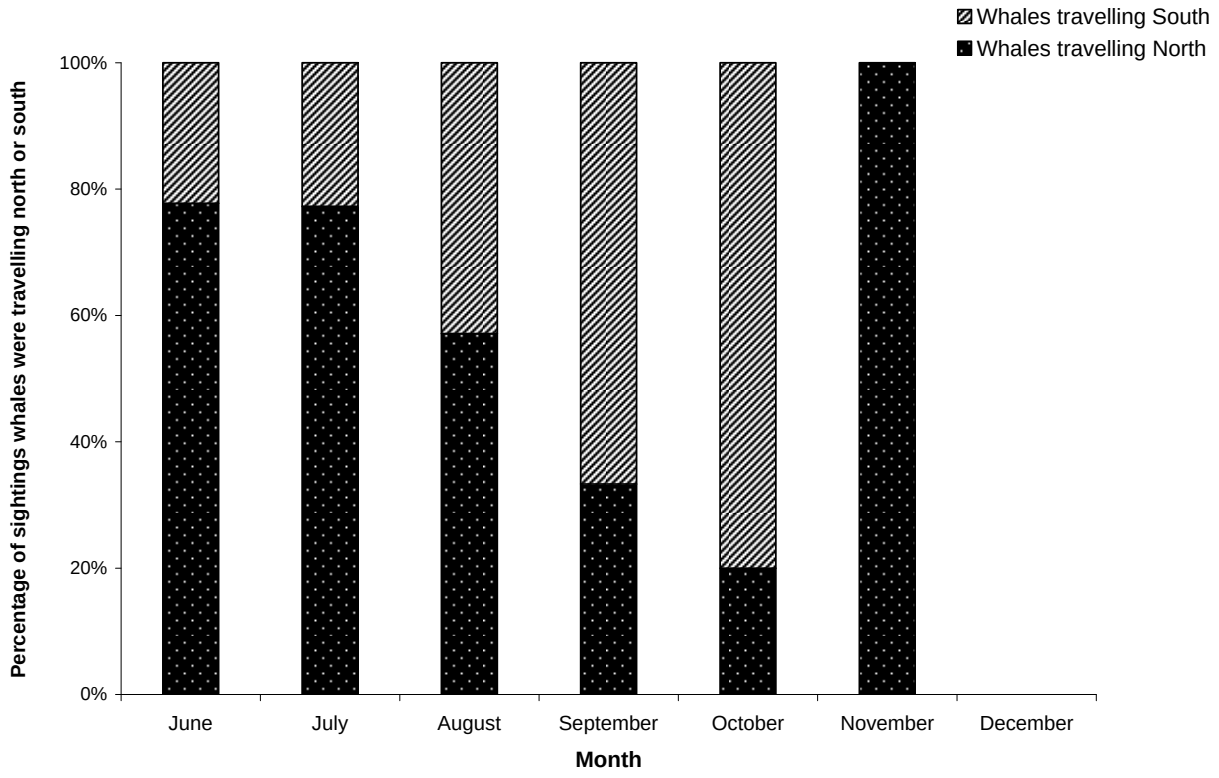


Figure 7 shows the frequency of sighted whales identified as travelling to the south or north. Generally the graph suggests that a higher frequency of whales travels north at the beginning of the migratory season. This is supported by Figure 8 which shows the percentage of monthly sightings were sighted whales were travelling north or south. This clearly shows that the percentage of whales travelling north declines as the season progresses while the percentage travelling south increases. The data for November is slightly misleading as there was only one sighting travelling north.

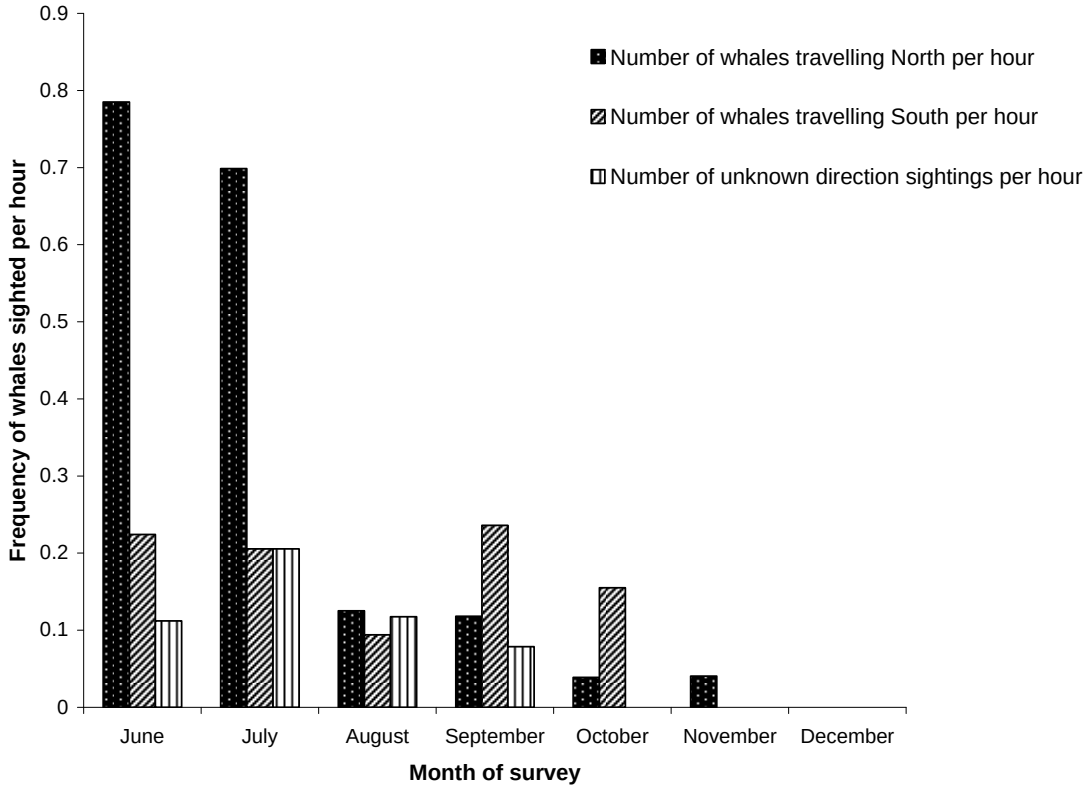
Figure 8. Percentage of whales sighted travelling north or south per month



Analysis shows that there are significant differences between the number of whales travelling north and south in the different months (ANOVA f = 3.852941, p = 0.05). Analysis of the directions of travel of the sighted individuals show that significantly more individuals travel north in July than they do in September (ANOVA f = 3.852941, p< 0.05).

This suggests that this study is documenting the passage of migrating individuals off the SW coast of Madagascar. Consistent with knowledge of the migratory behaviour of eastern populations it is likely that these whales are travelling to warmer breeding grounds at the beginning of the austral winter and returning to Antarctic feeding grounds as the weather begins to warm.

Figure 9. Number of whales sighted travelling north, south or direction unknown per month



Unfortunately it was often hard to determine direction of travel of the whales particularly in rough seas, and particularly as the season progresses because the whales showed less aerial activity when travelling southwards. Figure 9 includes the sightings when direction of travel was not noted, and shows that errors in determining direction of whales become more common as sightings become more frequent. The highest number of unknown direction sightings occurs in August, coinciding with the month with the highest number of sightings.

Discussion

This study highlights the seasonal changes in humpback whale abundance in the Mozambique Channel off the coast of Southwest Madagascar. Regular sightings were recorded following the first incidental sighting on June 16th 2007. Surveying was halted on 5th December, after 15 survey trips in November and December produced just one sighting suggesting the migratory period had ended.

It is expected that humpbacks will be documented travelling north at the beginning of the season and returning south at the end. The reduction in whales heading north throughout the season noted in this study was statistically significant. Figure 8 provides evidence to indicate that whales move south after moving north, as the percentage of whales travelling north declines as the season progresses while the percentage travelling south increases. There is a later peak in abundance of the southbound population which is consistent with observations and knowledge of their migratory behaviour.

However, less whales were sighted travelling south, and this is likely due to the variance in whale behaviour during the different stages of the migration. Whales travelling north towards breeding grounds often engage in courtship displays, and full body breaches and other aerial displays make these whales easier to see from the survey platform. With newly trained volunteers conducting the monitoring it is possible that less obvious blowing and travelling activities may not have been sighted as regularly. This may explain the reduced number of whales seen travelling south. On the return trip to feeding grounds at high latitudes whales are no longer focused on breeding and mating. Newly born calves escorted by their mother are unlikely to show much activity and other individuals are also less likely to exhibit aerial displays after 3 months without eating. Documented losses in body weight of up to one third (Leatherwood & Reeves 1983) support the conclusion that whales returning south are less likely to perform aerial displays.

Problems

The high percentage of August sightings with no identified direction of travel suggests that volunteers should be better trained before they are sent out to the platform and that they were often unable to determine direction of travel of the whales. Ideally the same observer would be used for each observation period to reduce observer bias but given both time and financial constraints this was not possible. With suitable funding it would be extremely beneficial to employ someone on a full time basis to observe from the platform. The local Vezo fishing populations spend long periods at sea fishing from small dug out canoes known locally as 'pirogues' and are accustomed to looking for anomalies at sea. The trained observers were transported to the Nosy Hao in pirogues, and when the pirogue captains joined the volunteers on the platform it was often commented that they sighted the cetaceans first.

The data collected during this project have generated an excellent insight into the relative abundance of whales in the south west region of Madagascar and hence migratory behaviour. However, there are also several limitations. The methodology used does not allow an assessment of the absolute population size or structure, nor does it allow the identification of individual whales. If the project could be developed to include a method for identifying the individuals travelling through the area the scope of the monitoring project would be greatly increased.

When survey effort was factored into the sighting data to produce figures for sighting per hour per month, the high values for June suggest that surveying may have commenced after the start of the migratory period. The first incidental sighting was used as the trigger for beginning the tri-weekly monitoring programme, but this may not be sufficiently early to record the whole migratory period so for future years it would be better to start the monitoring earlier, perhaps at the beginning of June.

Future Directions

The large number of incidental sightings from or around Nosy Andranombala suggests this island could form a useful base for further study. Andranombala is a small, 0.41 km^2 island approximately 14 km from Andavadoaka. It is 6 km offshore and surrounded by deeper water than Nosy Hao which is adjacent to a large lagoon. This may explain the abundance of incidental sightings. A second platform constructed here could generate a second data set which could be compared with sightings recorded from Nosy Hao. This island could also form a useful base for a boat based project if suitable funding could be generated. The barrier reef around Nosy Hao limits boat access and a successful boat based project operating in this area would have to be based on the mainland in Andavadoaka. This would increase petrol use and add 5-6 kilometres to the journey each day. If the boat was based on Andranombala semi permanently the fuel budget should be lower, although supply trips to the mainland would have to be made at regular intervals.

This study has shown that humpback whales are migrating both north and south along the west coast of Madagascar. It shows that a cheap and simple, volunteer-based monitoring programme can provide a valuable insight into the relative migratory flow of *Megaptera novaeangliae*. This study represents the first survey of the whale migration along the west coast of Madagascar and presents evidence that a large number of individuals are passing through the area. This highlights the need for further study on this part of the migratory route as tourist or mining developments in the region has the potential to negatively impact the migratory flow of the humpback whales.

At present it is unclear whether the whales passing the southwest coast of Madagascar belong to the C2 or C3 subpopulations. Due to the geographical location of the Comoros Islands it could be assumed that the whales transiting through the Mozambique Channel off the southwest coast of Madagascar belong to the C2 stock. However, this could only be confirmed through the identification of the individual whales and comparisons with WCS databases of individuals sighted around the Comoros Islands. This study was completed on a negligible budget without the use of motorboats, yet produced some very valuable findings. Increased financial support is now required to extend this project to include either photo identification or genetic tagging studies to identify the individual whales passing through the area in an attempt to classify the subpopulation and stock to which they belong.

The evidence in this report of the presence of humpback whales in the region highlights the potential importance of whale monitoring for driving the ecotourism market in the area and attracting more visitors. Whales are a large charismatic and flagship species and with efficient management and the use of a land based platform whale watching activities will have no negative effect on the individuals passing through this area. Encouraging local communities to offer whale watching trips to Nosy Hao provides an alternative source of income and reduces their direct dependence on the exploitation of marine resources.

Conclusions

(i) Humpback whales are migrating north- and southwards along the western coast of Madagascar between June and November.

(ii) It is likely that the migratory period begins earlier than this project began surveying. Future projects should take this into account during the planning stages.

(iii) The migratory season appears to end in October (although this may vary annually if climatic conditions differ).

(iv) Useful data on the humpback whale migration can be generated from a cheap and simple monitoring programme.

(v) Further study is required to better understand which sub-population and stock these whales belong to and thus determine what their destination is.

Acknowledgements

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References

Best PB, Findlay KP, Sekiguchi K, et al. (1998) Winter distribution and possible migration routes of humpback whales (Megaptera novaeangliae) in the Southwest Indian Ocean. *Marine Ecology Progress Series*, **162**, 287-299.

Best PB, Sekiguchi K,Rakotonirina BP, Rossouw A (1997) The distribution and abundance of humpback whales off Southwest Madagascar, August-September. *Report to the International Whaling Commission*, **46**, 323.

Best, P.B., Rademeyer, R.A., Burton, C., Ljungblad, D., Sekiguchi, K., Shimada, H., Thiele, D., Reeb, D. and Butterworth, D.S. (2003). The abundance of blue whales on the Madagascar Plateau, December 1996. *Journal of Cetacean Resource Management* **5**(3):253-60.

Cerchio, S., Pomilla, C., Ersts, P., Razafindrakoto, Y., Leslie, M., Andrianrivelo, N., Collins, T., Dushane, T., Dushane, J., Murray, A., Weber, D. & Rosenbaum, H (2006) Estimation of abundance of breeding stock C3 of humpback whales, assessed through photographic and genotypic mark-recapture data from Antongil Bay, Madagascar. *SC/A06/HW9 presented to the IWC Scientific Committee Workshop on the Comprehensive Assessment of Southern Hemisphere humpback whales*. April 2006, Hobart, Australia (unpublished).

Clapham P. (2002) "Humpback Whale", IN Perrin W.F., Wursig, B. & Thewissen, J.G.M (*ed*) *Encyclopedia of Marine Mammals*, pp 589–592. ISBN 0125513402

Clapham, P., Young. S and Brownell, R. (1999) Baleen whales: conservation issues and the status of the most endangered populations. *Mammal Review* **29:**1, 35–60.

Craig, A. S., Herman, L. M. & Pack, A. A. (2001) Estimating residence times of humpback whales in Hawaii. *Report by the Dolphin Institute on behalf of Hawaiian Islands Humpback Whale National Marine Sanctuary and National Oceanic and Atmospheric Administration.*

Ersts, P. J & Rosenbaum, H, C. (2003) Habitat preference reflects social organization of humpback whales (*Megaptera novaeangliae*) on a wintering ground. *Journal of the Zoological Society of London* **260**: 337–345

Katona, Steven K., and Hal Whitehead. 1981. Identifying Humpback Whales Using Their Natural Markings. *Polar Record* 20:439-444.

Kellogg R. (1929) What is known of the migration of some of the whalebone whales. *Annual report of the Smithsonian Institution* **1928:** 267-494.

Leatherwood S., Reeves R.R. 1983. The Sierra Club handbook of whales and dolphins. Sierra Club Books, San Francisco. 302 pp.

Mackintosh, N. A. 1942. The southern stocks of whalebone whales. *Discovery Reports XXII*: 197–300.

Mead, J. G., and Brownell, R. L., Jr. 1993. Order Cetacea, Pages 349-364, In: Mammal species of the world: A taxonomic and geographic reference. D. E. Wilson and D. M. Reeder (eds.), Smithsonian Institution, Smithsonian Press, Washington, D.C.

Rosenbaum. C., P. D. Walsh, P.D., Razafindrakoto, Y., Ely, O,V. and Desallie, R (1997) First description of a humpback whale wintering ground in Baie d'Antongil, Madagascar. *Conservation Biology* **11**:312-314.

Starbuck, A. (1878). History of the American Whale Fishery from its Earliest Inception to the Year 1876. United States Commission of Fish and Fisheries, *Report of the Commissioner for 1875-1876*, Appendix A. Government Printing Office, Washington, DC.

Web Resources

CBC website (2nd May 2008) http://research.amnh.org/biodiversity/center/programs/whales.html

IWC website (2nd May 2008) http://www.iwcoffice.org/conservation/estimate.htm#assessment