



Cruise report for DTAG support and photogrammetry research conducted on humpback whales (*Megaptera novaengliae*) in and around the Stellwagen Bank National Marine Sanctuary (SBNMS) conducted from R/V *Song of the Whale* 1st June to 7th July 2012

**By the
International Fund for Animal Welfare
and
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SUMMARY

The IFAW research vessel *Song of the Whale* (SOTW) visited the USA in July 2012. The aim of the visit was to collaborate with the Stellwagen Bank National Marine Sanctuary’s scientists on a DTAG study of humpback whales, test and develop new non-invasive techniques for measuring the length of whales and build public awareness of SOTW and IFAW’s whale research program locally in Massachusetts and nationally in the USA. The SOTW team hosted one public open day, two press days and took part in a 14 day DTAG cruise offshore from Cape Cod between 1st June and 7th July 2012. The humpback whale research was planned to take part in the Stellwagen Bank National Marine Sanctuary; however the vast majority of humpback whales encountered during the research period were bottom and surface feeding further offshore and subsequently this is where the research was conducted. A total of 21 whales were tagged with suction cup D Tags by the SBMNS/ NOAA team and 160 animals photographically identified throughout the period; SOTW team tracked eight of the tagged animals for periods from 45 minutes to 19 hours.

1 INTRODUCTION

1.1 Public Awareness

IFAW’s R/V *Song of the Whale* research program has conducted research on marine mammals around the world for 25 years. A long-term goal of the program has been to develop non-invasive

techniques to provide those data essential for the conservation of threatened species. *Song of the Whale* team has worked on projects across the North Atlantic and Mediterranean in over 25 countries including the United States and Canada. In order to further IFAW's public outreach and disseminate the research findings of SOTW and conservation messages, the team regularly host open days and publicity events onboard SOTW, especially in and around those areas local to the research project. The SOTW team spent summers between 1997 and 2001 and again in 2005 working in the Gulf of Maine and Bay of Fundy studying right whale vocalisations and behaviour to determine the feasibility of using acoustic detection to prevent ship strikes. Through a combination of advocacy, policy work with industry and research, IFAW was subsequently instrumental in developing the real time detection/warning system of buoys now in use and moving the shipping lanes on the approach to Boston Harbour to reduce the risk of ship strikes to right whales. Additionally, IFAW has conducted several workshops and published scientific papers on the possibilities of protecting right whales with acoustic recording devices. New England now boasts one of the most well-developed acoustic-based conservations schemes in the world which was achieved through the joint efforts of a number of organisations, of which IFAW was included. The production of IFAW's new Whale Alert iPad Application and the visit of SOTW in the summer of 2012 aimed to reignite interest in and awareness of IFAW and the whale conservation activities of the organisation both locally and around the world.

1.2 Stellwagen Bank National Marine Sanctuary DTAG project

While in USA, the SOTW team also took part in a project conducted by Dave Wiley's research team from the Stellwagen Bank National Marine Sanctuary (SBNMS) to attach DTAG and Crittercams to humpback whales (*Megaptera novaeangliae*). Since 2002, Dave Wiley has been using DTAGs to study whale foraging and acoustic behaviour off MA. Over 90 animals have been tagged in the last 10 years, with some individuals tagged several times (*Pers. comm.* Dave Wiley). The goal of the project in 2012 was to investigate the use of the water column by humpback and fin whales (*Balaenoptera physalus*) and determine how prey patch characteristics may influence their behaviour. It is hoped results from these studies will inform mitigation measures related to collisions between whales and commercial vessels or fishing gear. A secondary aim was to collect acoustic data to evaluate the efficacy of passive acoustic monitoring for these species by age and reproduction class. These goals were realised through tagging the animals with synchronous-motion acoustic recording DTAGs, while concurrently measuring prey field size, shape and composition. The DTAG was developed by Peter Tyack and Mark Johnson at Woods Hole Oceanographic Institute (Johnson and Tyack, 2003) and records the pitch, roll, heading, dive depth, fluke strokes and vocalisations of a tagged animal over a period of time. The DTAG is a small, lightweight, pressure

tolerant and waterproof tag, temporarily attached to a whale using four silicon suction cups (Friedlaender *et al.*, 2009). The tags have a proven track record having been used on several species around the world (Johnson *et al.*, 2003; Nowacek *et al.*, 2002; Nowacek *et al.*, 2004, Ware *et al.*, 2006, Woodward and Winn, 2006).

Additionally, 2012 was the 20th anniversary of the creation of the Stellwagen Bank National Marine Sanctuary and as such, members from sister sanctuaries in the Caribbean Sea came to join the team on SOTW to understand more fully the conservation objectives and successes at Stellwagen. Kai Wulf from Saba Marine Sanctuary, Dutch Antilles and Gaelle Vandersarren from Guadeloupe National Park/ SPAW-RAC joined the team for part of the week and while on board were given a lecture about the process of moving the shipping lanes near Stellwagen and the recent changes in fishing gear used within the Sanctuary.

1.3 Paired-Laser Photogrammetry

Morphometric information on marine mammals is required in order to understand more about the life histories, development and behaviour of different populations and age classes. Traditionally this information could only be collected through live capture or analysis of dead animals, such as beached specimens or those killed during whaling. It is possible to measure the proportions of some species using acoustic techniques (for example sperm whale length; e.g. Rhineland & Dawson, 2004) but these techniques are not available for all species and vary considerably according to age class. In 2012 the SOTW team tested a paired laser technique to measure the relative length of humpback and minke whales during the Stellwagen Bank research. Paired laser photogrammetry has been used on a number of other smaller species of cetacean (Durban and Parsons, 2006; Rowe & Dawson, 2008; Webster *et al.*, 2010) and elasmobranchs (Deakos, 2010) in the past with some success. The technique uses lasers mounted on a camera at a known distance apart. Photographs of the laser dots projected onto the subject animals body perpendicular to the camera are taken. Through knowing the exact distance between the dots and the relative size of a dorsal fin or fluke to the total animal size, the total length of an animal can be estimated. There are no published examples of this technique being used on larger whales such as humpbacks or minke whales. The humpback whale population of the Gulf of Maine has been studied since 1979 and 5,200 individual whales have been identified in photographic identification catalogues (www.whalenet.org). Many of the whales in this area have known sex and age classes which will allow the accuracy of using the laser - photogrammetry technique on large whales to be analysed. If the technique proved successful then it could be used reliably on less well known population in the future.

AIMS

1. Public awareness - Increase the public awareness of IFAW's non-invasive whale research program aboard their purpose built research vessel *Song of the Whale*.
2. Assist in the SBNMS DTAG cruise to help celebrate the sanctuary's 20th anniversary.
3. Test and develop a non-invasive research technique to measure body proportions of living marine mammals.

2 METHODOLOGY

Song of the Whale arrived in Boston, USA, on the 1st June after crossing the Atlantic from the Azores, Portugal. Several weeks were spent in port for open days and press events and general boat maintenance before heading out on a research cruise to Stellwagen Bank Marine Sanctuary on the 17th June.

2.1 Public Awareness

During the visit, SOTW was moored at the Waterboat Marina and Boston Yacht Haven Marina, both excellent locations in central Boston to raise IFAW and SOTW's public profile.

A World Ocean Day Event, on the 2nd June, took place at the New England Aquarium and provided an ideal base for an open day on *Song of the Whale*. Over three hours approximately 200 people were shown around SOTW and given information about IFAW, its work with whales generally and more specifically SOTW's work around the world, especially in the USA.

On the 15th June, Kerry Branon, press officer from IFAW HQ, arranged a full day of press interviews for a number of local and national papers and TV news stations.

While out on research trips, two visits from major donors were arranged to showcase the research vessel in action; a press visit from Fox Connecticut News also took place at sea.

2.2 Stellwagen Bank National Marine Sanctuary DTAG survey

Synchronous motion, acoustic recording tags (DTAGs) and National Geographic Crittercams attached to suction cups were placed on animals using pivoting ca.10 m poles mounted on the bow of the NOAA RHIB *Balena*. The Crittercam video images were used to truth the DTAGs, confirming the data collected from the pitch and roll emulated the behaviour of the animals, and thus Crittercams were often placed simultaneously with the DTAGs on the same animal. Photo ID images, video footage

and behavioural sequencing data were taken throughout the tagging process from *Balena*. Each DTAG was equipped with a pressure sensor and 3-axis magnetometer and accelerometers that measure depth, heading, pitch, and roll five times per second. The tags also had VHF transmitters emitting pulses at a known frequency. Each time the whale surfaced and the tag was above water, the pulses were detected using VHF receivers based on the *Balena* as well as a number of other vessels: NOAA's R/V *Auk*, IFAW's R/V *Song of the Whale* and NOAA's R/V *Nancy Foster*. Data were recorded on the tag during deployment and were later downloaded for analysis.

NOAA's R/V *Auk* engaged in fine scale prey mapping in close proximity to tagged whales, while the R/V *Nancy Foster* provided mid-range prey mapping. On those nights without tagged whales, the R/V *Nancy Foster* conducted multi-beam surveys of selected areas for maritime heritage and/or fine scale bathymetry and sediment determination.

The SOTW team's main role in the tagging survey was to provide a tracking vessel. R/V *Song of the Whale* is a 21 metre auxiliary-powered cutter-rigged sailing research vessel, owned by IFAW and operated by Marine Conservation Research (MCR) Ltd. A four-way cardinal direction facing antenna system comprising 4 x Telonics Yagi antennas was mounted approximately seven metres above sea level on top of an A-frame on the aft deck of SOTW. This was connected to an Advanced Telemetry Systems (ATS) light box which provided a visual representation of the relative VHF pulse signal strength received by the four antennas. Depending on the strength of the pulse received by each aerial one to five LED's would light up demonstrating in which quadrant the tagged whale had surfaced and how far away it was.

This method of tracking a tagged whale continued during daylight and night time hours. Each DTAG was programmed to stay on for a maximum of 24 hours whilst each Crittercam was programmed to remain on for daylight hours.

During daylight hours focal follows were carried out from the tracking vessel collecting data including: behavioural sequencing using 60 three-letter codes, GPS location, group size and composition, photo ID images of the target animal and all others associated and images of any movement of the tag on the animal.

Additionally each hour a “snapshot” scans of the whales in the area was undertaken to highlight potential tagging areas and every half hour a “snapshot” of birds in the area were counted to have another proxy for areas of high productivity.

2.3 Paired-Laser Photogrammetry

Two Z-bolt BTG10 green laser pointers were mounted in parallel on the tripod mounting ring of a 70-200mm telephoto lens separated by 100 mm. Photographs of the flukes of humpback whales and / or the dorsal fin to blowhole area of a humpback or minke whales were taken. Ideally the green dots from the lasers would show in the digital image captured. For the technique to work, it was important the fluke or body of the animal had to be at a 90° angle to the photographer to allow an image without any angle distortion. Each digital image recorded the exact focal length of the lens during the shot allowing length measurement of the animal from the images collected.

3 RESULTS AND DISCUSSION

Although the initial plan for the DTAG survey was to occur within Stellwagen Bank Marine Sanctuary during the research period 17th – 29th June very few animals were sighted within the SBNMS. However, several hundred humpback whales were seen surface and bottom feeding further offshore to the south of the sanctuary and therefore all of the tagging effort occurred here.

3.1 Stellwagen Bank Marine Sanctuary DTAG survey

In total, the 2012 DTAG survey tagged 21 individual animals and photo-identified 160 individuals (Figure 1). The SOTW team carried out eight tracking events ranging from 45 minutes to 18 hours and 58 minutes (Figure 2). The tracking events were for a mixture of DTAGs and Crittercams placed on animals. As this research was led by Dave Wiley at SBNMS and NOAA, the tracking data, 3D modelling and acoustics are not presented in this report.



Figure 1: A whale's eye view of R/V *Song of the Whale*. A still crittercam image of a tagged whale "DropZone", which was tagged with both a DTAG and Crittercam and tracked by SOTW.

Every half an hour a "snapshot" of the birds in the area were counted to add to the ecosystem indications of high productivity areas. Shearwaters were the most numerous genus we saw during the DTAG cruise especially in areas where the whales were surface feeding. Both sooty and great shearwaters were seen in groups of up to several hundred individuals. In areas where the whales were feeding storm petrels were also sighted in groups of approximately 50 or less. Large gulls, mostly black-backed, were also seen in much smaller numbers, typically one or two in areas where the whales were not surface feeding.

Humpback whale research off Cape Cod, USA from R/V Song of the Whale, summer 2012

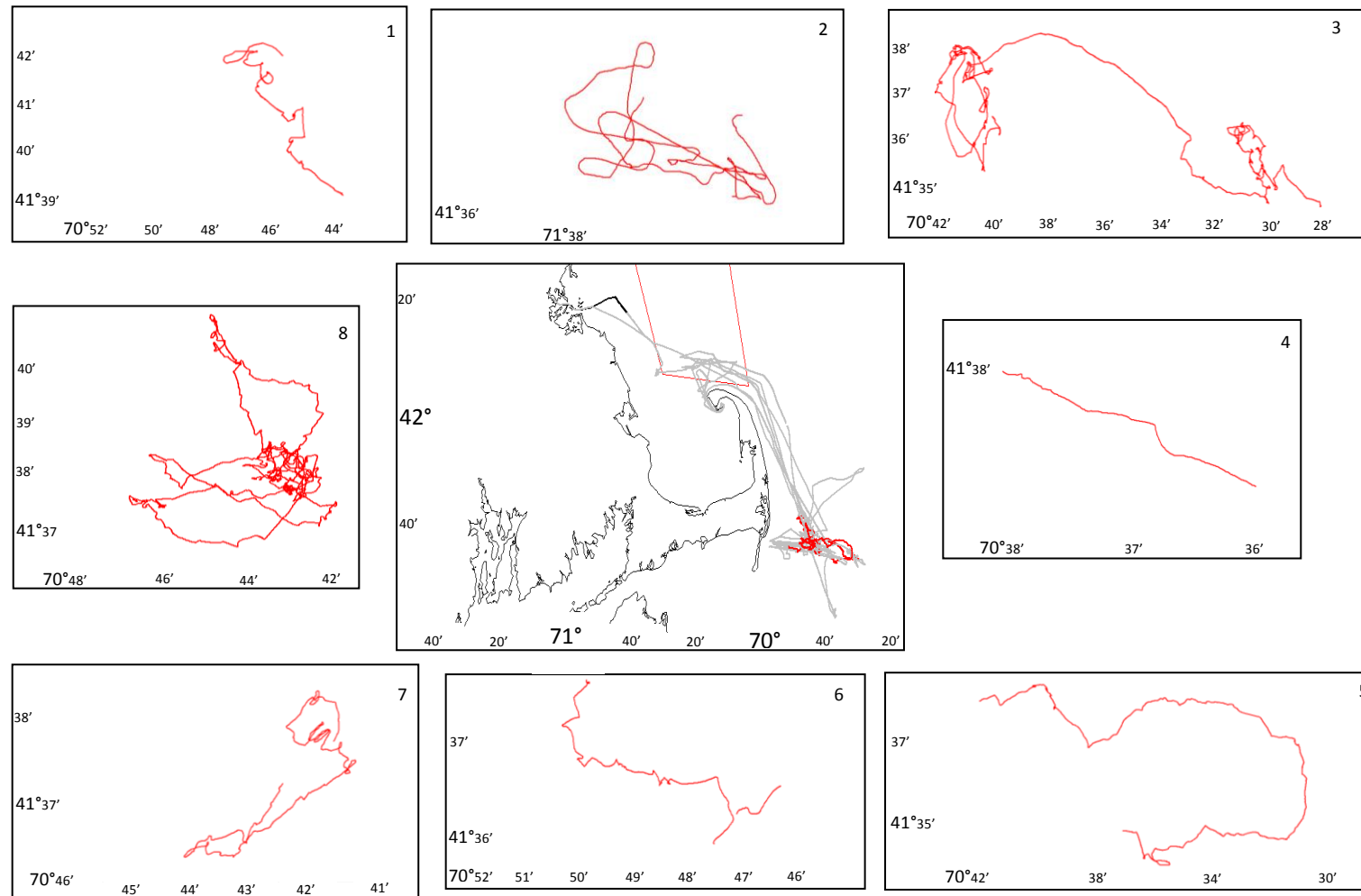


Figure 2: A central map showing Cape Cod and Stellwagen Bank National Marine Sanctuary (red box) with the tracking effort of the cruise shown in red, and the ship's track in grey. The eight images around the central map show each of the tracking events SOTW conducted. 1. 19/06/2012 15:58 to 20:17; 2. 20/06/2012 20:43 to 23:00; 3. 21/06/2012 14:30 to 22/07/2012 08:15; 4. 22/06/2012 13:36 to 14:22; 5. 24/06/2012 14:13 to 21:49; 6. 26/06/2012 18:43 to 21:05; 7. 27/06/2012 16:23 to 19:58; 8. 28/06/2012 12:14 to 29/07/12 07:12.

3.2 Paired-Laser Photogrammetry

Photogrammetry images were taken opportunistically when whales were within 100 metres of the *Song of the Whale*. Approximately 600 images were taken in this manner. Few of these were successful photogrammetry images however due to several limitations discovered when conducting this research in the field. The most common constraint was having animals perpendicular to the photographer in order to get a usable shot. This issue was exacerbated by the opportunistic methodology used to capture these images and a more dedicated effort with the vessel would lessen this limitation substantially. Additionally, the lasers, although relatively high power, did not show up in the photographs when an animal was more than 40 metres away which may be due to the lasers power output being insufficient given the ambient light levels and distance to the whale, or due to a combination of this, the focal length of the lens and image resolution. The SOTW team were using a 70-200mm telephoto lens and with this it was difficult to capture the animal's side profile with blow hole to dorsal fin in the correct area of the photograph to get the lasers on the animal when the animal was further than 40 metres away. This issue was less problematic for fluke shots (Figure 3).

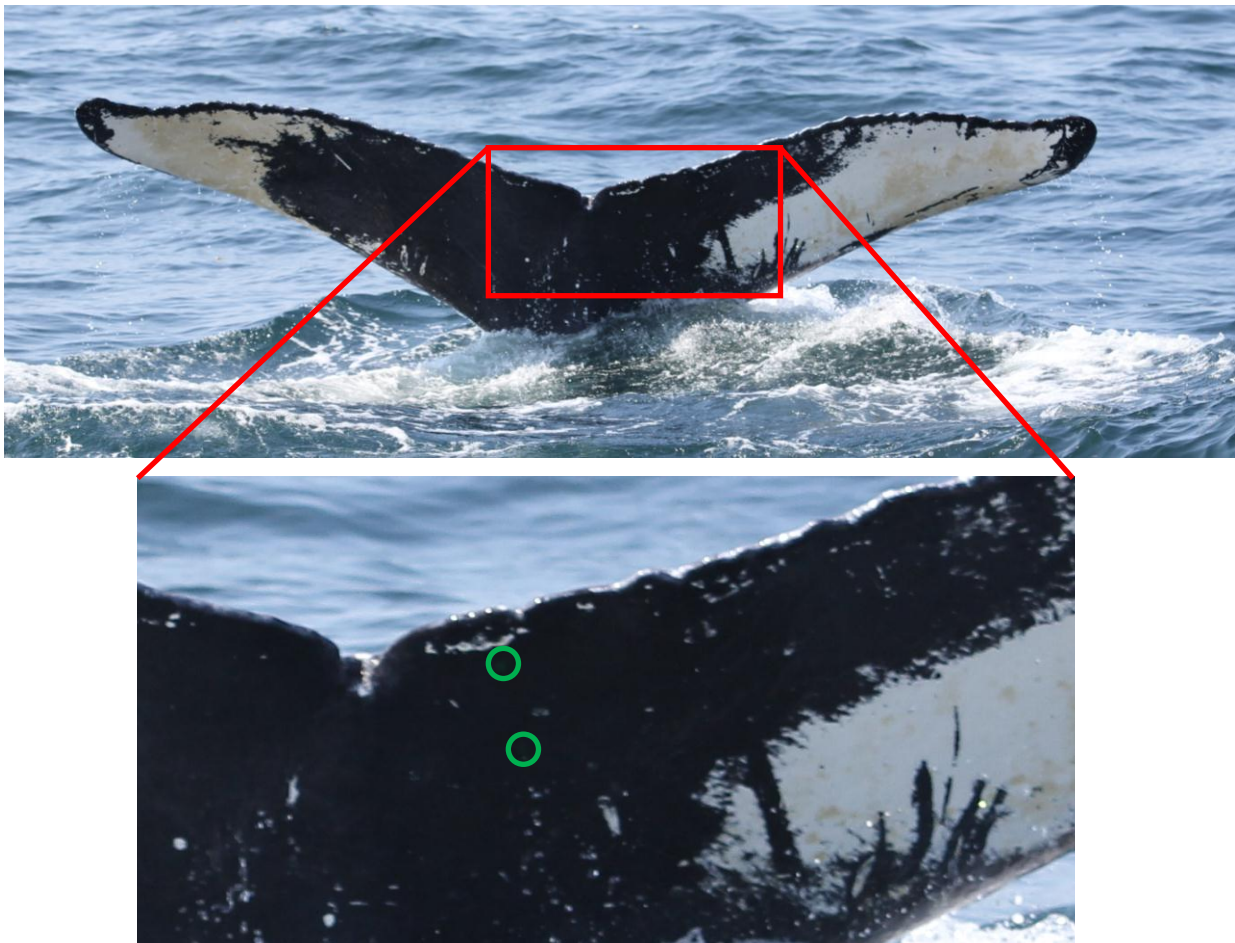


Figure 3: A fluke shot taken at 34 metres from the vessel using 200 mm zoom. The circles highlight the two green laser dots which can be used to estimate the width of the fluke and in turn the size of the animal.

3.3 Additional Effort and Public Outreach

On the 23rd June the SOTW team aided the Provincetown Centre for Coastal Studies (PCCS) in searching for an entangled whale “Dome” and her calf. Unfortunately the whale was not found. On the afternoon of the 23rd June the tagging cruise halted for some hours during the day to help the National Marine Fisheries Service collect a number of pop-up buoys which had been deployed earlier in the year to detect right whales. The M/V *Nancy Foster* went offshore to try and collect one buoy while the SOTW headed to Davis Bank to find a second buoy. The SOTW team collected the pop-up buoy successfully.

On the 25th June there were reports of an entangled leatherback turtle in the vicinity in which SOTW was working. SOTW agreed to commence a search for this animal with the IFAW funded spotter plane from the PCCS disentanglement team. The spotter plane did spot the entangled turtle however the turtle dived before SOTW could reach the area; the turtle was not seen again. In the afternoon of the 25th June SOTW headed close into Cape Cod to pick up a news crew from FOX Connecticut news. Unfortunately the weather was very poor so no whales were seen; however a successful round of interviews and boat footage were taken.

On two separate occasions during the research cruise June major donors travelled out to SOTW to see the research team in action. Both visits were very successful.

As this research cruise was a dedicated tracking project, sightings of marine mammals were not collected in the traditional way.

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