

Satellite tracking of southern right whales (*Eubalaena australis*) at the Auckland Islands, New Zealand

SIMON CHILDERHOUSE, MICHAEL C. DOUBLE, NICK GALES

Australian Marine Mammal Centre, Australian Antarctic Division, DEWHA, Hobart, Australia

ABSTRACT

We attached satellite tags to 6 humpback whales off the Auckland Islands in sub-Antarctic New Zealand during July 2009. The tags lasted for an average of 75 days (range: 1-167 days) and provided data on migratory movements of three individuals between the Auckland Islands and assumed feeding areas south of Australia

KEYWORDS: SATELLITE TRACKING, SOUTHERN RIGHT WHALE, STOCK D, STOCK E, AREA IV AREA V, ANTARCTICA

INTRODUCTION

Satellite telemetry has been used routinely in wildlife biology for nearly two decades and has been applied successfully in studies of many marine organisms including penguins, albatrosses, seals and even sharks e.g. (Bonadonna *et al.*, 2000; Gifford *et al.*, 2007; Jouventin *et al.*, 1994; Weimerskirch *et al.*, 1993). The use of this technology in understanding the migration of large whales has, however, lagged behind other taxa largely due to the inability to catch and attach tags to such large species. It is only relatively recently that research groups developed reliable tags that can be implanted into free-ranging whales (e.g. Gales *et al.*, 2009; Heide-Jørgensen *et al.*, 2001; Mate *et al.*, 2007). Such tags have now been used in studies of many large whales species such as blue (Heide-Jørgensen *et al.*, 2001; Mate *et al.*, 1999), humpback (Dalla Rosa *et al.*, 2008; Gales *et al.*, 2009; Lagerquist *et al.*, 2008), sei (Olsen *et al.*, 2009), right (Baumgartner & Mate, 2005), bowhead (Mate *et al.*, 2000) and minke whales (Heide-Jørgensen *et al.*, 2001), although large scale deployments are still rare.

There has only been one other satellite tracking study of southern right whales in South Africa where 21 tags were deployed in 2001 with tags lasting from 25-161 days (Mate & Best 2008). The study showed alongshore and offshore movement of whales and identified some probable feeding areas, associated with the Sub-Tropical convergence and the Polar Front. Resighting of tagging individuals up to 1,502 days after tagging showed that most females with calves that were tagged were later resighted with a calf at intervals comparable to those that the same individual showed before tagging (Best and Mate 2007).

The Auckland Island population of right whales was estimated to number around 938 (95% CI 740-1140) individuals in 1998 and to be at less than 5% of pre-exploitation size (Patenaude 2002). Some migratory connections of right whales from the Auckland Islands have been reported including photo-identified right whales from Campbell Island (Patenaude *et al.* 2001) and South Australia (Pirzl *et al.* 2009) but not from mainland New Zealand (Childerhouse unpublished data). However, recent genetic evidence has matched individuals between the Auckland Islands and mainland New Zealand (Carroll *et al.* 2010). It has been hypothesised the Auckland Islands and the mainland New Zealand population of whales could represent two separate stocks given apparent differences in recovery (Patenaude 2002, Richards 2002, 2009) but genetic evidence has suggested the areas are not differentiated (see Carroll *et al.* 2010).

The aim of this work was to investigate (i) the feasibility of tagging southern right whales using a new tag designed by the Australian Antarctic Division and (ii) the migratory pathways and habitat utilisation of Auckland Islands right whales.

METHODOLOGY

The tags consisted of a custom-designed, implantable housing that contained Wildlife Computer (Redmond, Washington, USA) Spot 5 transmitters. The tags are designed to implant up to a maximum of 290mm into the back of the whale (generally just forward and to the left or right side of the dorsal fin). The front 80mm of the tag disarticulates from back section of the tag post-deployment; a flexible 5mm multi-braided stainless steel wire maintains a coupling between the two parts. The tag is designed to penetrate beneath the skin and hypodermis and anchor the tag within the variable muscle and connective tissue matrix that underlies the blubber. Retention of the tag is maintained through two actively

sprung plates, and a circle of passively deployed 'petals'. All external components of the tag are built from stainless steel and the tag is surgically sterilised prior to deployment (for photographs see Gales *et al.*, 2009).

Each tag is deployed with the use of a compressed air gun (modified ARTS) set at pressure of between 7.5 and 10 bar. A projectile carrier is attached to the rear of the tag by some retention teeth and is fired at the whale from the bow-sprit of a 5.8m rigid-hulled inflatable boat at a range of 3-8m. The rapid deceleration of the tag and carrier as they strike the whale leads to the withdrawal of the retention teeth that hold the tag to the projectile carrier and their subsequent disengagement. Once deployed, each tag turns on during the subsequent dive of the whale. They will then transmit upon each initial surfacing, and each 30 seconds of subsequent 'dry time' (if surface time >30sec). When first deployed the tags will run from the time they are turned on until 00:00 hrs UTC. They then transmit on a 6hr on, 18hr off duty cycle until the tag falls off the whale, malfunctions or the single AA lithium battery is exhausted.

Argos locations were filtered using the Speed-Distance-Angle function in the R package (R Development Core Team, 2007) 'argosfilter' (Freitas *et al.*, 2008) which has been designed specifically for the tracking data from marine mammals and is based on the algorithm developed by McConnell *et al.* (1992). This function will remove locations from the data set based on unrealistic swimming speeds, distances between successive locations and turning angles. The conservative default settings (maximum swimming speed of 7.2 km/h) were used for mapping purposes; more careful application of this filter will be applied for later analyses.

Skin biopsies were collected for genetic analyses. These were collected using a biopsy dart fired from a modified .22 Paxarms system (Krutzen *et al.*, 2002). Biopsies were usually collected simultaneously with the deployment of the satellite tag. Biopsies were stored in 70% ethanol and DNA subsequently extracted using either a salting-out protocol (Aljanabi & Martinez, 1997) or by using a the Tissue DNA purification kit for the Maxwell 16 DNA extraction robot (Promega Corporation). The sexes of the tagged whale were determined using a 5' exonuclease assay of the polymorphisms in the sex-linked Zinc Finger genes as described by Morin *et al.* (2005).

RESULTS AND DISCUSSION

Six tags were deployed on adult right whales, all without calves, during July and August 2009 at the Auckland Islands (50°S 166°E). Tags were deployed from a small inflatable that approached the whale slowly until within 5m of a whale when it was tagged. Longevity of tags lasted from 1 to 167 days with an average transmission time of 75 days. All tags were deployed well, achieving 95% or more implantation and in the middle of the back on a slight upward angle. There was no apparent difference in the deployment between the tags that had short or long transmission times.

Only three whales had transmitting tags when they left the Auckland Islands. All of these travelled to the south of South Australian between 38° and 48°S, although one of these whales visited the New Zealand mainland before heading west.. These are similar to high density areas of right whales reported in Kato *et al.* (2007) and Bannister *et al.* (1997) when the joint Japan/IWC cruise surveyed the area which is in the vicinity of the Sub-tropical convergence.

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Table 1. Summary of satellite tracking data after filtering from deployments on southern right whales at the Auckland Islands, New Zealand.

Argos No	Sex	Deployment date (UTC)	First fix (UTC)	Last fix (UTC)	No days between first & last fix	No days data received	Total no locations
96373	Male	25/07/2009	26/07/2009	9/01/2010	167	101	534
96374	Female	31/07/2009	31/07/2009	27/12/2009	149	146	1233
96375	Male	25/07/2009	2/08/2009	16/09/2009*	49	41	83
96376	-	24/07/2009	1/10/2009	26/10/2009	25	19	22
96377	-	24/07/2009	24/07/2009	24/07/2009	0	1	5
96378	-	1/08/2009	1/08/2009	29/09/2009	59	58	442

* an additional low quality transmission was received from this tag on 8/12/09 but did not provide a position

Figure 1. Individual movements after filtering of six southern right whales tagged at the Auckland Islands, New Zealand in July-August 2009

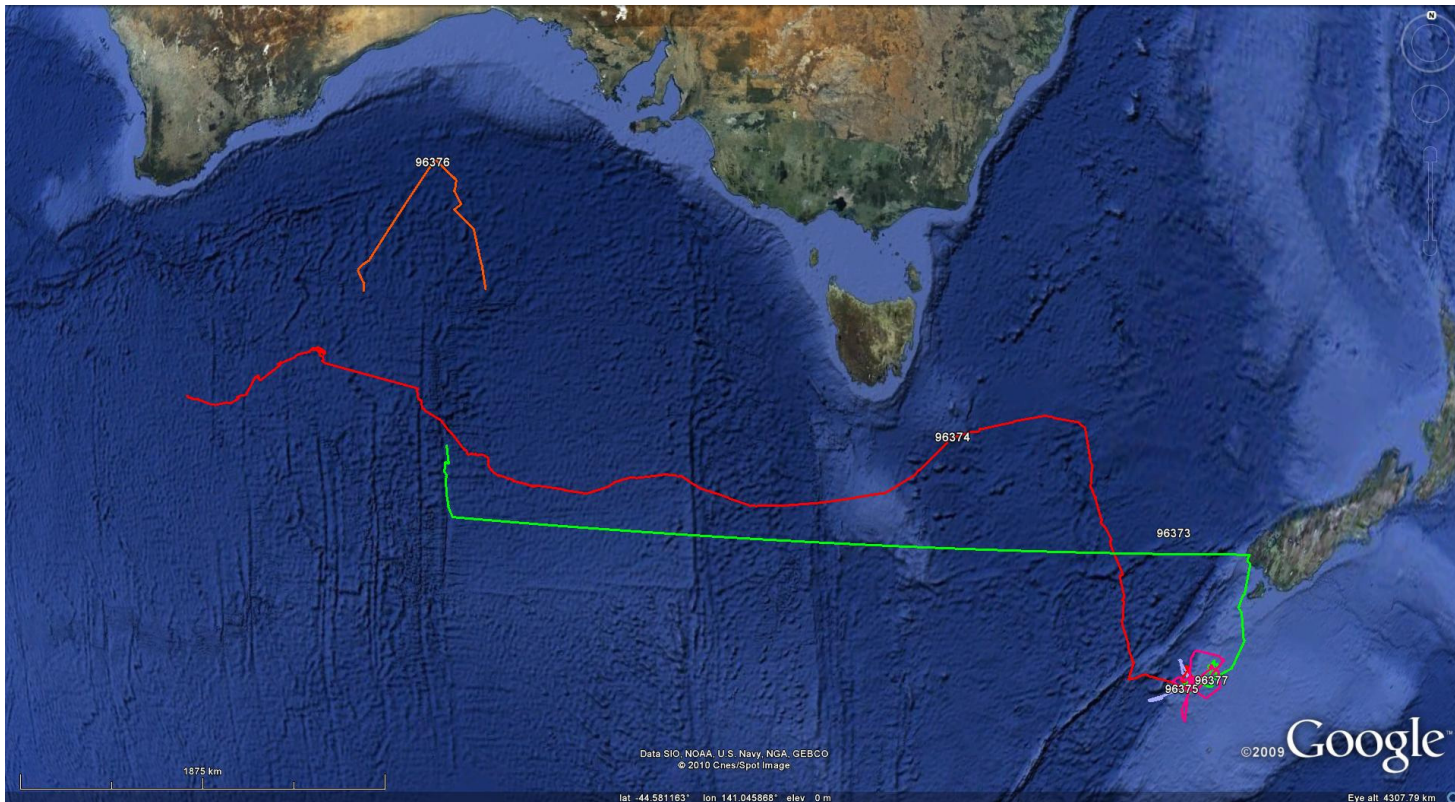


Figure 2. Individual movements after filtering of six southern right whales tagged at the Auckland Islands, New Zealand in July-August 2009

