MULTI-SPECIES CETACEAN SATELLITE TAGGING TO EXAMINE MOVEMENTS IN RELATION TO THE 2008 RIM-OF-THE-PACIFIC (RIMPAC) NAVAL EXERCISE

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Introduction

The Rim-of-the-Pacific (RIMPAC) naval exercise is a biennial multi-week multinational naval exercise that has been undertaken around the main Hawaiian Islands since 1968. Immediately prior to the 2004 RIMPAC exercise a group of 150-200 melon-headed whales, *Peponocephala electra*, a species that is typically found in deep waters in Hawai'i, entered Hanalei Bay on the north shore of the island of Kaua'i, and remained in the bay for more than 24 hours (Southall et al. 2006). While the exact cause of the event remains unknown, a review of available evidence concluded that active sonar transmissions by naval vessels prior to and during the period when the whales were inside the bay were a likely, if not plausible, contributing factor (Southall et al. 2006). Considerable uncertainty remains regarding the cause(s) of this event in part because no information is available on where the group of melon-headed whales was prior to the initiation of sonar use. This example illustrates the difficulty in understanding, assessing, and/or predicting the potential reactions of cetaceans to naval sonar use. Such assessment is problematic for a variety of reasons, including: limited observations of cetaceans before and during active sonar operations; inter-specific variability in reactions (beaked whales appear to be more susceptible to impacts than other cetaceans, see Cox et al. (2006) for a review); likely variable reactions depending on type and number of sound sources and the proximity of individual cetaceans to the sound sources; and potential intra-specific variability in reactions.

Monitoring movements or behavioral reactions of individual cetaceans to large scale naval sonar exercises is particularly difficult due to the wide spatial scale of such exercises, the presence of operations during night-time hours and during sea conditions that preclude effective visual monitoring, and due to uncertainty regarding the distances at which individuals may show reactive movements to sonar use. In theory, the most powerful method to examine movements of individuals in relation to sonar exercises would be to have individuals of multiple species instrumented with tags that determine locations of the individuals prior to the exercise to monitor movements before, during and after the exercise. The recent development of small remotely-deployed satellite tags for use on small and medium-sized cetaceans (Andrews et al. 2008) has allowed for such an operation to be undertaken.

Since 2006 small remotely-deployed satellite tags have been used to examine movements of five species of cetaceans in waters around the main Hawaiian Islands. Prior to the RIMPAC 2008 exercise these tags had been deployed in Hawaiian waters on three Blainville's beaked whales (*Mesoplodon densirostris*), three Cuvier's beaked whales (*Ziphius cavirostris*), four false killer whales (*Pseudorca crassidens*), five short-finned pilot whales (*Globicephala macrorhynchus*), and three melon-headed whales (Schorr et al. 2007; Baird et al. 2008a; Hanson et al. 2008; Schorr et al. 2008), providing a basis of information against which future results can be compared.

As part of a larger effort to examine the diving behavior of deep diving odontocetes and characterize their foraging habitat, attempts were made to deploy medium-term satellite tags on a number of species of small and medium-sized cetaceans around the main Hawaiian Islands in June and July 2008, in association with the 2008 RIMPAC exercise. Here we provide a quick look at the results of these efforts and discuss factors that need to be taken into account for planning of future efforts to use satellite tags to monitor movements in relation to naval exercises in Hawaiian waters.

Results and Discussion

Information on the methods used are presented in Appendix 1. Over 31 field days between June 25 and July 28, 2008, small-boat operations based first off Kaua'i (7 days) and then Hawai'i (24 days) covered 3,637 km of trackline and resulted in 110 sightings of 13 species of cetaceans (Table 1). Tagging efforts resulted in the deployment of 33 medium-term satellite tags on four species of odontocetes over this period, the largest number of satellite tags ever deployed on multiple species of cetaceans in this short of a time period (Table 2). Species tagged were: Blainville's beaked whales (five individuals), melon-headed whales (five individuals), false killer whales (seven individuals) and short-finned pilot whales (16 individuals). Average transmission duration of the tags was 37 days (median = 34 days, n = 33), allowing for examination of movements before, during, and in many cases after the completion of the RIMPAC naval exercise.

This effort has demonstrated the feasibility of this approach to examine movements of individuals in relation to a large scale naval exercise, as well as provide a basis for future planning of similar efforts. In addition, these tags have provided unprecedented information on movements of individuals of four species in relation to the main Hawaiian Islands. Movements of tagged individuals have spanned an area greater than 13,000 km^2 (Figure 1). Analyses of movements are ongoing, and this data set will allow for an assessment of movements in relation to mid-frequency sonar use when sonar data are provided by the Navy.

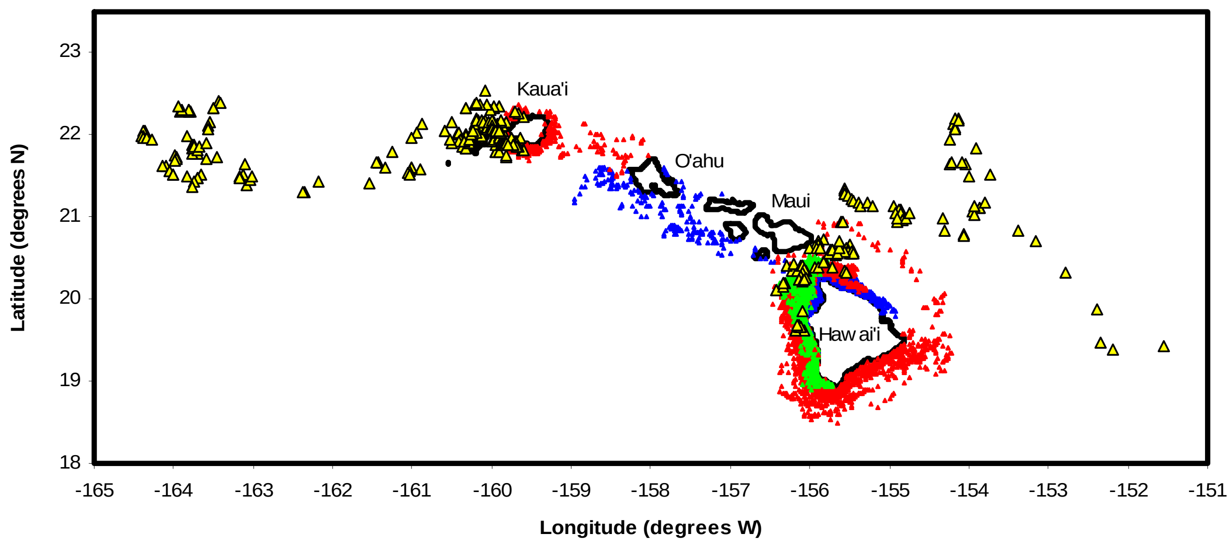

Figure 1. Map showing locations of satellite-tagged cetaceans tagged during June and July 2008. All individuals were tagged either off S.W. Kaua'i or W. Hawai'i. Species: false killer whales – blue; Blainville's beaked whales – green; short-finned pilot whales – red; melon-headed whales – yellow outlined with black. Some points overlap so that not all locations of some species (all except melon-headed whales) may be visible.

Three of the four species remained associated with the main Hawaiian Islands over the duration of tag attachments. Only melon-headed whales exhibited large scale directional movements away from the islands, with two individuals moving greater than 400 km from the initial tagging locations in 18 days, one of which reached a maximum distance from the main islands of 430 km 10 days after tagging (Figure 1). Blainville's beaked whales remained associated with the island off which they were tagged for the entire duration that location data were received (median = 63 days, maximum = 71 days). False killer whales remained associated with the island off which they were tagged for approximately 50 days before making large-scale movements among the main Hawaiian Islands (up to 330 km from the initial tagging location), although remaining within 83 km of shore (Figure 2). One short-finned pilot whale tagged off Kaua'i largely remained associated with the island with one week-long transit to/from O'ahu over a 44-day period. Short-finned pilot whales tagged off the island of Hawai'i remained generally associated with the island.

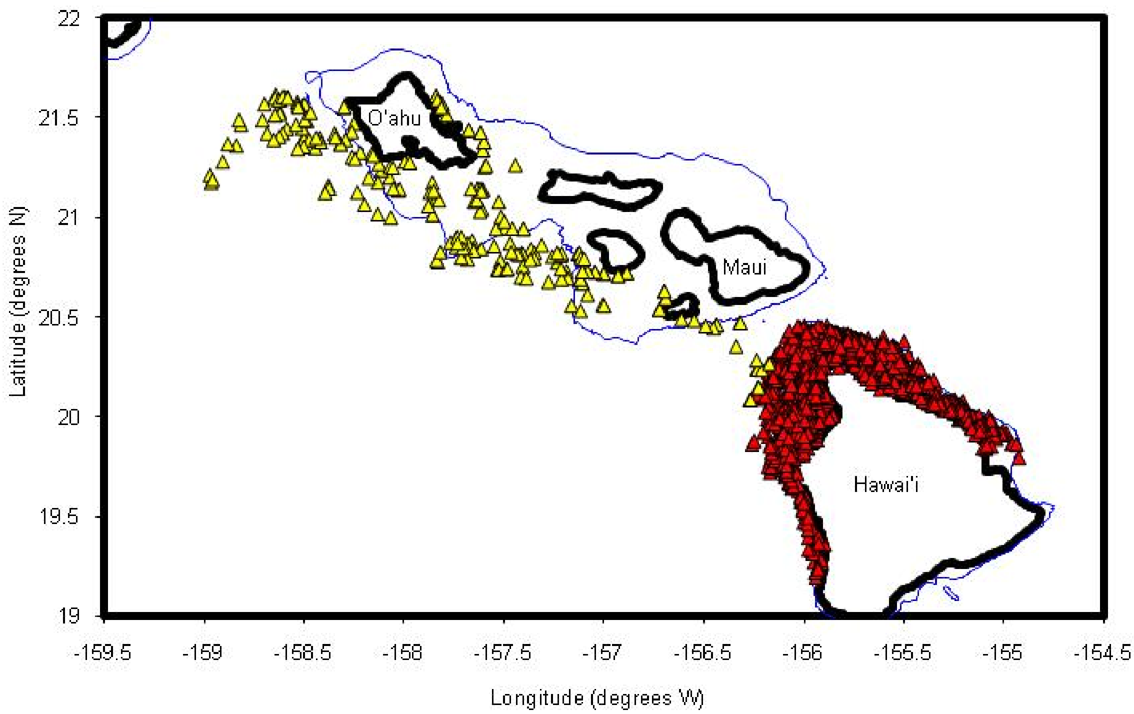

Figure 2. Map showing locations of satellite tagged false killer whales from July 16 through September 30, 2008. The blue line represents the 1000 m depth contour. Only two tags were still transmitting when tagged individuals left the vicinity of the island of Hawai'i, one on September 11 and one on September 14, 2008. Points for these two individuals, starting on those dates, shown in yellow.

In addition to the satellite tag deployments, dive data (using suction-cup attached data logging tags) were collected from two Blainville's beaked whales and one false killer whale, and acoustic data were collected from two short-finned pilot whales tagged with Burgess BioAcoustic Probes. Over 48,000 photographs were taken for contribution to individual photo-identification catalogs of 10 different species, and 30 skin samples were obtained for contribution to stock structure analyses.

Considerations for the feasibility of obtaining cetacean movement information in relation to a large-scale naval exercise

While the efforts during RIMPAC '08 demonstrated the feasibility of obtaining movement information of multiple species of cetaceans during a large-scale naval exercise, a variety of considerations need to be taken into account when planning for future efforts along these lines. Tagging operations off the island of Kaua'i utilized a charter vessel (a 6.7 m SeaCat), while off the island of Hawai'i tagging operations utilized a research vessel (a 8.2 m Boston Whaler) owned by a collaborating organization that had been custom-modified specifically for tagging (with an elevated control tower and bow pulpit), and which had been used successfully in numerous previous tagging operations. In seven field days off Kaua'i, four species of cetaceans were encountered and tags were deployed on two species (melon-headed whales and short-finned pilot whales). The overall number of sightings and the number of species sighted was limited primarily by sea conditions, while the ability to deploy additional tags on pilot whales that were encountered was limited by the tagging platform used during the Kaua'i effort. In 24 field days off Hawai'i, 13 species were observed and 29 tags were deployed on four species. Tagging operations for pilot whales off Hawai'i were curtailed after the first week of field effort due to the limited availability of satellite tags. During 24 days of field effort off Hawai'i there were 21 encounters with pilot whale groups that did not contain satellite tagged individuals. If the availability of satellite tags were not limited it would have been feasible to deploy tags on twice as many groups.

In order to have a reasonable probability of being able to assess the impact of a naval exercise on the movement patterns of cetaceans (monitored using remotely-deployable satellite tags), at least four conditions have to be met:

- A sufficient number of groups of the target species need to be encountered prior to the start of an exercise.
- A sufficient number of tags need to be deployed on individuals of the target species prior to the start of the exercise, in order to have sufficient sample sizes for each species.
- The tags need to remain attached and continue to transmit through the period of the exercise.
- The tagged individuals need to either remain in the general area of tagging (if the exercise is to occur in that area) or move into the exercise area.

There were a number of lessons learned from this and prior tagging projects in Hawaiian waters relevant to these factors:

- The amount of effort required to find a sufficient number of groups will depend on the number and type of tagging platforms, the sea conditions, and the species-specific encounter rates. Long-term average encounter rates and typical sea conditions in different areas can be used to predict the likelihood of encountering different target species. Depending on the target number of tag deployments for each species, the amount of effort required can be determined in advance for different target areas. In Hawaiian waters, working conditions for tagging operations are good off the west side of the island of Hawai'i but are generally poor off all other islands. Thus the number of species as potential tagging targets will be greater off the island of Hawai'i than elsewhere, and to obtain similar sample sizes the amount of effort off other islands will have to be substantially greater than off Hawai'i.

- The ability to approach individuals close enough to deploy tags is influenced by the specific configuration of the tagging platform (height of the driver above water to be able to track animals underwater, vessel maneuverability, presence of a sturdy bow-pulpit to provide a stable platform for tagging), the skill of the vessel operator, the skill of the tagger, the sea conditions, and the general approachability of different species. Tagging vessels with a high steering platform and bow pulpit are not readily available off islands other than Hawai'i. Vessel charters that allow individuals other than owner/captain to drive the vessel are difficult to find, yet the experience of the vessel operator driving small vessels around cetaceans for the purposes of tagging is critical in deploying tags, and should be of primary importance when choosing a suitable tagging vessel. Similarly, there are a limited number of individuals who have the skill and experience to successfully deploy satellite tags in a variety of sea conditions and circumstances. All of these factors may limit the ability to deploy sufficient numbers of tags off different islands to assess impacts, and should be taken into account in long-term planning for future efforts.
- Duration of tag function varies by species, with small fast moving species appearing to have shorter attachment durations than large slow moving species. While we are often unable to assess attachment duration accurately, as it requires re-locating a tagged animal immediately after a tag falls off, transmission duration varied considerably: melon-headed whales, median = 10 days, maximum = 18 days; false killer whales, median = 34 days, maximum = 76 days; short-finned pilot whales median = 35 days, maximum = 72 days; Blainville's beaked whales, median = 63 days, maximum = 71 days. Transmission duration is unlikely to be related to pressure, as the deepest-diving species, Blainville's beaked whales (Baird et al. 2008b; Baird unpublished) had the longest average transmission duration, thus it is more likely that the shorter duration attachments for other species reflect tag loss. Maximum transmission duration is also limited by duty cycling of the transmitters due to battery capacity. During June/July 2008 duty cycling chosen varied by species taking into account diving behavior and the need to get higher resolution movement data during the RIMPAC exercises.
- Movement rates and patterns vary both by species (e.g., pilot whales and beaked whales show much more limited movements than melon-headed whales), and within-species (e.g., tagged false killer whales remained in localized areas for extended periods followed by long-range rapid movements to new areas). Such movement patterns must be taken into account when planning for future efforts to examine movements of cetaceans in relation to naval exercises. For example, the relatively rapid directional movements of melon-headed whales documented suggest that exposure of animals to sonar in the area tagged is unlikely to occur unless the sonar operations were to take place within a few days of tagging, while for short-finned pilot whales and Blainville's beaked whales, movements over periods of days to weeks were generally limited to the area tagged.

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Literature Cited

Andrews, R.D., R.L. Pitman and L.T. Balance. 2008. Satellite tracking reveals distinct movement patterns for Type B and Type C killer whales in the southern Ross Sea, Antarctica. Polar Biology DOI 10.1007/s00300-008-0487-z.

Baird, R.W., G.S. Schorr, R.D. Andrews, M.B. Hanson, D.L. Webster, D.J. McSweeney, and J. Barlow. 2008a. Using dorsal fin-attached satellite tags to examine movements and stock structure of Hawaiian odontocetes. Presentation to the Pacific Scientific Review Group, National Marine Fisheries Service, Monterey, California.

Baird, R.W., D.L. Webster, G.S. Schorr, D.J. McSweeney and J. Barlow. 2008b. Diel variation in beaked whale diving behavior. Marine Mammal Science 24:630-642.

Cox ,T.M., T.J. Ragen, A.J. Read, E. Vos, R.W. Baird, K. Balcomb, J. Barlow, J. Caldwell, T. Cranford, L. Crum, A. D'amico, G. D'spain, A. Fernández, J. Finneran, R. Gentry, W. Gerth, F. Gulland, J. Hildebrand, D. Houser, T. Hullar, P.D. Jepson, D. Ketten, C.D. Macleod, P. Miller, S. Moore, D. Mountain, D. Palka, P. Ponganis, S. Rommel, T. Rowles, B. Taylor, P. Tyack, D. Wartzok, R. Gisiner, J. Mead, and L. Benner. 2006. Understanding the impacts of anthropogenic sound on beaked whales. Journal of Cetacean Research and Management 7:177-187.

Hanson, M.B., R.D. Andrews, G.S. Schorr, R.W. Baird, D.J. McSweeney and D.L. Webster. 2008. Transmitter and attachment performance of remotely-deployed dorsal fin-mounted tags on short-finned pilot whales in Hawai'i. Document PSRG-2008-13 presented to the Pacific Scientific Review Group, National Marine Fisheries Service, Monterey, California.

Schorr, G.S., R.W. Baird, D.L. Webster, D.J. McSweeney, M.B. Hanson, R.D. Andrews and J. Barlow. 2007. Spatial distribution of Blainville's beaked whales, Cuvier's beaked whales, and short-finned pilot whales in Hawai'i using dorsal fin-attached satellite and VHF tags: implications for management and conservation. Talk presented at the 17th Biennial Conference on the Biology of Marine Mammals, Cape Town, South Africa, November-December 2007.

Schorr, G.S., R.W. Baird, M.B. Hanson, D.L. Webster, D.J. McSweeney, and R.D. Andrews. 2008. Movements of the first satellite-tagged Cuvier's and Blainville's beaked whales in

Hawai‘i. Report prepared under Contract No. AB133F-07-SE-3706 to Cascadia Research Collective, Olympia, WA from the Southwest Fisheries Science Center, National Marine Fisheries Service, La Jolla, CA 92037 US.

Southall, B.L., R. Braun, F.M.D. Gulland, A.D. Heard, R.W. Baird, S.M. Wilkin, and T.K. Rowles. 2006. Hawaiian melon-headed whale (*Peponocephala electra*) mass stranding event of July 3-4, 2004. NOAA Technical Memorandum NMFS-OPR-31.

Table 1. Summary of sightings by species during June and July 2008. Depths of sightings determined using ArcGIS.

Species	# of sightings	Group size median (range)*	Depth (m) median (range)*
Short-finned pilot whale	43	19 (2-50)	1445 (1021-3085)
Rough-toothed dolphin	23	7 (2-70)	1768 (970-2706)
Pantropical spotted dolphin	7	45 (4-120)	2284 (121-4692)
Bottlenose dolphin	7	12 (5-34)	121 (70-880)
Dwarf sperm whale	5	1 (1-2)	1268 (106-4727)
Melon-headed whale	4	320 (220-340)	1633 (1211-1965)
False killer whale	4	22 (13-30)	634 (109-1485)
Spinner dolphin	4	12 (10-25)	13 (5-217)
Blainville's beaked whale	2	9, 11	946, 1492
Cuvier's beaked whale	2	1, 4	1400, 2383
Risso's dolphin	2	1, 4	1366, 3450
Striped dolphin	2	20, 35	2495, 4790
Sperm whale	2	9, 13	4220, 4645
Unidentified odontocetes	3	1 (1)	2131 (1624-2708)

*If only two sightings both values presented.

Table 2. Summary of satellite tags deployed during June and July 2008.

Species	# individuals tagged	Transmission duration (days) median (range)
Melon-headed whale	5	10 (3-18)
Blainville's beaked whale	5	63 (45-71)
False killer whale	7	34 (6-76)
Short-finned pilot whale	16	35 (12-72)
Total	33	34 (3-76)

Appendix 1. Methods

Tags and tag programming

Tags were constructed with a SPOT5 "Fin Mount" (Wildlife Computers, Redmond, Washington, USA), Argos-linked location-only Platform Transmitter Terminal (PTT). The Fin Mount configuration includes two fiberboard plates with helicoils inserted at each end for dart attachment, with the PTT and plates cast in epoxy. Dimensions of the tags were 63 x 30 x 21 mm. Each tag incorporated two 6.5 cm (for beaked whales, false killer whales or short-finned pilot whales) or 4.5 cm (for melon-headed whales) long medical-grade titanium darts that were screwed into the holes in the bottom of the tag. The darts were designed to penetrate the connective tissue in the dorsal fin and remain embedded with a series of backwards facing 'barbs' which acted as anchors for the darts (see Andrews et al. 2008). Weight of the entire package was approximately 49 g. The transmitter itself was designed to remain external to the body to reduce the invasiveness of the technique.

Duty cycling (maximum number of transmissions/day, hours per day transmitting, minimum time lag between transmissions) was determined taking into account theoretical battery capacity (35,000 transmissions), species-specific diving/surfacing patterns, timing of tag deployment during the study, and timing of satellite overpasses. Beaked whale tags were set to transmit for the greatest number of hours per day due to their long dive durations (which may exceed one hour), thus increasing the likelihood of locations being received over a greater portion of each day. Details of duty cycling are given in Table A1. Transmitters were duty-cycled to turn on during times of the day when satellite overpasses were most likely to occur. The likelihood of satellite overpasses were determined using the pass predictions generated from the Argos website. This predicts the overpass time for all satellites currently orbiting and capable of receiving uplinks from the PTT's in the general location of deployment. Tags can only be programmed to transmit in hourly blocks, and duty cycling was chosen to take advantage of hours where multiple satellites were passing overhead, with an emphasis placed on obtaining uplinks spread throughout the day. Tags deployed on short-finned pilot whales up to July 8, 2008, were set to transmit daily for the first 43 days and then every second day thereafter.

Field work

Field work was conducted based out of Kekaha, Kaua'i from June 25 through July 1, 2008, and out of Honokohau Harbor, Hawai'i from July 2-27, 2008. Off Kaua'i a 6.7 m Sea Cat was used, and off Hawai'i the primary research vessel was a 8.2 meter Boston Whaler with a custom-built bowsprit. Searches were conducted in a non-random, non-systematic manner, with effort spread over as broad a range of depths as possible while remaining in areas with sea states of Beaufort 3 or less, and which could be readily reached from Honokohau Harbor. Efforts were made to minimize overlap of survey tracklines among days. For periods when the NOAA R/V *Oscar Elton Sette* was operating in the area, search patterns were modified to minimize overlap of survey coverage as sightings of target species were shared.

Tags were deployed using a Dan-Inject JM Special 25 (Børkop, Denmark) pneumatic projector with a modified arrow to hold the tag in flight, from an estimated range of 2.5 - 10 m. Tags were attached to the dorsal fin or dorsal ridge area, to take advantage of the strong connective tissue in that region and provide the best location for a clear transmission of the signal when the animal surfaced. Both the target animal and other individuals within the groups were photographed before and during tagging. For beaked whales, the sex of tagged whales was determined using the presence/absence of erupted teeth and scarring patterns. For short-finned pilot whales sex of tagged whales was determined based on relative body size and the size/shape of the dorsal fin. Photographs of tagged whales and companion animals were compared to photo-identification catalogs to determine sighting history, and photographs of previously tagged animals were taken on subsequent days that they were encountered to assess tag attachments

Satellite data acquisition and processing

PTT transmissions were received by a series of NOAA Polar Orbiting Environmental Satellites (Argos user manual[1]). Each satellite has a visible circular 'footprint' of about a 5,000 km-diameter in which it can receive signals from transmitting tags. The polar orbiting path of the satellites means that there are fewer overpasses as you get closer to the equator. In June/July 2008 the total number of satellite passes over the region was between 15-18 times per day. The PTT's signal can only be received by the satellite during its overpass (between 8 and 15 minutes, average of 10), but is dependent on the elevation of the overpass above the horizon. The path of each overpass is not the same elevation above the eastern or western horizon. As a result, some overpasses are so low on the horizon that the period where the satellite may receive signals from transmitting tags is of short duration, and consequently the calculation of accurate location, based on the Doppler-shift principle, is compromised. Within a single overpass, a satellite must receive at least two uplinks from the PTT in order to determine a location, and to improve the accuracy of the location these must be spread out across the duration of the overpass. The more messages received and the longer spread between first and last message during the overpass generally leads to a higher location class (see below).

Transmitter locations received from Argos include a location class (LC) indicating degree of accuracy in the reported position based both on the number of messages received in a single overpass, and the temporal spacing of those messages. LC 3, 2, and 1 each have a set estimate of accuracy; whereas LC 0, A, B, and Z are undefined. Therefore, all locations must be assessed for plausibility before being used to estimate an animal's location (*e.g.* Argos User Manual). We used the Douglas Argos-Filter[2], version 7.06, to assess locations for plausibility, using two independent methods (distance between consecutive locations, and rate and bearings among consecutive movement vectors). The Douglas filter incorporates several user-defined variables in the filtering process, including maximum-redundant distance (Maxredun -- temporally near-consecutive points within a defined distance are kept by the filter), maximum sustainable rate of movement (Minrate – speed in km/hr based on a reasonable rate of movement sustainable for several hours or days), location classes to keep (the filter will automatically keep all LC's of this defined class and higher), and Ratecoef. The Ratecoef assesses locations by looking at the angle created by three subsequent points, and is based on the concept that the animal is unlikely to leave one location, travel towards a subsequent location, and then immediately move back to the same location again. The filter passes or fails a point depending on the distance between locations. Larger angles become suspect (i.e. the filter becomes more conservative) as Ratecoef increases.

The maximum-redundant-distance was set at 3km (two or more near-consecutive points within 3 km of each other are kept by the filter). The maximum sustainable rate of movement varied by species (Table A1), with rates set to be higher than those typically exhibited by

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[1] Available from http://www.argos-system.org/manual

[2] Available from http://alaska.usgs.gov/science/biology/spatial/douglas.html

traveling individuals of each species, to help retain points which have spuriously large movement rates between them due to short amount of time between uplinks to the satellite. All Argos locations of class LC2 and better were automatically retained. Bearing between locations (Ratecoef) was assessed to further eliminate outlying points using a rate of coefficient of 25.

Table A1. Tag characteristics by species

Species	Dart length (cm)	Minimum time lag between transmissions (sec)	Total hours per day transmitting	Max speed used in Argos filter (km h^{-1})
Melon-headed whale	4.5	45	16	15
Blainville's beaked whale	6.5	15	18	10
False killer whale	6.5	30	13	20
Short-finned pilot whale	6.5	30	16 (11 ind), 14 (5 ind)	15