

## **Examination of Health Effects and Long-Term Impacts of Deployments of Multiple Tag Types on Blue, Humpback, and Gray Whales in the Eastern North Pacific**

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### **LONG-TERM GOALS**

Our goal is to provide new insights into the long term consequences of different types of tags on several additional species of large whales including blue, humpback, and gray whales by conducting long term follow up of previously tagged individuals in the eastern North Pacific. We examine the long term impacts on health, reproduction, and mortality utilizing the past deployments of implant and suction cup tags on blue, humpback, and gray whales in the eastern North Pacific and our extensive monitoring of these populations. Despite extensive use of implant tags for more than 30 years, only limited studies have been conducted of the health effects and long-term consequences of tag deployments on whales. This field is rapidly expanding including increased use of deep penetration tags on many populations including critically endangered populations such as the North Pacific right whale and the western gray whale. Studies of North Atlantic rights whales revealed a wide variety of conditions of the tag site after deployments of penetration tags varying from very minor divots to more extensive swellings.

### **OBJECTIVES**

The overall objectives for this multi-year project were as follows:

1. Examine the long-term survival of tagged animals in relation to animals that were not tagged.
2. Test for differences in the visual health status of tagged versus untagged animals.
3. Examine the condition of the tag site and evaluate healing in tagged animals.

### **APPROACH**

Long term impacts of tagging will be examined by conducting detailed follow-up of blue, humpback, and gray whales that have had tags deployed on them to examine site healing, health, and any long-term consequences of tag deployment on reproduction, health, or survival. Our focus on three species of baleen whales in the Eastern North Pacific represents an ideal test case to study this for two primary reasons:

1. Some of the longest histories of tag deployments have been conducted in this area on these species. This includes over 400 deployments of a wide variety of tags ranging from suction-cup, external tags anchored into blubber, and full implant tags on blue whales. This sample includes the largest number of implant tag deployments of any whale population (OSU implant tag deployments on 186 eastern North Pacific blue whales, for example).
2. Extensive sighting histories of blue, humpback, and seasonal-resident gray whales are available off the US West Coast from photo-identification studies; these studies have been virtually uninterrupted since 1986 with continued monitoring planned. In all three species, the majority of the population has been photo-identified and resighting rates are very high. Seasonal resident gray whales in this region have annual resighting rates of 70% or more and catalogs of identified blue and humpback number over 2,000 individuals each.

We used both photographs and genetics to conduct the first systematic reconciliation of the animals tagged with the long-term photo-ID datasets. Photographs and video taken from deployments were used to catalog both the photo-ID identities and the markings immediately around the tag site of whales to add to those where a match between tagged animal and photo-ID has already been made and those gathered of during the study. Additional determinations of identity is being made based on genetic matches between samples taken from about 100 implant-tagged whales and those collected from animals in these populations.

## **WORK COMPLETED**

The following major areas of work were completed in the initial years of effort:

1. OSU genetics lab (Dr Scott Baker) conducted genetic analyses of OSU tagged blue whales to aid in identification of tagged animals through genetic matching and to determine sex.
2. We have collaborated with OSU's Radio Telemetry Group to obtain photographs and video of blue whales that have been previously tagged by OSU. This work has now been completed in the last year and identification photographs of as many tagged animals as possible identified.
3. We have now completed the matching of identification photographs and images from video taken during tag deployments to our long term photographic catalogs of blue whales and used these add additional known identified whales that have been tagged.
4. We have compiled identifications and sightings of follow up photographs and sightings of eastern North Pacific gray whales tagged in 2009.
5. We have conducted additional field work including work in collaboration with other studies obtaining photographs of blue whales including for photographic identification, for examination of potential tag sites, and for visual health assessment of blue whales.
6. Held preliminary meetings with our veterinary/pathology team to discuss methods of categorizing tag injuries.
7. Begun compiling long term time series of tagged whales for examining tag site healing and body condition.

8. Collaborated with CICIMAR on a comparison of their catalog of blue whales in Mexico with ours to extend the sighting histories of tagged animals and add to the time series photographs.
9. Collaborated with Jeff Jacobsen to examine if there are additional humpback whales from satellite tagging operations on Socorro that can be linked to photographic identifications to allow long term assessment of tag site condition and resighting.
10. Continued obtaining detailed photographs of blue, humpback, and gray whales off the US West Coast to provide information on survival, allow better assessment of health, and also a detailed view of parts of the body where tags may have been applied. Typically in the past, only the portion of blue whales used in photographic identification were obtained so these recent photographs will provide a better basis of assessment of health and tag condition than had been available.

## RESULTS

Summarized below are the results of different components of the research completed to date. Results of genetic analyses conducted of whales satellite tagged by OSU have been completed and were summarized in the previous annual report. Some of the preliminary results of determining the photo-ID of blue, humpback, and gray whales that had been tagged to be able to conduct follow up examinations are summarized below (Table 1).

**Table 1. Summary of photo-ID and resightings of different species of whales tagged with suction cup or implant tags.**

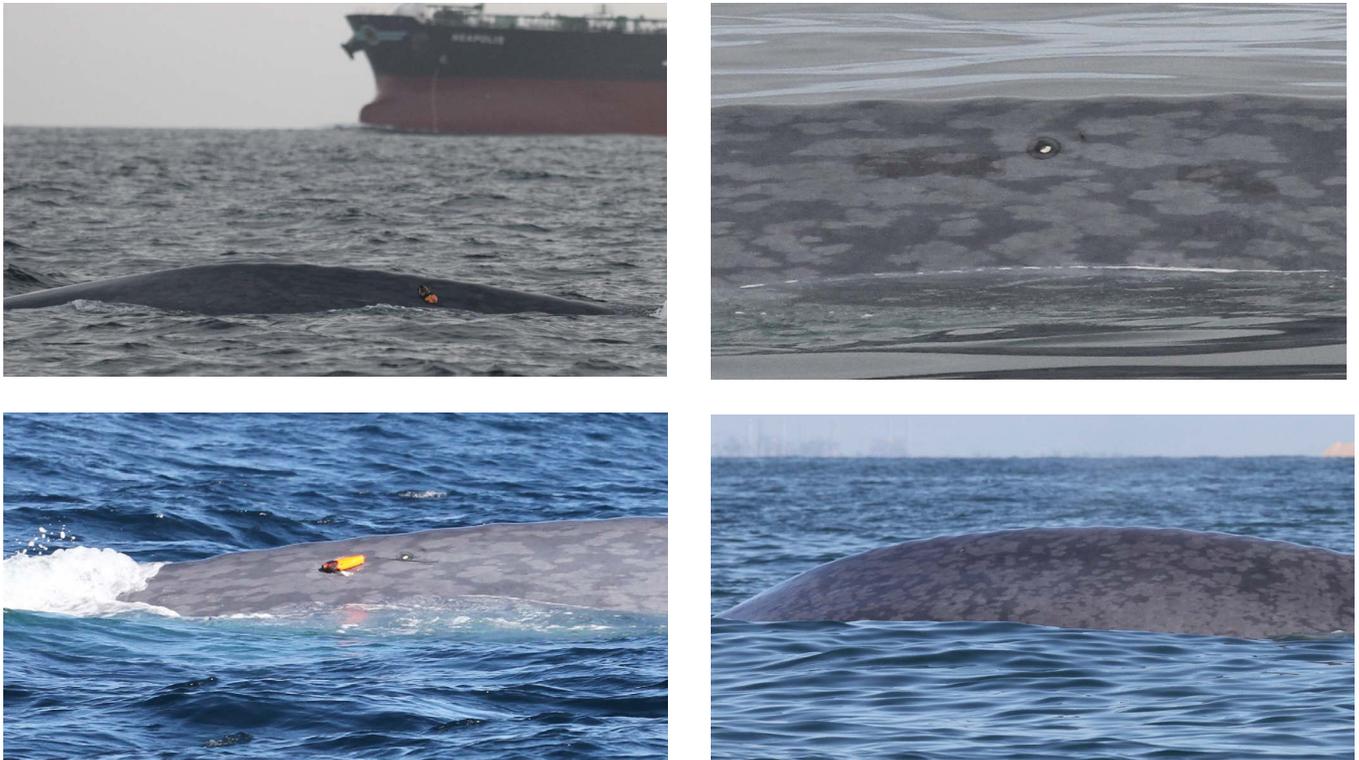
Species	Attach Type	Total Tags Deployed	Deployments whale photo-IDed	Unique identified whales Tagged	Resighted a later season Post Tagging	Percent Resighted
Blue whale	Cup	270	201	120	77	64%
Blue whale	Implant	181	64	62	46	74%
Gray whale PCFG	Implant	18	18	18	15	83%
Gray whale MX	Implant	17	6	6	0	0%
Humpback	Cup	20	12	10	10	100%
Humpback	Implant	33	4	4	3	75%

### *Blue whales*

Our largest sample of identified whales comes from the large number of blue whales that have been tagged with either implant tags or suction cup tags (Table 1). Of the 270 suction cup tags deployed on blue whales through 2011, good identification photographs were available for 201 cases and these represented 120 different individuals (some whales were tagged more than once). We were able to close to double the number of implant tagged blue whales that were photo-identified from what was previously available and now have 64 of 181 implant tagged whales identified and these represented 62 different whales. Our resighting rates for tagged blue whales is currently slightly higher for implant tagged blue whales than suction cup tagged whales due to most of the suction cup tagging having

occurred in recent years from work on ship strike and the SOCAL BRS (Southall et al. 2012) so there have not been many opportunities to resight these animals since they were tagged.

The large sample now available of blue whales that had suction-cup tags applied (see for example Oleson et al. 2007, Calambokidis et al. 2008, Goldbogen et al. 2011) will be useful both as a comparison to implant tags but also to assess impacts of these tags as well. While suction-cup tags have been considered lower impact than implant tags, some preliminary results indicate that in some cases these types of tags can cause injuries that penetrate the skin. Figure 1 shows a series of photographs of a blue whale tagged with a suction cup attached GPS tag on 21 September 2011 that show injury to skin.



***Figure 1. Progression of photographs of a blue whale suction cup tagged on 21 September 2011 and then follow up photographs taken on 3-7 October 2011 (including photograph with 2<sup>nd</sup> tag, an Acousonde attached). These show an injury at the site of the suction cup deployment that penetrates the skin.***

### *Gray whales*

Of 18 gray whales OSU satellite tagged in the Pacific Northwest in fall 2009, now all 18 were photo-identified either with photographs taken at the time or later and all were known animals present in Cascadia's catalog of eastern North Pacific gray whales. (Table 2). Additionally two of the animals OSU has tagged in Mexico had suitable identification photographs to allow tracking though are not likely to have the same follow up potential as those in the PCFG. Cascadia maintains a catalog of eastern North Pacific gray whales that consists of about 1,000 individuals identified off California, Oregon, Washington, and British Columbia by Cascadia and other collaborators (under a project primarily sponsored by the National Marine Mammal Laboratory). The core of this catalog is the estimated 200-250 gray whales that regularly use the Pacific Northwest for feeding each spring,

summer, and fall. In addition to photo-ID, recent genetics studies have revealed significant differences in mtDNA between these animals and other eastern North Pacific gray whales suggesting these should be treated as an independent demographic unit (Frasier et al. 2011, Lang et al. In prep). Analysis of the follow up these satellite tagged whales is being conducted under this project and has also been undertaken by OSU with the OSU effort focused on some of the more short term portions of the follow up (see Hayslip et al. 2011) and Cascadia more focused on longer term follow up. Resightings of the PCFG whales through 2011 has been very good with 15 of 18 tagged whales resighted in both 2010 and 2011, although one of these was known to have died at the end of 2011 (CRC 411). The identity of this whale as one of those that had been tagged was not realized until well after the stranding and unfortunately no examination was conducted to allow determination of any possible connection of the death to the tagging that had occurred more than two years earlier.

**Table 2. Identification histories of gray whales that were tagged by OSU in fall 2009. These were all whales in the PCFG. Does not include gray whales satellite tagged by OSU in Mexico in previous years.**

ID	TAG Number	1985	1991	1993	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
32	PTT 5205938	1						2	16			18	3	6			2		1		
89	PTT 5223029			2				20	21	30	13	4	23	11	19	17	8	16	4	16	23
164	PTT 5210836		1		7					3	1	1			1	1		1	3	14	8
196	PTT 5210838					1				2		1	9		6	14	6	8	6	20	11
205	PTT 5210842					2	9		6	1	3	3	5					7	9	1	6
206	PTT 5205923					4		3	2	1	3	4	3				2		2	1	2
215	PTT 5205670					2		1				5	4	1			3		2		
291	PTT 5223032							2	2	1	3	6	10	4	1	5		1	1	3	13
302	PTT 5205801							4	8	1		4	14	10	1	15	6	15	6	15	14
411	PTT 5223038								1	4	8	4					2	3	2	6	11*
525	PTT 5200847								1	2	1			1	2	1	3	20	13	4	1
537	PTT 5200831									2			1				1	1	1	5	5
615	PTT 5223033										1	1						2	1	5	3
643	PTT 5204174										1	2	1		2			3	2	1	7
659	PTT 5200827											2		5		1		1	3	5	4
797	PTT 5223035												1	2	7	18	12	11	4		
854	PTT 5201385														1			3	3	2	5
981	PTT 5223041																1		1	5	8
Total seen		1	1	1	1	4	1	6	7	10	9	14	11	8	9	8	11	14	18	15	15

\*Found dead December 2011 near Bandon, OR

## IMPACT/APPLICATIONS

The study will provide new insight into the long term consequences of implant and other tags in terms of healing of injuries from tags and impacts on health and survival. These types of tags provide important information for both ecosystem health and public education but fully understanding the long-term impacts of these tags is important to achieve these ends.

## RELATED PROJECTS

There are a number of projects that are related to the one proposed here. OSU continues to conduct detailed examination of gray whales that were satellite tagged including follow up field work that is in addition to what is being done as a part of the project reported here. The work proposed here also ties into the long-term photographic identification research being conducted by Cascadia Research of blue, humpback and gray whales (with support from the National Marine Mammal Laboratory, and Southwest Fisheries Science Center). Follow up photographs taken for this study as well as additional

tagging of whales are also being obtained related to other research on blue whales such as the SOCAL Behavioral Response Study and examination of ship strike impacts.

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