NATIONAL MARINE FISHERIES SERVICE

Assurance of Animal Care and Use Form
AFSC/NWFSC IACUC

IACUC Use Only

IACUC Number:A/NW 2010- 6 **USDA Classification:** C / D / E
(Circle One)

Date Received: _____ **Initial Review Date:** _____

IACUC Training Complete: ☐

IACUC Recommendations: Approved: ☐ Not Approved: ☐

Withhold Approval Pending Modification ☐

Type of Submission: New ☐ Modification ☐

3-Year Renewal ☐

IACUC Chair Signature: _____**Date:** _____

Instructions on Filling Out Form…….

25 January 2009

A. Administrative Data

Project Title:

Modification to add satellite and suction cup tagging to additional cetacean species and regions with the north Pacific Ocean

Center, Division and Program: NWFSC, Conservation Biology, Marine Mammal Ecology

Principal Investigator: Mike Ford – Contact Brad Hanson

Mailing Address: 2725 Montlake Blvd E, Seattle, WA 98112

Telephone: 206-860-3220 Fax: 206-860-3400
Email:Brad.hanson@noaa.gov

Initial Submission ☐ **Renewal** ☐ **or Modification** ☐**X**

Project Title):

Anticipated Start Date: October 2010 Anticipated End Date: April 2011

Study Site(s) Location (or Where Animals Will Be Housed): Eastern North Pacific Ocean

Other approved IACUC Animal Care and Use Assurance relating to this project:

Institution:_Cascadia Research Collective__ IACUC Number__Pending_____

Permits: Identify all relevant permits (Federal, State and other) necessary to conduct this project. Provide permit type(s), permit number(s), and expiration date(s). Please indicate if a permit application is pending a decision.

Permit Type	Permit Number	Expiration Date
ESA/MMPA Federal	781-1824	April 2011

*The NMFS policy intends to comply with the **Animal Welfare Act** (AWA) - Title 7 of U.S. Code §2131 et. seq. and implementing regulations and adhere to the principles of the **U.S. Government Principles** for the Utilization and Care of Vertebrate Animals Used in Testing, Research, and Training (USGP) and follow the guidelines in the National Research Council **Guide for the Care and Use of Laboratory Animals.***

B. Justifications

In accordance with USGP #2, "Procedures involving animals should be designed and performed with due consideration of their relevance to human or animal health, the advancement of knowledge, or the good of society."

1 Research Goals:

a. What are the scientific issues addressed by the research?

The purpose of this research is to improve information to meet Agency mandates on stock structure, movement patterns, and habitat use of cetacean species on various spatial and temporal scales in the eastern North Pacific Ocean.

Specifically, how will this research improve human or animal health or advance knowledge?

These type of data are required to meet specific Agency objectives under the ESA and MMPA.

b. What are the specific goals of the animal studies described in this protocol?

To maximize data gained while minimizing impacts to individuals and stocks.

c. Explain why animal studies are preferred to **non-animal alternatives** in achieving these research goals.

There are no non-invasive procedures available that can provide the same spatial and temporal resolution, or adequate sample size for this type of movement data.

In accordance with the Animal Welfare Act – "…the principal investigator has provided written assurance that the activities do not unnecessarily duplicate previous experiments."

2 Does this research **duplicate** previous experiments? ☐ **YES** **X** ☐ **NO**

If YES, please explain why this duplication is necessary.

3 Do the animal procedures planned for this research involve only **simple field observation** with no impact on either the animals or their environment?
(e.g. Aerial surveys, brand or tag resighting, focal "animal" follow, vessel surveys)

☐ **YES** **X** ☐ **NO**

If **YES**, it is not necessary to complete the informational sections of this protocol form. Instead, answer the following:

a. Use Appendix A to describe the study activities. Include all precautions to ensure no adverse impact on the study animals and their environment.
b. Include copies of any required permits.
c. Sign this form under Section H
d. Submit this package to the NMFS Regional IACUC Chair

If **NO**, the remainder of this form must be completed. (but complete Appendix A for observational studies and then, proceed to the next section.

In accordance with the USGP #3, "The animal selected for a procedure should be of an appropriate species and quality and the minimum number required to obtain valid results."

4 List the **research species** (and stock) and describe why is the most appropriate species to use in these studies:

For species/stocks currently on our permit we want to add the following activities or increase number of takes per year: Eastern North Pacific southern resident killer whales (*Orcinus orca*) – 6 dart implant tags, Pacific white-sided dolphin (*Lagenorhynchus obliquidens*) – 20 dart implant tags, fin whale (*Balaenoptera physalus*) – increase implant tags to 20, Cuvier's beaked whales (*Ziphius cavirostris*) – 20 dart implant tags, pygmy sperm whales (*Kogia breviceps*) – 20 dart implant tags and Risso's dolphin (*Grampus griseus*) – 20 implant tags. For sperm whales (*Physeter macrocephalus*), add 10 implant tags (dart).

Add the following species/stocks for tagging: Eastern north Pacific northern resident killer whales (*Orcinus orca*), and Hawaii killer whale (*Orcinus orca*), false killer whales (*Pseudorca crassidens*), pygmy killer whale (*Feresa attenuata*), melon-headed whales (*Peponocephala electra*), Blainville's (*Mesoplodon densirostris*) and Longman's (*Indopacetus pacificus*) beaked whales, dwarf sperm whales(*Kogia sima*), and bottlenose (*Tursiops truncatus*), rough-toothed (*Steno bredanensis*) dolphins. Takes requested would be by tagging using dart implant tags. For each species, up to 20 individuals may be tagged (using dart tags) per year for the duration of the permit.

Very little is known about the movement and habitat use patterns of these species. Additional information is needed to meet stock structure and habitat delineation requirements under the ESA and MMPA.

5 How many animals do you plan to use for the protocol? Please provide a justification for the numbers of animals used (e.g., statistical power, survey, etc). Complete the following table below to define the numbers(s) of animal(s) to be used in each **category and type procedure(s)**. Use the following animal welfare categories:

The maximum number of tags we will apply to whales in any one population will be between 10 and 20 each year. Encounter rates with most of these species except for killer whales are low and it is unlikely we will be able to put out more than a maximum of 5 – 10 tags on the species that we are interested in. For most of these species even just a couple of tags will provide extremely valuable data on movements. In order to achieve the practical benefit of furthering our knowledge of the movement patterns and habitat usage by these species, ideally we would aim for a much larger sample size. Low encounter rates, however, will constrain our ability to reach large sample sizes, especially given our man-power and budgetary constraints. Although conclusions based on such small sample sizes relative to the cohort population must be made with caution, we anticipate that even small samples will provide tremendous insights that will contribute to the knowledge and conservation of these species, especially because extremely little is known about most of them. Hindell et al. (2003; Dispersal of female southern elephant seals and their prey consumption during the austral summer: relevance to management and oceanographic zones. J. of Appl. Ecol. 40:703-715) examined the number of tracking records from southern elephant seals that were needed in order to give a useful representation of the spatial distribution of the population from a single island. They found that the relationship between number of seals and spatial area began to reach an asymptote at around 25 – 40 seals. Many of the species we plan to tag are likely to migrate over a spatial area similar in size to that of southern elephant seals, so in order to obtain a complete assessment of habitat use for a single species in one region we would require a similarly large sample size, and therefore we are confident that our sample size is not excessive.

Category (adapted from AWAR):
B: applies only to animals held captive in non research status (display, rehabilitation, brood stock, holding).
C: applies to little or momentary pain or discomfort
D: applies to potential discomfort or pain which is relieved by the appropriate anesthetic or analgesic
E: applies to discomfort of pain which is not relieved thus requires written justification and full IACUC approval and documented in the annual report to APHIS (must consider the 3 R's)

In accordance with the AWA: "The principal investigator has considered alternative to procedures that may cause more than momentary or slight pain or distress to the animals, and has provided a written narrative description of the methods and sources (e.g. the Animal Welfare Information Center) used to determine that alternative were not available…."

Species (Common Name)	**Age/Sex**	**Category C (procedure)**	**Category D (procedure)**	**Category E (procedure)**	**Total # of animals needed for duration of project**
Balaenoptera physalus fin whale	Adult and sub-adult males and females	20/year (dart tagging)			20/year (dart tagging)
Physeter macrocephalus sperm whales	Adult and sub-adult males and females	20/year (dart tagging)			20/year (dart tagging)
Orcinus orca Northern resident killer whales	Adult and sub-adult males and females	20/year (dart tagging)			20/year (dart tagging)
Orcinus orca Southern resident killer whales	Adult males and females	6/year (dart tagging)			6/year (dart tagging)
Orcinus orca Hawaii killer whales	Adult and sub-adult males and females	20/year (dart tagging)			20/year (dart tagging)
Kogia breviceps Pygmy sperm whales	Adult and sub-adult males and females	20/year (dart tagging)			20/year (dart tagging)
Ziphius cavirostris Cuvier's beaked whales	Adult and sub-adult males and females	20/year (dart tagging)			20/year (dart tagging)
Mesoplodon Spp. Beaked whales	Adult and sub-adult males and females	20/year (dart tagging)			20/year (dart tagging)
Grampus griseus Risso's dolphin	Adult and sub-adult males and females	20/year (dart tagging)			20/year (dart tagging)
Lagenorhynchus obliquidens Pacific white-	Adult and males and females	20/year (dart tagging)			20/year (dart tagging)

sided dolphin					
Mesoplodon densirostris Blainville's beaked whale	Adult and sub-adult males and females	20/year (dart tagging)			20/year (dart tagging)
Indopacetus pacificus Longman's beaked whales	Adult and sub-adult males and females	20/year (dart tagging)			20/year (dart tagging)
Feresa attenuata pygmy killer whale	Adult and sub-adult males and females	20/year (dart tagging)			20/year (dart tagging)
Peponocephala electra melon-headed whales	Adult and sub-adult males and females	20/year (dart tagging)			20/year (dart tagging)
Pseudorca crassidens false killer whales	Adult and sub-adult males and females	20/year (dart tagging)			20/year (dart tagging)
Tursiops truncatus bottlenose dolphins	Adult and sub-adult males and females	20/year (dart tagging)			20/year (dart tagging)
Steno bredanensis rough-toothed dolphins	Adult and sub-adult males and females	20/year (dart tagging)			20/year (dart tagging)

6 If you have placed any animal numbers in **categories D and E**, you must complete the following (use Appendix B if additional space is necessary)
   a. Explain why the pain or discomfort cannot be relieved and what procedure will be used to minimize discomfort.
   b. What informational methods and resources did you use to determine that (no-animal or non-painful) alternative were not appropriate for this research?
      i. Include the databases that were searched (include keywords used).
      ii. Include literature citations
      iii. Include meetings with knowledgeable individuals (name, date)
      iv. Include other methods/resources

C. Experimental Procedures

1. General Procedures. *(Detail research procedures in Appendix B)*

a. Capture, Samples and methods of collection

Sample Type	Collection method	Sample size	Number of animals
Satellite-transmitter dart tags	**N/A**	**N/A**	**6-20/species**

In accordance with the AWA, "Procedures that may cause more than momentary or slight pain or distress to the animals will a) be performed with appropriate sedatives, analgesics, or anesthetics unless withholding such agents is justified for scientific reasons in writing by the principal investigator and will continue for only the necessary period of time; b) involve in their planning, consultation with the attending veterinarian…, c) not include the use of paralytics without anesthesia…"

2. Animal Restraint

a. Physical (*Describe method, duration, equipment used)*

N/A

. b. Chemical

N/A

Anesthetics and Analgesics:

If anesthetics or analgesics are to be used, please provide the following information: procedure, anesthetic, dose and method of administration

Procedure	Anesthetic	Does & Method of Administration; Reference	Duration	Intervention
N/A				

3. **Marking and Instrumentation***(Describe mark or tag type, or instrument type to be used. Provide mass of attachment device, range of body mass of study animal, device mass a proportion of body mass and the recommended device mass as a percent of body mass)*

Tag or Instrument	Size (dimensions & mass)	% of body mass	Attachment Method
Satellite-linked transmitter	6.3 cm in length, 3 cm in width, and 2.2 cm in height, 44-49 grams	*< 0.1%*	*Percutaneous anchor darts*

In accordance with AWA: "Activities that involve surgery include appropriate provision for pre-operative and post-operative care of the animal in accordance with established veterinary medical and nursing practices. All survival surgery will be performed using aseptic procedures, including surgical gloves, masks, sterile instruments, and aseptic techniques."

4. Surgical Procedures – Is surgery to be performed? ☐ **YES** ☐**X NO**

a. If **YES**, list surgery location/room:
b. If **YES**,

i. is it a terminal procedure? ☐ **YES** ☐ **NO**

ii. is it a survival procedure? ☐ **YES** ☐ **NO**

c. If **YES**, then describe the surgical procedure to be performed in Appendix B. Be sure to include the protocol to be followed to ensure asepsis.
d. If aseptic procedures are not to be performed, use this space below to justify why not and describe the procedure of choice.
e. Describe the post-operative care (both immediate and long-term).

5. Injury to animals – Accidental injuries which might occur to animals during handling

(Describe the most like injuries which might occur to research animals, how frequent injuries are expected and planned procedures to treat injuries.)

N/A

6. Euthanasia –All methods of euthanasia must follow the American Veterinary Medical Association Panel on Euthanasia Guidelines on Euthanasia (June 2007, 36pp). Any deviations must be scenically justified. Even if you do not intend to euthanize animals as part of the project, a method of euthanasia must be listed in case of emergency. (Describe agent, dose and route of administration).

-Will the animals be terminated if severely injured during handling? ☐ **YES** ☐ **X NO**

-Will animals be terminated as part of handling protocol ☐ **YES** ☐ **X NO**

If **YES,** provide the method of euthanasia and disposal of animal upon completion. If **NO,** provide method of euthanasia in case of emergency.

N/A

Please consult NMFS Research Protocol Guidelines (TBD) for acceptable practices. (AVMA Guidelines, AAZV Guidelines, etc)

In accordance with the AWA, "Personnel conducting procedures on the species being maintained or studied will be appropriately qualified and trained in those procedures."

7. Training

Please describe below the **training and qualifications** of yourself and other individuals who are included in this protocol. In particular, please be very specific about the hands-on training of those individuals performing procedures which may produce animal discomfort (i.e., restraint, injections, blood collection, surgery, tagging, biopsy, tooth extraction, urine, fecal, gastric, milk, semen, sample collection, euthanasia, etc.). Use Appendix C to further describe training and experience.

Dr. Brad Hanson, NWFSC. Dr. Hanson has been a Research Biologist with the NWFSC since 2003 and is an Affiliate Faculty at the University of Washington. Dr. Hanson has 30 years experience studying cetacean behavior and ecology. Since 2003 most of his research has focused on the ecology of southern resident killer whales. He conducted small cetacean satellite tag development work for his Ph.D. in the late 1990s.

D. Husbandry Practices (laboratory and field)

1. Temporary Holding (*period greater than 1 hour and less than 24 hours)*
(Describe holding facilities or equipment, i.e. pens, cages, nets ,shade, water,etc)

N/A

2. Long term holding (periods greater than 24 hours)

Will the research require holding the animals in captivity? ☐ **YES** **X☐ NO**

1. If **YES**, describe the husbandry practices that will be used.
2. If **YES**, describe procedures for disposition of dead animals, including whether or not a necropsy will be performed.
3. Will the animals be removed from the facility? ☐ **YES** **X☐ NO**
   a. If **YES**, for how long?
   b. If **YES**, to where?
   c. If **YES**, will they be returned to the facility? ☐ **YES** **X ☐ NO**
   d. If **NO**, why not? **Animals are not being captured**

E. Environmental Safety

1. Are infectious agents to be used and is there potential for exposure?

☐ **YES** ☐ **X NO**

If YES, the agent(s) is…..

If YES, is the agent infectious to humans? ☐ **YES** ☐ **NO**

2. Are chemical hazards to be used? ☐ **YES** ☐**X NO**

If **YES**, the chemical hazard is……

3. Are radioisotopes to be used? ☐ **YES** ☐ **X NO**

If **YES**, the radioisotope is……

4. Are other biohazards of concern like exposure to zoonotic agents?

☐ **YES** ☐ **X NO**

IF **YES**, the biohazard(s) is……

Note - If any of the above questions are answered YES, all procedures must comply with NMFS Environmental Safety requirements (TBD).

F. Use of Controlled and/or Prescription Substances (*Source, arrangements for use, ordering, record keeping, storage and precautions taken to avoid unauthorized access)*

N/A

G. NMFS Training on Animal Care and Use (TBD)

Have you and all of the personnel listed in the table below as investigators completed Training Module 1 of the AFSC/NWFSC Animal Care and Use Training Program?

☐ **X YES** ☐ **NO**

If **YES**, give data

All listed personnel have completed Training Module

If **NO**, you must complete this Training Module before the IACUC will consider this Animal Care and Use Assurance Form.

G. Occupational Health and Safety

List all the names and telephone numbers of personnel including yourself associated with this project and identified in this protocol who will work with animals or animal tissue. Check the appropriate box to indicate whether or not each individual has completed the NMFS Animal Care and Use Training Program. Also, check the appropriate box to indicate if each individual has fulfilled requirements for vaccination and/or testing.

NMFS IACUC Training	**Vaccination/Testing**	**Name**	**Phone**	**Email**
X☐Yes X☐ No	☐Yes ☐ No	Brad Hanson	206-860-3220	brad.hanson@noaa.gov
X☐Yes ☐ No	☐Yes ☐ No	Candi Emmons	206-302-2432	candice.emmons@noaa.gov
X☐Yes ☐ No	☐Yes ☐ No	Greg Schorr	206-931-4638	gschorr@cascadiaresearch.org
X☐Yes ☐ No	☐Yes ☐ No	Robin Baird	425-879-0360	rwbaird@cascadiaresearch.org
☐Yes ☐ No	☐Yes ☐ No			
☐Yes ☐ No	☐Yes ☐ No			

H. Assurance

I attest to the accuracy and completeness of the information provided. I promise to conduct this work with animals in accordance with the protocol as approved by the NMFS IACUC under the NMFS Animal Care and Use Policy. I will not make any substantive changes in the above protocol without first obtaining the approval of the NMFS IACUC, and I will not use any procedures which are not included in this form.

Principal Investigator/Applicant: **_____Date:_____**

Appendix A

Observational Study Description(s) from page

N/A

Appendix B

Experimental Procedures Description(s) from page..

Describe the animal procedures that are to be performed and the necessity in fulfilling the goals and objectives of the project. Be sure to be specific about any procedures which may impact the health and comfort of the study animals (e.g., frequency of performance of any procedures, methods of restraint, blood sample volumes, etc.). Please provide a justification for the animal numbers used.

Satellite tagging undertaken by NWFSC staff will use the Low Impact Minimally Percutaneous External-electronics Transmitter (LIMPET) tag (Andrews et al. 2008, Schorr et al. 2009), with a dart attachment system. This system is currently in use by other researchers working with killer whales in Alaska and in the Antarctic, as well as beaked whales and several other species in the Bahamas, and these tags have been successfully deployed by Cascadia Research Cpllective (e.g. Schorr et al. 2009, Baird et al. 2010) on 14 different species: bottlenose dolphin, Risso's dolphin, killer whale, short-finned pilot whale, false killer whale, melon-headed whale, pygmy killer whale, Cuvier's beaked whale, Blainville's beaked whale, sperm whale, fin whale, blue whale, minke whale and humpback whale (under NMFS Scientific Research Permits No. 540-1811, 774-1714, 782-1719, 781-1824, and/or 731-1774) (Figure 1).

Figure 1. LIMPET satellite tag attached to dorsal fin of a fin whale. Photo © E. Falcone, Cascadia Research.

The location-only tag body is dome-shaped in the current configuration (a Wildlife Computers Spot-5 PTT), approximately 6.3 cm in length, 3 cm in width, and 2.2 cm in height, with a 17 cm long antenna sticking out of the center of the half dome

(Figure 2). In current configurations location-only satellite tags weigh 44-49 grams. The location-depth tag (Wildlife Computers Mk10a) is approximately 5.3cm in length, 5.2cm in width, and 2.4cm in height (Figure 3) and weighs 54-59 grams. As well as location, this tag allows for the collection of basic dive parameters including max depth and dive length. Ongoing developments in tag design and manufacture will likely result in smaller tag in the future.

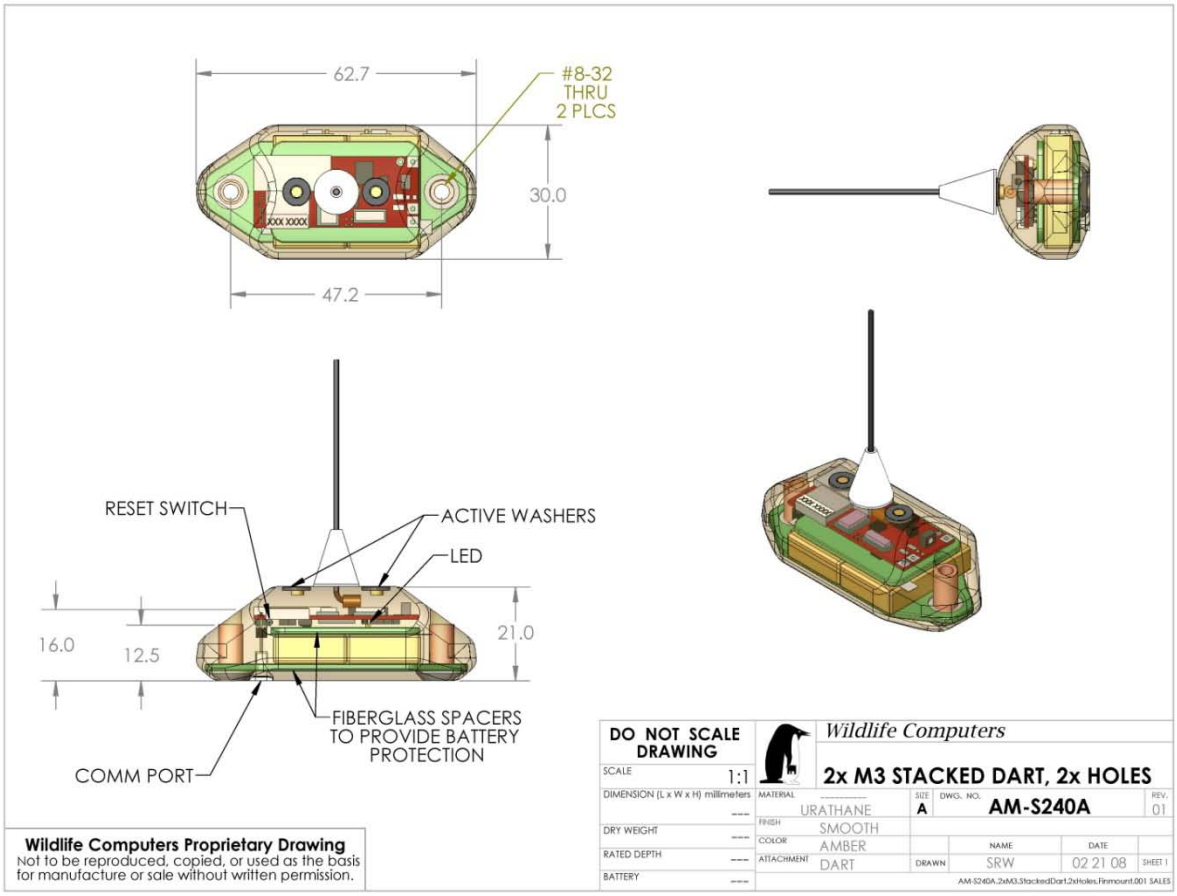

Figure 2. Current location-only Spot5 tag shape and configuration. Units are in mm. Used with permission of Wildlife Computers.

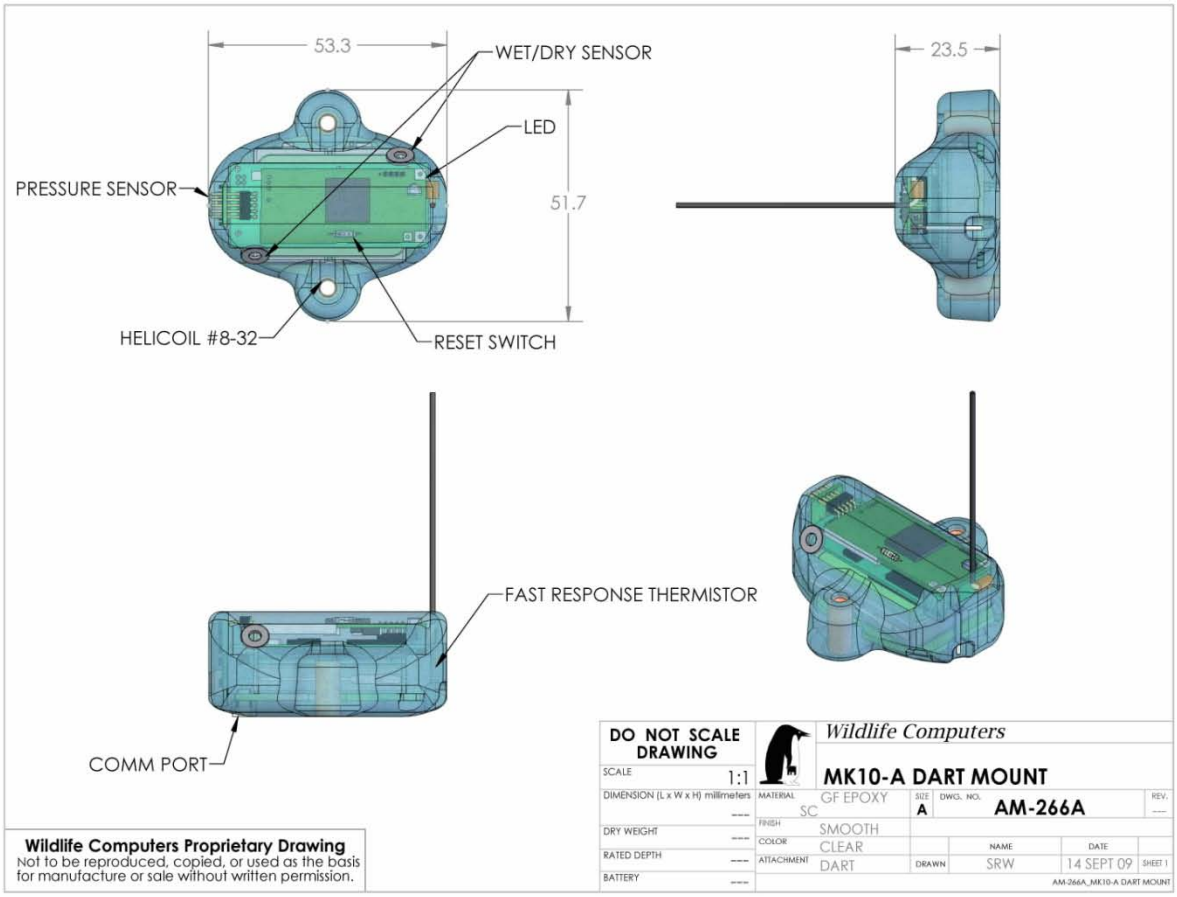

Figure 3. Current location and depth transmitting tag, Mk10a size and configuration. Units are in mm. Used with permission of Wildlife Computers.

On the flat side (bottom) of the tag is a retention system. Currently this uses two medical-grade titanium darts, approximately 0.6 cm in diameter, with 3 to 6 backwards facing petals that act to anchor the tag (Figure 3). Alternative darts are under consideration and testing, including a hollow design with very small backward facing barbs. Transmitter and dart designs as well as deployment systems are constantly being evaluated based on performance results of each deployment by the NWFSC and collaborating individuals (e.g., Baird, Schorr), and thus exact dimensions, weights and configurations may vary. However, all considerations are made to minimize tissue damage while allowing for retention durations to match battery life.

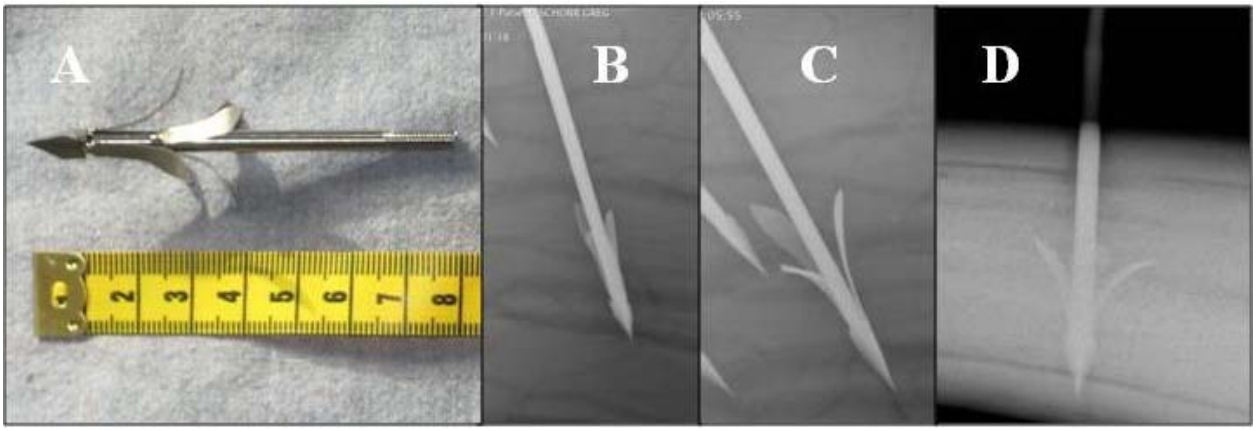

Figure 4. A: Current configuration of the dart used for larger odontocetes and mysticetes with two rows of backward facing petals. B**:** X-ray image showing a dart (with one row of petals only) in a killer whale dorsal fin (collected from a stranded individual unrelated to any tagging activities) after dart penetration. Note the backward facing petals are tight against the dart shaft, indicating that they were compressed upon entry into the fin which will minimize tissue damage upon entry. C: X-ray image of the same dart in B, after 11.4 kg of outward pull was exerted on the dart shaft. Note the petals have splayed outward from the dart shaft as they cut through tissue and moved into the holding position as designed (note the tips of two other darts visible in this x-ray). D: X-ray image of the same dart after 22.7 kg of outward pull. The petals have more fully splayed outward from the dart shaft and are now presenting a flat surface nearly perpendicular to the axis of outward force.

Dart length may vary by species (Table 1); tags used on smaller species (e.g., bottlenose and Risso's dolphins) will have shorter dart lengths. Currently, the longest darts in use are 7cm in length such that when the transmitter is deployed flush on the fin the backward facing petals will be located behind the vertical sheath of the dorsal fin (the tissue layer with the greatest structural integrity) in order to provide the most secure anchoring.

Table 1. Table of species to be dart tagged indicating approximate dart length and target attachment location. The specific number of species to be tagged will be outlined in each individual protocol submitted.

Species	**Dart Length**[1]	**Attachment location target**
Mesoplodont beaked whale[2]	4-7cm	Dorsal Fin
Cuvier's beaked whale	4-7cm	Dorsal Fin
Baird's beaked whale	4-7cm	Dorsal Fin
Longman's beaked whale	4-7cm	Dorsal Fin
Blue whale	4-7cm	Dorsal Fin/ Dorsal Ridge
Fin whale	4-7cm	Dorsal Fin/ Dorsal Ridge
Sei whale	4-7cm	Dorsal Fin/ Dorsal Ridge
Minke whale	4-7cm	Dorsal Fin/ Dorsal Ridge
Bryde's whale	4-7cm	Dorsal Fin/ Dorsal Ridge
Humpback whale	4-7cm	Dorsal Fin/ Dorsal Ridge
Gray whale	4-7cm	Dorsal Ridge

Sperm whale	4-7cm	Dorsal Fin/ Dorsal Ridge
Killer whale	4-7cm	Dorsal Fin
Short-finned pilot whale	4-7cm	Dorsal Fin
False killer whale	4-7cm	Dorsal Fin
Pygmy killer whale	3-6cm	Dorsal Fin
Risso's dolphin	3-6cm	Dorsal Fin
Melon-headed whale	3-6cm	Dorsal Fin
Rough-toothed dolphin	3-6cm	Dorsal Fin
Common bottlenose dolphin	3-6cm	Dorsal Fin
Pacific white-sided dolphin	3-6cm	Dorsal Fin
Pygmy sperm whale	3-6cm	Dorsal Fin
Dwarf sperm whale	3-6cm	Dorsal Fin

[1)] Dart lengths are approximate and may change with new information or design, but will not exceed maximum length listed here. [2]There are several species of beaked whales in the genus *Mesoplodon* within our study areas that are collectively referred to here as Mesoplodont beaked whales

Tags may be deployed with a Pneumatic projector (Figure 5), a crossbow, or a pole, at distances from 2-30 m. The tag is attached to an arrow using a holder and water-soluble tape which secures the tag to the arrow until contact with the whale is made. Upon impact with the whale, the arrow most often immediately bounces free. In the few cases where the arrow holds on, it will generally separate from the tag upon submersion in the water.

Figure 5. Projector (upper), tag (middle) and arrow with tag holder (lower) used to deploy most LIMPET tags. The reel with the line on the projector may be used for a retention line system if tags are deployed in circumstances where arrow recovery is difficult (e.g., from larger vessels in offshore waters).

Tags are expected to stay attached for periods ranging from approximately 1-25 weeks and all release within a year.

High resolution photographs will be taken of all tagged animals whenever possible for individual photo-identification (to assess population identity and for examining tag impacts), to confirm sex (e.g. with beaked whales), to document tag

deployment location on the body and to document tag orientation (e.g., whether to tag is flush against the dorsal fin).

In some cases, skin/blubber biopsy samples will also be collected from satellite-tagged animals for genetic confirmation of sex, species (e.g., with *Mesoplodon* beaked whales), population identity, reproductive state, or for other studies. Some satellite tagged individuals may also be tagged with short-tem suction-cup attached data logging tags in order to record dive behavior or acoustics.

Research Effects and Mitigation Measures

1. Effects

Effects of tagging can be short- and long-term in nature. Potential short-term effects include behavioral changes of individuals associated with vessel approach for tagging, reactions of non-target individuals to deployment on a group member, reactions of both target and non-target individual to a missed shot, and immediate reactions to the tag attachment itself. Based on observations during satellite tag deployment attempts to date, these types of short-term effects are expected to be no greater than those typically associated with biopsy sampling, such as a short-term increase in speed and/or change in direction, or temporary suspension of the surfacing series during which the attempt or deployment was made. Reactions of non-target individuals typically depend on the proximity of these individuals to the target; nearby individuals may exhibit a flinch and/or fast dive response similar to when target individuals are suction cup tagged or biopsy sampled. We have found that some of the species studied can be closely approached shortly after reactions to tagging with no apparent avoidance.

A compilation of reaction information from the application of 144 medium-term satellite or VHF dart tags deployed on 14 different species is shown in Table 2. Reactions were grouped based on the intensity and duration of behavior into four categories following Weinrich et al. (1992) and Berrow et al. (2002): none, low, moderate, and strong (Table 2). The majority (81.9%) of the tagging events resulted in a moderate reaction, generally represented by a fast dive and/or tail flick. Eleven (7.6%) event had no reaction observed, twelve had low-level reactions and three had strong reactions. Of the three animals observed to have a strong reaction, one exhibited two tail lobs followed by two breaches (a short-finned pilot whale). Follow-up observations and photographs of the animal show a return to normal surfacing within three minutes post-tagging, and normal behavior continued through the remainder of the encounter, lasting over an hour. The second animal (a minke whale), which exhibited a tail throw followed by a fast dive, was observed repeatedly approaching the tagging vessel after the tagging event, and swimming in a normal fashion. The third individual (a bottlenose dolphin) exhibited three breaches about 45 seconds after tagging, then resumed normal behavior and re-approached the bow 15 minutes post-tagging. All of these instances illustrate that while tagged animals may have short-lived moderate to strong reactions (as defined by Weinrich et al. 1992), they are highly ephemeral in nature.

Table 2. Reactions to satellite and VHF dart-tagging by species, 2006 - 2009. Reaction levels follow Weinrich et al. (1992) and Berrow et al. (2002).

Species (N)	No Reaction # (%)	Low Level (e.g. slight acceleration) # (%)	Moderate (e.g. Fast dive, tail flick, acceleration) # (%)	Strong (e.g. several tail flicks, breaches) # (%)

Short-finned pilot whale (40)	0 (0)	1 (3)	38 (95)	1 (3)
False killer whale (23)	2 (9)	0 (0)	21 (91)	0 (0)
Melon-headed whale (13)	0 (0)	0 (0)	13 (100)	0 (0)
Pygmy killer whale (4)	0 (0)	0 (0)	4 (100)	0 (0)
Killer whale (9)	1 (11)	2 (22)	6 (67)	0 (0)
Risso's dolphin (2)	0 (0)	1 (50)	1 (50)	0 (0)
Bottlenose Dolphin (1)	0 (0)	0 (0)	0 (0)	1 (100)
Blainville's beaked whale (11)	0 (0)	0 (0)	11 (100)	0 (0)
Cuvier's beaked whale (8)	0 (0)	0 (0)	8 (100)	0 (0)
Sperm whale (12)	0 (0)	2 (17)	10 (83	0 (0)
Fin whale (16)	7 (44)	4 (25)	5 (31)	0 (0)
Minke whale (1)	0 (0)	0 (0)	0 (0)	1 (100)
Blue whale (3)	1 (33)	1 (33)	1 (33)	0 (0)
Humpback whale (1)	0 (0)	1 (100)	0 (0)	0 (0)
Total (144)	11 (7.6)	12 (8.3)	118 (81.9)	3 (2.1)

A review of long-term tagging impacts (days to years post-deployment) was conducted by Hanson et al. (2008) on four different species of odontocetes tagged in Hawaii with LIMPET tags, using long-term photo identification to assess tagging related tissue injury and healing. Most commonly, animals photographed post-tag loss showed only small white scars, and in some cases small depressions or raised areas, around the implant site. These tags have transmitted for up to 121 days and follow up photographs have been collected up to 838 days post-tagging (Hanson et al., 2008).

Based on follow-up observations of more than 40 tagged individuals, in most cases the release appears to be a result of tissue breakdown immediately adjacent to the dart penetration site. This tissue breakdown is most likely associated with a foreign body response to the dart but the process may be accelerated by the additional tension put on the tissue adjacent to the darts by drag forces acting on the tag body. There is also the possibility of vascular disruption if a dart intersects with an artery in the dorsal fin. This could lead to a lessening or loss of blood flow distal from the tag site. Most cetacean fins have ample cross-current circulation, so it is thought that this type of disruption would not result in a complete loss of blood flow to the distal areas of the dorsal fin. Only one animal from our re-sighting history has shown any type of tissue loss distal to the tag site. However, no other individuals with similar sized dorsal fins have been sighted post-tagging showing anything other than small white scars and/or small depression or raised area. It is also possible that the tag might be dislodged by a conspecific—we have seen suction cup tags pulled off with one species—or by the tagged animal rubbing on other animals or against an inanimate object. However, we have seen no behaviors or evidence to suggest this occurrence with LIMPET tags.

Because the dart tags penetrate the skin, connective tissue and/or blubber, and remain attached for up to several months, a risk of infection is a potential long-term effect. It should be noted however that odontocetes inhabiting warmer tropical waters are regularly bitten by cookie-cutter sharks, which create wounds up to several cm deep and 5-10 cm in diameter, and thus the injury associated with tag attachment may not be particularly unusual for these species.

The findings by Hanson et al. (2008) indicate that no major long-term impacts have been associated with attachment of dart-style tags and no tagging-related mortalities have ever been documented.

2. Measures to minimize effects

Tags will be deployed without capturing individuals, thus eliminating risks associated with capture and handling. Approaches for the purposes of tagging will be made in such a way as to minimize disturbance to individuals, with the research vessel gradually reducing speed as the group is approached to match the group/individual speed and direction. To minimize harassment of non-target individuals, when there is an appropriate individual that is somewhat separated from the main body of a group, these individuals will be targeted for tagging. It should be noted however that for some species (e.g., beaked whales) opportunities for tagging are rare and there may be no option for tagging individuals away from the main body of a group. An individual will be not be intentionally tagged more than once per year. No more than two tagging attempts per individual per encounter, or four tagging attempts per individual per year, will be made.

To minimize hydrodynamic drag, the smallest, lightest possible package available is used. Current versions of the location-only tags weigh 44-47 grams, and location/depth tags weigh 54-59 grams, in comparison to typical suction-cup attached tags being deployed which weigh from approximately 250-800 grams.

To minimize risk of infection, prior to deployment the darts are cleaned in a multiple step process. First they are scrubbed using a small bottle brush and pipe cleaner in a warm soapy water mixture. They are then rinsed with water and placed in a dilute bleach solution (10%) for 10 minutes or longer, then rinsed again with water. The darts are placed in boiling water for 5 minutes, and then soaked in acetone, and finally soaked for 10 minutes or longer in 70% Isopropyl alcohol. Once dry, the darts are covered with a sterile covering. Surgical gloves are worn during the entire process, and tips are handled using sterile tweezers. Once in the sterile covering, the darts are screwed onto the bottom of the tag, and the whole assembly is then placed in a clean Ziploc bag. Immediately prior to deployment, after the tag has been positioned in the holder and projector, the darts are soaked again with 70% Isopropyl alcohol.

Sex and age classes to be tagged include adult and juvenile males and females. No tagging attempts will be made on calves estimated to be less than one year of age or females accompanied by calves less than six months of age. Extra care will be taken when tagging females which have calves older than six months present to avoid any unnecessary risks.

Approaches to individual cetaceans for satellite tagging will be similar to those currently employed for suction-cup tagging, with the research vessel generally matching the speed and direction of the individuals in the group. Satellite tagging activities may result in incidental harassment takes of non-target individuals, and also of target individuals during unsuccessful tagging attempts. These takes are currently authorized under active permits.

3. Monitoring effects of activities

Reaction of the tagged individual will be noted and will be recorded by video where possible. Once tagged, attempts will be made to conduct focal follows of the tagged animals, with photographs and short-term data being recorded by observers on the boat. The tagged animal is followed at distances ranging from 5-500 meters (depending on the species and behavior of the tagged animals; e.g., dolphins which bowride or do not avoid

vessels are followed at much closer distances than large whales). The tagged animal and other group members are photo-identified, and acoustic information may be recorded to monitor vocal activity of the tagged animal or group. During field projects when tagging is undertaken, and during subsequent field projects, attempts will be made to obtain photographs of tagged individuals to examine wound healing and modes of tag failures. Species to be tagged are all of interest by the applicant for photo identification purposes and are always approached and photographed during research activities. In addition, photographs taken by other researchers working in the area will be utilized where possible. Information on behavior of the tagged animal relevant to other group members (e.g., whether similar behavior is being exhibited by other animals, animal's response to the vessel post-tagging) can be used to evaluate the reactions to tagging. Interactions between the tagged animal and other individuals (including other species of cetaceans) are recorded. If, during the course of follow up studies, an unusual wound or healing process is noted, the information will be brought to the attention of a vet.

References

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, D.L. Webster, D.J. McSweeney, M.B. Hanson, and R.D. Andrews. 2008. Multi-species cetacean satellite tagging to examine movements in relation to the 2008 Rim-of-the-Pacific (RIMPAC) naval exercise. A quick look report on the results of tagging efforts undertaken under Order No. D1000115 from the Woods Hole Oceanographic Institution

Baird, R.W., G.S. Schorr, D.L. Webster, D.J. McSweeney, M.B. Hanson, and R.D. Andrews. 2010. Movements of satellite-tagged false killer whales around the main Hawaiian Islands. Endangered Species Research doi.10.3354/esr00258.

Barrett-Lennard, L.G., T.G. Smith, and G.M. Ellis. 1996. A cetacean biopsy system using lightweight pneumatic darts, and its effect on the behavior of killer whales. Marine Mammal Science 12: 14-27.

Berrow, S.D., B. McHugh, D. Glynn, E. McGovern, K.M. Parsons, R.W. Baird, S.K. Hooker, 2002. Organochlorine concentrations in resident bottlenose dolphins (*Tursiops truncatus*) in the Shannon estuary, Ireland. Marine Pollution Bulletin 44: 1296-1303.

Clapham, P.J., and D. K. Mattilla, 1993. Reactions of humpback whales to skin biopsy sampling on a West Indies breeding ground. Marine Mammal Science 9(4): 382-391.

Chivers, B.L., P.J. Corkeron, W.H Blanshard, T.R. Long and A.R. Martin. 2001. A new VHF tag and attachment technique for small cetaceans. Aquatic Mammals 27:11-15.

Gorgone, A.M., P.A. Haase, E.S. Griffith, and A.A. Hohn. 2008. Modeling response of target and nontarget dolphins to biopsy darting. The Journal of Wildlife Management 72: 926-932.

Hanson, M.B., R.D. Andrews, G.S. Schorr, R.W. Baird, D.L. Webster, and D.J. McSweeney, 2008. Re-sightings, healing, and attachment performance of remotely-deployed dorsal fin-mounted tags on Hawaiian odontocetes. Document PSRG-2008-10, Pacific Scientific Review Group, Kihei, Hawaii.

Heide-Jørgensen, M.-P., Kleivane, L., Oien, N.., Laidre, K.L., Jensen, M.V., 2001a. A new technique for deploying satellite transmitters on baleen whales: tracking a blue whale (*Balaenoptera musculus*) in the North Atlantic. Marine Mammal Science 17, 949-954.

Heide-Jørgensen, M.P., E.S. Nordøy, N. Øien, L.P. Folkow, L. Kleivane, A.S. Blix, M.V. Jensen, K.L. Lairde, 2001b. Satellite tracking of minke whales (*Balaenoptera acutorostrata*) off the coast of northern Norway. Journal of Cetacean Research and Management 3: 175-178.

Mate, B., R. Mesecar, and B. Lagerquist. 2007. The evolution of satellite-monitored radio tags for large whales: One laboratory's experience. Deep-Sea Research II 54: 224-247.

Norman, S.A., R.C. Hobbs, J. Foster, J.P. Schroeder, and F.I. Townsend. 2004. A review of animal and human health concerns during capture-release, handling and tagging of odontocetes. Journal of Cetacean Research and Management 6: 53-64.

Richard, P.R., M.P. Heide-Jørgensen, and D.St. Aubin. 1998. Fall movements of belugas (*Delphinapterus leucas*) with satellite-linked transmitters in Lancaster Sound, Jones Sound, and Northern Baffin Bay. Arctic 51: 5-16.

Schorr, G.S., R.W. Baird, M.B. Hanson, D.L. Webster, D.J. McSweeney and R.D. Andrews. 2009. Movements of satellite-tagged Blainville's beaked whales off the island of Hawai'i. Endangered Species Research doi:10.3354/esr00229.

Scott, M.D., R.S. Wells, A.B. Irvine, and B.R. Mate. 1990. Tagging and marking studies on small cetaceans. In: The Bottlenose Dolphin. S. Leatherwood and R. R. Reeves, eds. Academic Press. San Diego, 489-513.

Weinrich, M.T., R.H. Lambertson, C.R. Belt, M.R. Schilling, H.J. Iken, and S.E. Syrjala. 1992. Behavioral reactions of humpback whales, *Megaptera novaeangliae*, to biopsy procedures. Fishery Bulletin 90: 588-598.

Appendix C

Training and Experience description(s)

Training

All personnel involved in actively deploying satellite tags will either have prior experience, or will have undergone appropriate training in the technique by a qualified senior staff at NWFSC. This training will include at a minimum, sterilization procedures, firearm safety briefing, and target practice with the delivery device to be used. Individuals will be familiar with the target species behavior, and will demonstrate an adequate level of proficiency in target practice.

Experience descriptions

Candice Emmons has been a Research Biologist with NWFSC since 2006. Ms. Emmons has fifteen years experience in field work with cetaceans. The majority of this work has been with killer whales in Washington and Alaska. Since 1999, she has participated in a tagging and biopsying of different cetacean species including North Atlantic right whales, humpback whales, and killer whales.

Dr, Robin Baird, Cascadia Research Collective. Dr. Baird has been a Research Biologist with Cascadia Research (Olympia, WA) since 2003, is an Adjunct Professor at Portland State University and an Affiliate Assistant Professor at the University of Washington. Dr. Baird has 22 years experience studying cetacean behavior and ecology. Since 2000 most of his research has focused on behavior, ecology, and population assessment of Hawaiian odontocetes, in particular beaked whales. He has been conducting photo-identification and tagging studies of cetaceans since 1989.

Greg Schorr, Cascadia Research Collective Greg has 10 years of experience conducting research on a variety of cetaceans and has been a research biologist at Cascadia Research (Olympia, WA) since 2005. His focus has been the study of animal behavior and ecology and he has experience in constructing and attaching numerous tag types including suction-cup data loggers, surgically attached telemetry devices, and remotely deployed VHF and satellite tags. He has deployed over 100 satellite tags on free-ranging cetaceans