



Marine Species Monitoring Report For the U.S. Navy's  
Northwest Training Range Complex

Annual Report  
2 May 2014 to 1 May 2015

1 July 2015



**Cover Photo: Male California sea lion with satellite tracking tag attached photographed January 9, 2015. (Photo courtesy of Mathew Tennis, Pacific States Marine Fisheries Commission, under NMFS permit #13430)**

**In Support Of  
Letter of Authorization  
Under The Marine Mammal Protection Act  
And  
Incidental Take Statement  
Under the Endangered Species Act  
For Incidental Harassment of Marine Mammals Resulting From  
U.S. Navy Training Activities  
In The Northwest Training Range Complex**

**Marine Species Monitoring Report**

**For the U.S. Navy's**

**Northwest Training Range Complex-**

**Annual Report**

**2 May 2014 to 1 May 2015**

**Prepared in Accordance With  
50 C.F.R. §218.115(f)**

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**1 July 2015**

Citation for this report is as follows:

Department of the Navy. 2015. Marine Species Monitoring Report for the U.S. Navy's Northwest Training Range Complex- Annual Report 2 May 2014 to 1 May 2015. U.S. Pacific Fleet, Pearl Harbor, Hawaii. Final July 1, 2015.

*Acknowledgements:*

Monitoring Team and Performers- The Northwest Training Range Complex Navy funded Compliance Monitoring team is comprised of non-Navy civilian academic and contract scientists.

Marine mammal tagging effort conducted by: Oregon State University led by Dr. Bruce Mate, and by the Alaska Fisheries Science Center, NOAA Fisheries led by Dr. Bob DeLong.

Passive acoustic monitoring conducted by Marine Physical Laboratory, Scripps Institution of Oceanography at University of California San Diego, led by Dr. John Hildebrand.

## EXECUTIVE SUMMARY

Below is a broad assessment of accomplishments from Navy-funded monitoring conducted from 2 May 2014 to 1 May 2015 for the U.S. Navy's (Navy) Northwest Training Range Complex (NWTRC).

Current NWTRC compliance monitoring completed from 2011 through May 2015 consisted of the below research elements which has been relatively consistent over the course of the monitoring period:

- Marine mammal tagging and satellite tracking;
- Passive acoustic monitoring.

1) Satellite tracking: Satellite tracking tags can be an effective indicator of marine mammal distribution and movement patterns at short (days-weeks) and long (months-year) time scales (Department of the Navy 2011, 2012, 2013, 2014, Schorr et al. 2013, Mate 2013, Mate et al. 2014). The Navy believes for future tagging efforts from 2014 forward, longer term tags are preferred for continued monitoring. Long term tags will not only provide information on marine mammal distributions in terms of local bathymetric features, but also allow determination of percentages of time individuals spend within and outside of the Navy areas.

Tagging results from blue whales, fin whales, Southern Resident killer whales, and California sea lions are contained in this report and associated technical reports from participating researchers.

2) Passive Acoustic Monitoring: Long-term fixed passive acoustic monitoring is an effective way to determine seasonal species-specific occurrence of vocalizing and potentially foraging animals, although it does not account for non-vocalizing animals. Passive acoustic monitoring can also be used to record natural and anthropogenic sounds leading to better assessment of ambient noise conditions.

By May of 2015, Navy funded passive acoustic monitoring will have been ongoing off the coast of Washington State for 12 years.

Passive acoustic detection results from July 2013 to April 2014, the latest date series available, are presented in this report and associated technical reports from participating researchers. In addition a historic analysis of all data collected from January 2011 through April 2014 was conducted to delineate various killer whale ecotypes detected.

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## 1.0 INTRODUCTION

The United States Navy (Navy) developed at-sea range complex-specific Monitoring Plans under the Navy's Monitoring Program for marine species monitoring as required under the Marine Mammal Protection Act (MMPA) of 1972 and the Endangered Species Act (ESA) of 1973.

This report summarizes Navy-funded monitoring within the Navy's Northwest Training Range Complex (NWTRC) conducted between 2 May 2014 and 1 May 2015.

This document is an annual report summarizing monitoring results, prepared in accordance with 50 CFR §218.115(f).

The NWTRC serves as water space for ships and submarines to conduct training from the Strait of Juan de Fuca in the north, to approximately 50 nm (92.6 km) south of Eureka, California in the south, and from the coast line of Washington, Oregon, and California westward to 130° West longitude.

The southern boundary of the range complex is at 40° N latitude (Department of the Navy 2010b). For range management and scheduling purposes, the NWTRC is divided into numerous subcomponent training areas, the most important being Warning Area 237 (W-237) (**Figure 1-1**).

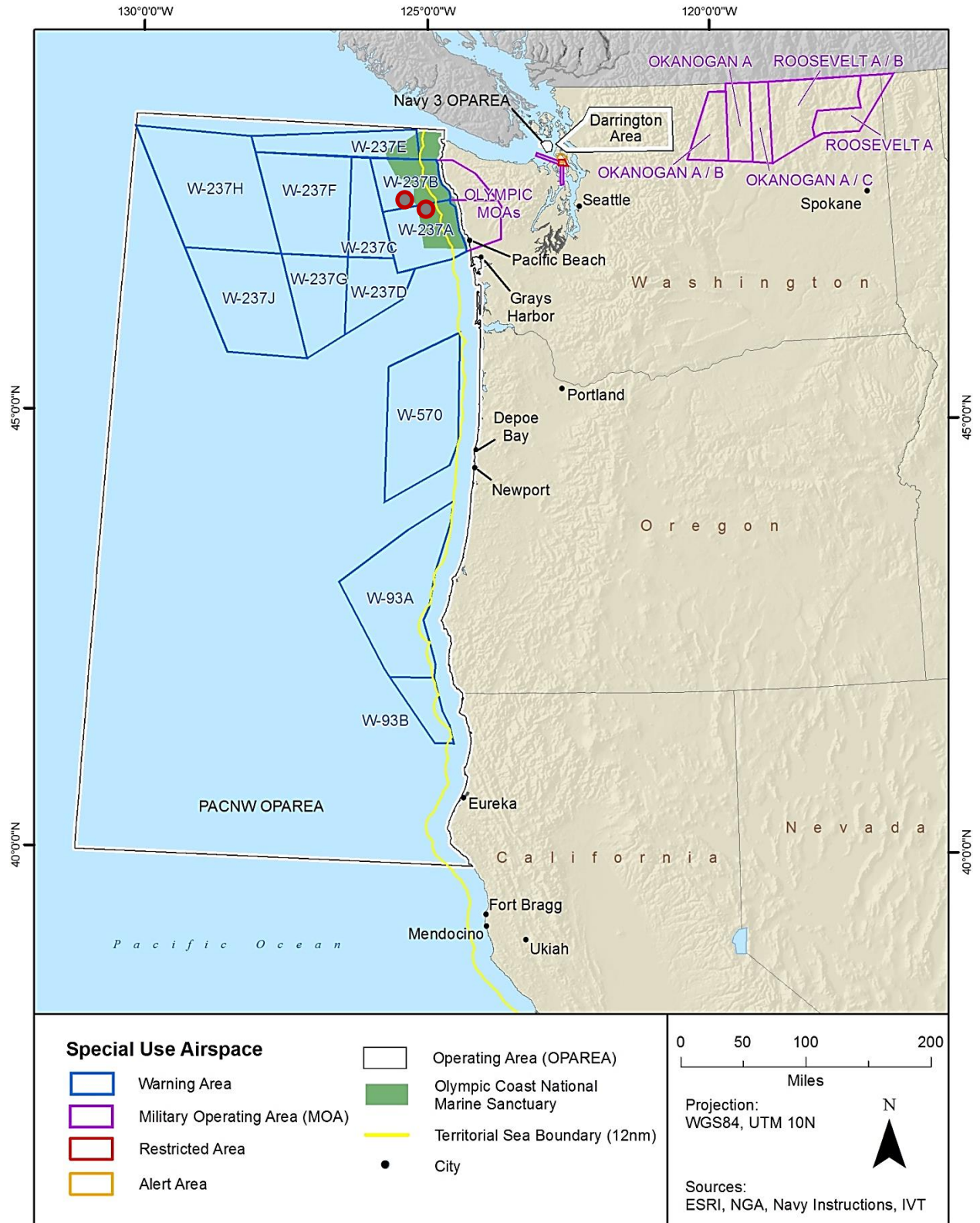
In terms of this annual report, the Navy has maintained through May 2015 the same approximate level of commitment in terms of annual metrics and funding for Compliance Monitoring technologies and resources as was originally established in 2011.

Current NWTRC Compliance Monitoring completed from 2011 through May 2015 consisted of the below research elements which has been relatively consistent over the course of the monitoring period:

- Marine mammal tagging
- Passive Acoustic Monitoring



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**Figure 1-1. NWTRC Complex.**

(Approximate location of bottom-mounted Compliance Monitoring passive acoustic devices shown in red circle ● )

## 2.0 MARINE MAMMAL TAGGING

One of the initial NWTRC monitoring metrics was to begin contributing to regional marine mammal occurrence and movement patterns via satellite tagging on an opportunistic basis.

The below projects describe ongoing results:

### **Baleen (Blue and Fin) Whale Tagging in Southern California in Support of Marine Mammal Monitoring Across Multiple Navy Training Areas (Southern California Range Complex, Northwest Training Range Complex, and Gulf of Alaska Temporary Maritime Activities Area)**

*(B. Mate, Oregon State University)*

In 2014, the Navy funded a long term multi-year study to document blue and fin whale occurrence, distribution, movement, and residency times along the U.S. West Coast and Gulf of Alaska. In particular, this study will seek to acquire new scientific data to address the question of:

**“What are the movement patterns, occurrence, and residence time of blue and fin whales within Navy training and testing areas along the US West Coast as compared to patterns within the rest of the Pacific Ocean?”**

The same tagging technology and techniques as reported in Mate et al. (2007), Mate (2013) and Mate et al. (2014) was employed during a field season started in the summer of 2014. Specific study objectives include: 1) determining blue and fin whale distribution and habitat use through deployment of location-only satellite tags, 2) determining blue and fin whale behavior changes over time by individual and between individuals over the course of several weeks using Advanced Dive Behavior (ADB) tags<sup>1</sup>; and 3) conducting an analysis using existing similar blue whale tag data from 1994-2009 (Bailey et al. 2009, Irvine et al. 2014) combined with new tag track data collected from 2014 and beyond. The Navy's intent is to expand this into a multi-year effort to allow the gathering of a larger data set of animal movements.

Major observations from Mate et al. 2015 include:

*“Twenty-four blue whales (20 location-only tags, 4 ADB tags) and six fin whales (3 location-only tags, 3 ADB tags) were tagged during August and September 2014, between Mugu Canyon, west of Malibu, and San Diego.*

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<sup>1</sup> “The newly developed Advanced-Dive-Behavior (ADB) pop-up tags collect high-resolution measurements of movements in three dimensions, as well as 3-axis accelerometer data that identify lunges to monitor foraging effort. The satellite-linked component of this tag is capable of acquiring updated satellite sensor data every 10 seconds (while the tag is at the surface) and GPS quality (160 m error radius) locations to supplement those collected by the Argos system. The ADB tags collect high-resolution (1 Hz) time-depth data, and have a magnetometer, which combined with three-axis accelerometer provide full-body orientation data. Tags detach at a pre-programmed time by “burning” a wire release so the tag can float to the surface, be retrieved, and more detailed data download than can be transmitted via satellite.” (text courtesy of B. Mate).

*There was a great deal of individual variation in the tracks of both blue and fin whales, with blue whale locations extending from the northern tip of Vancouver Island in British Columbia to the Costa Rica Dome area off Central America, and those of fin whales extending from southern Oregon to central Baja California.*

*Both blue and fin whales were tracked in the Northwest Training Range Complex (NWTRC) and the Southern California Training Range Complex (SOCAL), but neither species traveled into the Gulf of Alaska Temporary Maritime Activities Area (GOA). Only one blue whale had locations within area W237 within the NWTRC area (in August, September, and October). Blue whale presence was observed in both SOCAL and NWTRC in August, September, October, and November. There was also extensive movement north and south from the tagging area by some whales during this same period, with two reaching Cape Mendocino in northern California and three others crossing into Mexican waters by the third week of August. There was extensive movement off San Diego as well, where whales were tagged during the second leg of the cruise. By the end of September, the blue whales were spread out between the area off Magdalena Bay in southern Baja California and the tip of the Olympic Peninsula in Washington.*

*Two blue whales had locations inside both the SOCAL and the NWTRC areas. Two others had training range locations only within NWTRC, and 16 had locations only within SOCAL. Of the four blue whales with locations inside NWTRC, only one had locations inside area W237 (19 percent of its total locations). All locations within the training areas were less than 225 km from shore in SOCAL and less than 125 km in NWTRC for all but one whale. The exception was Tag #847 that had maximum distances from shore of 621 km within SOCAL and 287 km within NWTRC. Blue whale locations occurred in both SOCAL and NWTRC in 4 of the 6 months in which whales were tracked (August, September, October, and November).*

*Time spent in the NWTRC ranged from 3 to 45 percent for the four blue whales with locations 20 there (15–1,249 h). One of these whales spent 20 percent of its total tracking period or 468 h 21 within area W237.*

*Four fin whales had locations within SOCAL and one had locations within NWTRC. There were no fin whale locations inside area W237 within the NWTRC. The maximum distance from shore for these locations was 83 km within SOCAL and 72 km within NWTRC. One fin whale spent 811 h in the NWTRC, or 51 percent of its tracking period.”*

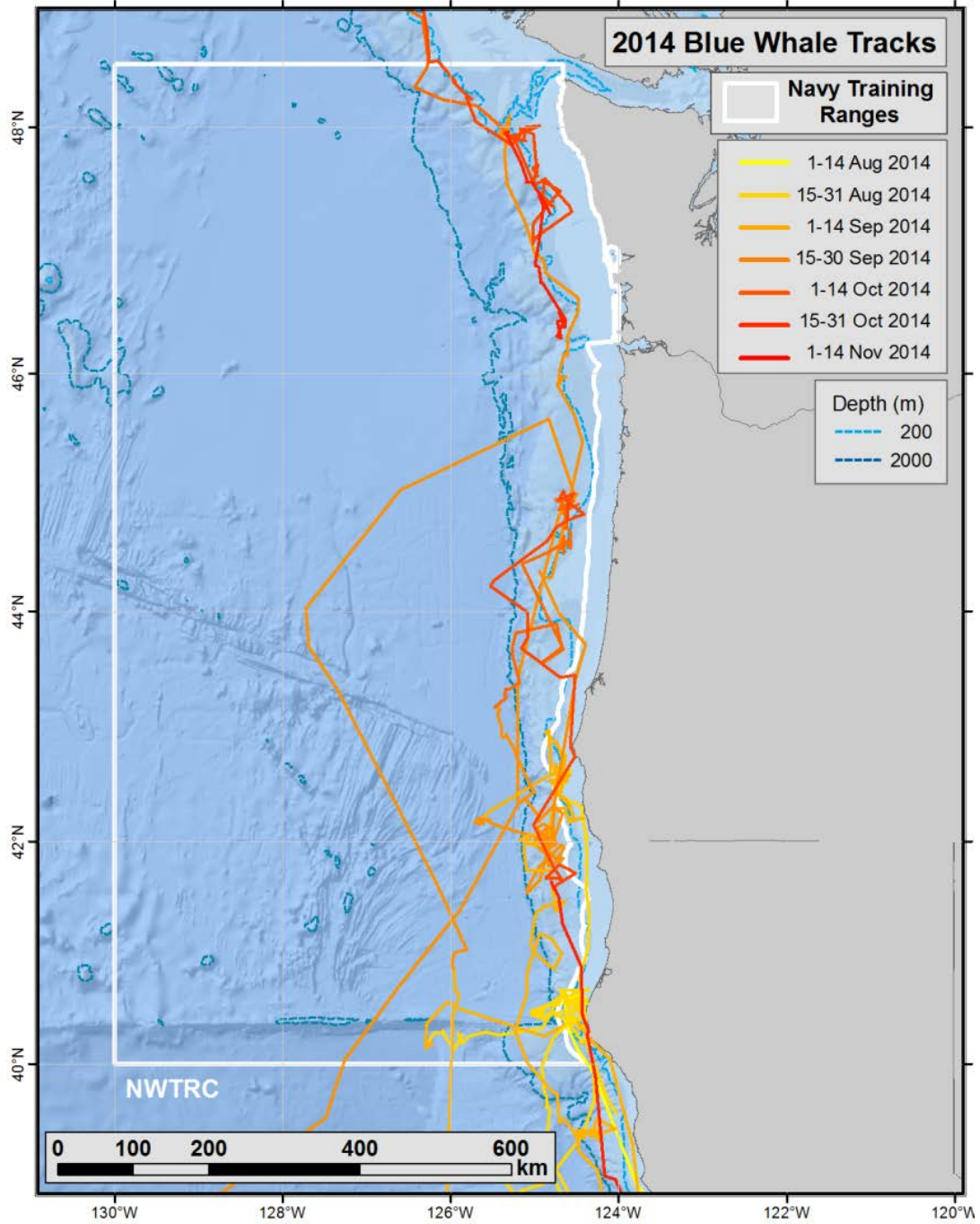


Figure 2-1. Satellite-monitored radio tracks in NWTRC for blue whales tagged off southern California, 2014. (Figure 2-3 from Mate et al. 2015)

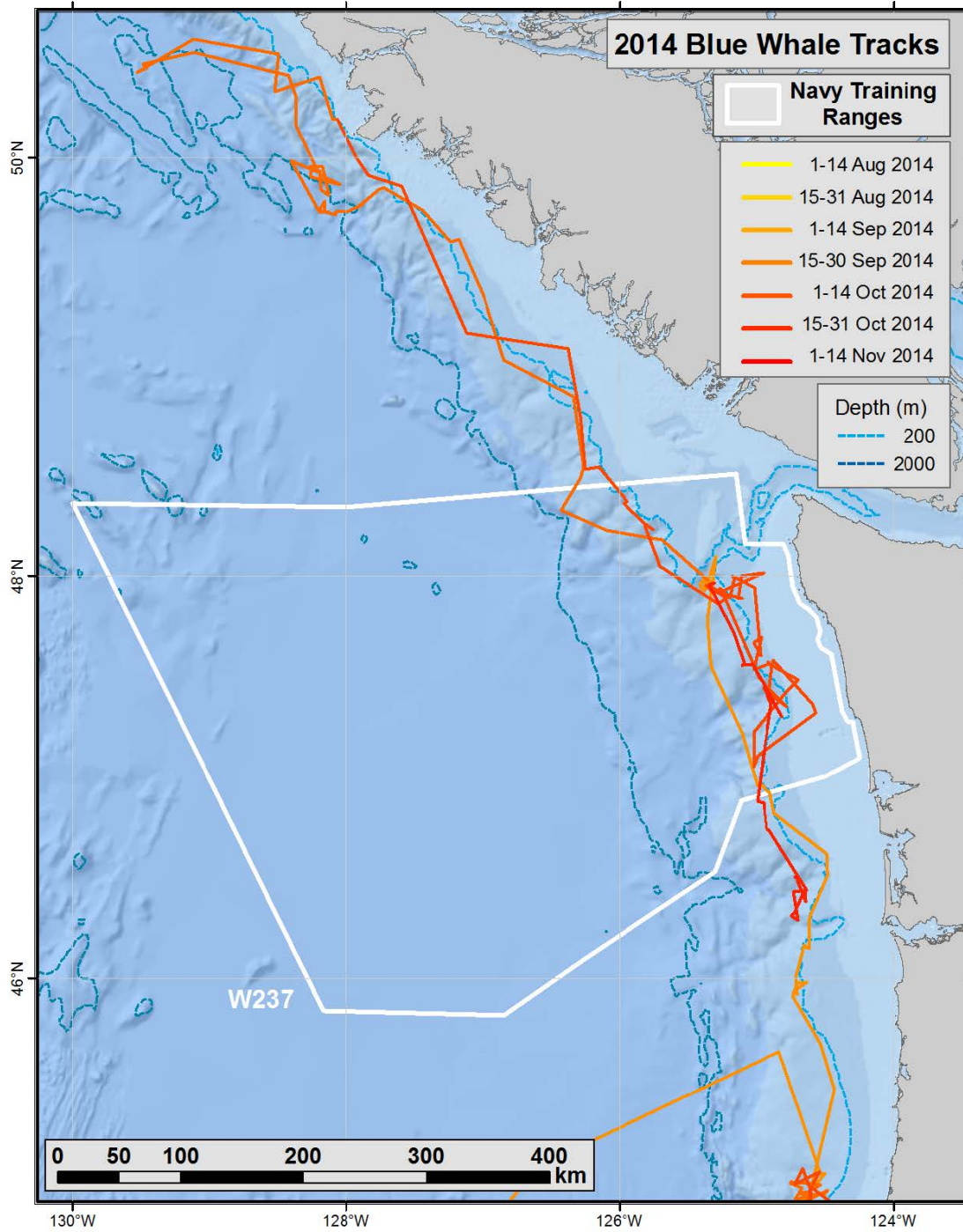
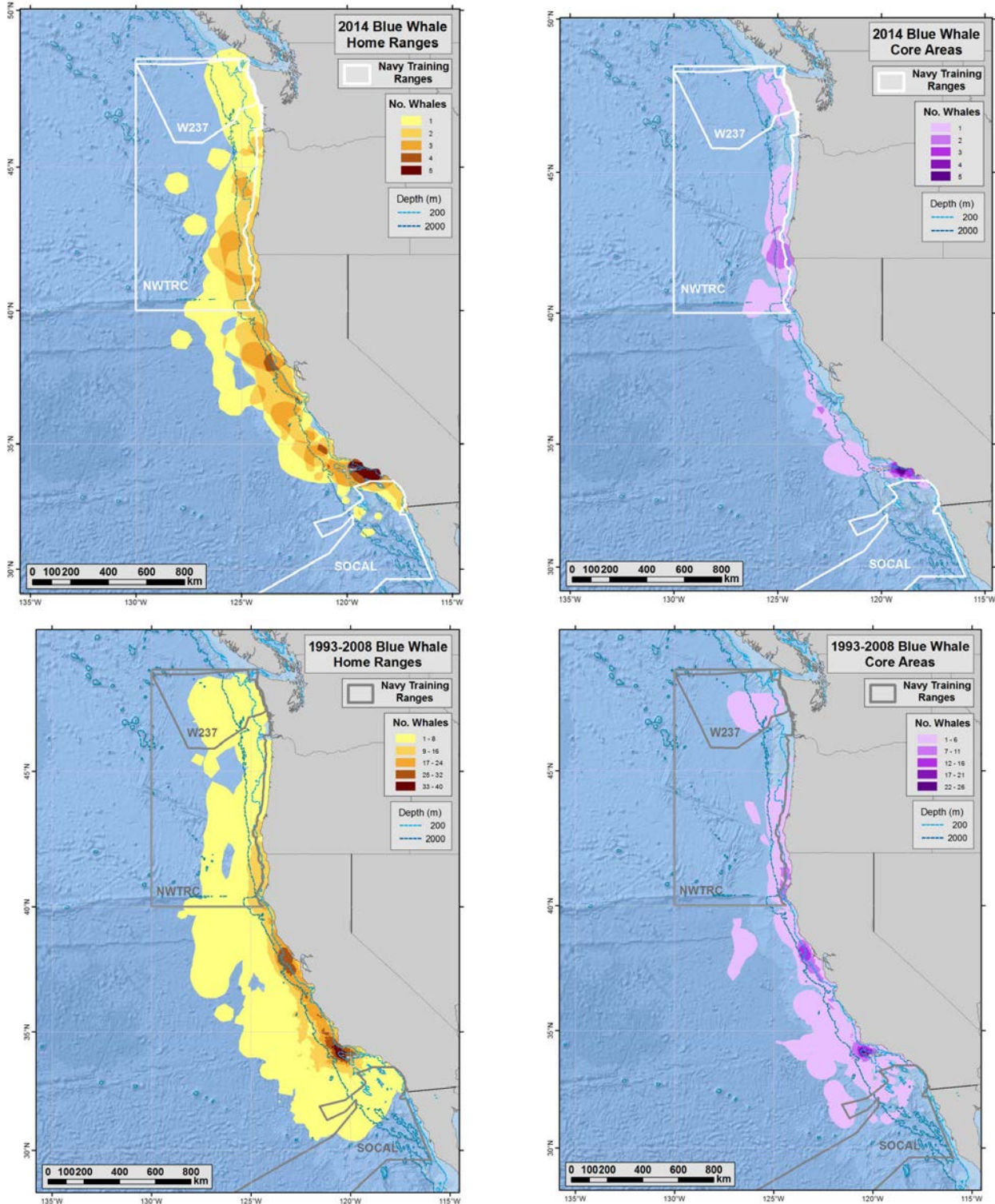


Figure 2-2. Satellite-monitored radio tracks in NWTRC for blue whales tagged off southern California, 2014. (Figure 2-4 from Mate et al. 2015)

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**Figure 2-3. [TOP] Home ranges (left) and core areas of use (right) in the U.S. EEZ for 5 blue whales tagged off southern California, 2014; [BOTTOM] Number of individual overlapping areas (n=104 individuals) within the U.S. EEZ estimated from kernel home ranges for blue whales satellite-tagged between 1998 and 2008 with tracks  $\geq 30$  daily locations. (left) 90% Home Ranges, and (right) 50% Core Areas**  
 Shading represents the number of individual whales with overlapping home ranges and core areas; Figure 2-9 and 4-3 from Mate et al. 2015)

## **Modeling the Distribution of Southern Resident Killer Whales in the Pacific Northwest**

*(Brad Hanson, NMFS' Northwest Fisheries Science Center)*

Integrating animal movement data with other sources of information, such as diet, has proved valuable in efforts to better understanding behavior, foraging patterns, and scaling of processes from the individual to population level. Considering how these spatial processes operate on different scales is particularly important when the threats to a population are also spatially distributed. There are a variety of methods available to quantify the spatial aspects of habitat use by animals in marine environments, including traditional approaches such as shipboard surveys, and more recently developed tools such as acoustic recorders and satellite tags. The latter allow for a more innovative and cost effective approach to address data gaps.

Autonomous passive acoustic recorders can provide important information on the distribution of cetaceans. Although these archival instruments can provide months of detection data for a particular location, one limitation to these devices is their short detection range, which is only a few kilometers of medium-sized cetacean given the peak frequency vocalizations. Additionally, the units are typically duty-cycled to lengthen the deployment and it is possible that whales could be missed while the unit is turned off. An additional potential bias of these instruments is that cetaceans do not always produce sounds and thus, they may not be detected. Furthermore, ambient noise from both natural (e.g., wind and rain), and anthropogenic (ship noise) may also reduce the detection range of passive acoustic recorders. The use of multiple recorders distributed throughout an area can function as a grid, potentially allowing determination of movement patterns by analyzing the duration in between detections at multiple recorders. However, in many cases the duration between detections may far exceed the time required for animals to travel between recorders and the path the animal took during this time gap cannot be resolved.

Conversely, satellite-linked tags deployed on cetaceans can provide multiple, relatively unbiased locations per day, however, these deployments are usually short in duration, typically on the order of weeks. In addition, working with raw satellite data presents a number of challenges and limitations: (1) time stamps between locations are never uniform, (2) locations are measured with varying degrees of precision, and (3) movement patterns may be affected by unseen behavioral patterns (travelling, foraging) or environments that an animal experiences (but is not directly observed). Consequently, whereas acoustic recorder data are spatially biased, individuals tagged with satellite-linked tags are temporally biased.

While each of these data types can be analyzed independently, we propose analyzing both data types simultaneously in a hierarchical framework. Bayesian state-space movement models have been widely used for the analysis of satellite tracking data, but these models have not been used to verify other types of monitoring data, such as acoustic recorder detections. By analyzing both data streams in a single framework, we aim to create more precise estimates of animal locations that are less spatially and temporally biased than either of the data types considered alone. Analyzing these data in a state-space

framework allows the inclusion of covariates, incorporation of measurement error uncertainty (imperfect detections, or uncertainty associated with satellite measurements), and potential switching between behavioral states. Reasonable model covariates would include (1) depth, (2) distance to shore, and (3) distance to nearest large freshwater input (because anadromous salmon represent a large portion of the diet of resident killer whales).

To accomplish this project NWFSC will bring together three unique, but intersecting, data sets including deployed passive acoustic devices (n=13-14), satellite tracking tags, and spatial habitat modeling. Early effort was published previously by NMFS in Hanson et al. (2013). The current effort will add additional data and analysis to the earlier 2013 work.

Specific accomplishments to be achieved under this Navy-funded project will include:

- Review all acoustic recordings for marine mammal vocalizations or echolocation clicks, particularly Southern Resident killer whales, data collected on acoustic recorders during 2012-2013, 2014-2015, and 2015-2016 field seasons;
- Estimate the probability of detection and improved identification based on a review of vocalization activity and from a state space model comparing satellite-linked locations with acoustic recorder detections;
- Develop state-space models of Southern Resident killer whale occurrence off the Washington coast.

A status update on this project is included in Hanson et al. (2015) which was in final preparation at the submission time of this report.



## **Tagging and Behavioral Monitoring of Sea Lions in the Pacific Northwest in Proximity to Navy Facilities (2013-2016)**

*(B. DeLong, National Marine Mammal Laboratory, Alaska Fisheries Science Center)*

There are significant scientific data gaps in identifying the location of local foraging areas and documenting the percentage of time pinniped species haul out near Puget Sound naval facilities. The numbers of animals observed hauled-out can be corrected into a population estimate by applying an estimate of the proportion of tagged animals that are hauled out at the time of the census. Satellite-linked dive recorders can be used to assess location of foraging activity and describe the diving behavior as well as record when the animal is hauled-out.

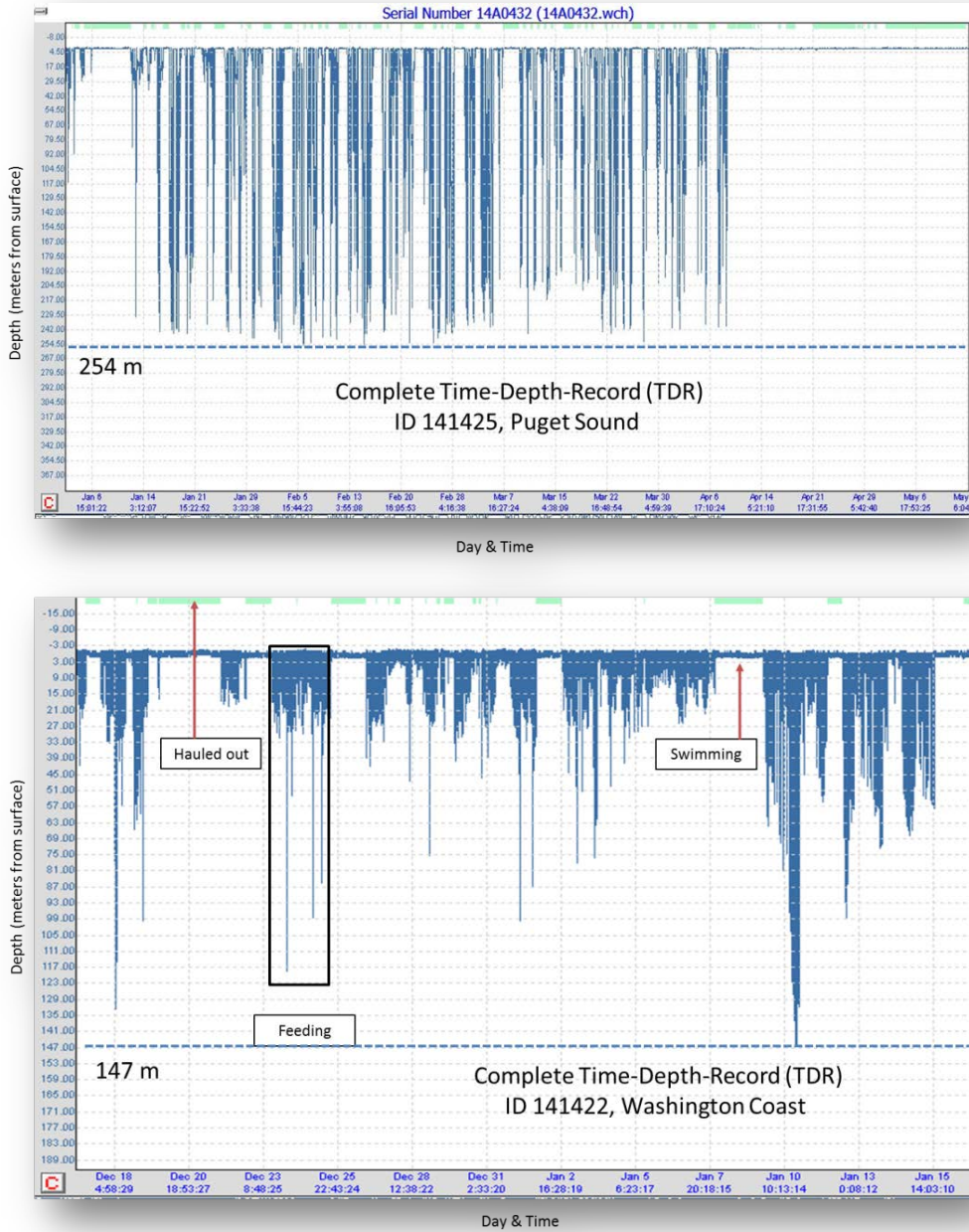
In Puget Sound, male California sea lions were instrumented with satellite tags in the fall of 2014. Scientists with NMFS' National Marine Mammal Laboratory and the Washington Department of Fish and Wildlife performed the attachment and subsequent track analysis. A total of 30 tags were purchased in 2014 with 16 attached. As of 22 May 2015, four tags were still transmitting (2 sea lions near British Columbia, 1 in the Columbia River, and 1 in northern California). Tags not attached (n=14) in 2014 will be attached during subsequent effort in the fall of 2015. Data from this study will provide a correction factor that can be applied to counts of animals hauled-out to estimate the total number of animals using the Navy facility, provide monthly proportion of animals in the water, and describe regional marine foraging habitats and animal foraging behavior.

In particular, integration of improved haulout percentages will lower over-predictive modeled takes which currently, due to lack of regional data, assume all pinniped species are always in-water for purposes of assessing exposures to training and testing activities. Information to be reported from this project will include: 1. Census data of adult males that haulout at select naval facilities in Puget Sound; 2. Monthly correction factors for count data from census locations by species if appropriate; 3. Geographical distribution and foraging behavior of California sea lion adult males in inland waters of Washington; and 4. Migration and foraging behavior of California sea lions in coastal Washington, Oregon and California.

Detailed analysis will be contained in NMFS final report after the 2015 tagging season. Key observations available now from 2014 tagging include:

- Tag tracks showed some animals remained in Puget Sound although with significant movement within the area; others traveled within inland and coastal waters of British Columbia; and others traveled along coastal Washington including the Columbia River;
- Sea lions that stayed in Puget Sound were generally deep divers while presumably foraging (~ 250m) and animals that went offshore were generally shallower divers (<147m);
- In comparison between two sea lions, one in Puget Sound and the other along the Washington Coast, the Puget Sound sea lion spent 49% of its time hauled out while the Washington Coast sea lion spent 80% of its time hauled out.

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**Figure 2-4. Dive profile record for two male California sea lions tagged in Puget Sound. [TOP] sea lion within Puget Sound and [BOTTOM] from sea lion that traveled from Puget Sound to Columbia River (i.e. along coastal Washington). (Graphics courtesy of B. DeLong)**

### 3.0 PASSIVE ACOUSTIC MONITORING

*(J. Hildebrand, Scripps Institution of Oceanography)*

The Marine Physical Laboratory, Scripps Institution of Oceanography, University of California San Diego designs, fabricates, calibrates, deploys, and analyzes data from bottom-deployed high frequency acoustic recording packages (HARP). In general, a HARP records marine mammal vocalizations, echolocation clicks, and anthropogenic sounds between 10 Hz-100 kHz.

The length of deployment has increased over the years with improvements to battery design and storage capacity. Currently, a typical deployment can last for up to eight months on continuous duty cycle.

As part of Navy funded Compliance Monitoring, two bottom-mounted HARPs continued deploy from 2011-2014<sup>2</sup> (**Figure 1-1**).

Within the NWTRC for this reporting year, one HARP was in deeper water on the shelf slope near Quinault Canyon (QC) at a depth of 4,541 ft (1,384 m) and a second was on the continental shelf off Cape Elizabeth (CE) at a depth of 394 ft (120 m).

In spring of 2014, HARP-CE was removed so that only one HARP was deployed for continued new data collection through May 2015. The reduction from two to one HARP was deemed acceptable given the previous 12 years of continuous coverage, and to allow for continued funding of the Southern Resident killer whale project described previously.

Trickey et al. 2015 provides the overall passive acoustic technical analysis for the latest period available<sup>3</sup>. Over 6,720 hours of passive acoustic data were obtained from two deployed HARPs cumulatively from July 2013 to April 2014. This data series has not always been continuous, especially for the shelf HARP which has been subject to fisheries interaction and unforeseen equipment difficulties due to high current flow.

Rice et al. 2015 analyzed data from January 2011 to April 2014 in order to determine seasonal occurrence and distribution of different killer whale ecotypes at the two HARP sites.

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<sup>2</sup> Previous Navy research funding and reporting occurred from 2004-2010 (Oleson et al. 2009, Oleson and Hildebrand 2012). Kerosky et al. 2013 and Debich et al. 2014 cover periods under compliance monitoring.

<sup>3</sup> Given the need to deploy the HARPs for periods up to 8-10 months, there is a corresponding lag in the data available for analysis for the NWTRC annual reports and when the HARPs are next field serviced with data retrieved for future analysis.

Major observations by sound category from Trickey et al. 2015 (**Passive Acoustic Monitoring for Marine Mammals in the Northwest Training Range Complex July 2013 – April 2014**) include:

*Baleen whale- Three baleen whale species were detected: blue whales, fin whales, and humpback whales. Seasonal patterns for Northeast Pacific blue whale B calls, fin whale 20 Hz calls, and humpback whale calls were similar, all showing peaks during the winter months. In contrast, blue whale D calls were only detected in July 2013 at site CE.*

*Minke whale boings, which were first recorded in the NWTRC in November 2012, were not detected during this monitoring period.*

*Likewise, North Pacific right whale up-calls were detected for the first time in the NWTRC in June 2013, but there were no definitive detections of this species during this recording period.*

*Toothed whale- Frequency-modulated (FM) echolocation pulses from three beaked whale species were detected at the offshore site QC. Stejneger's beaked whale detections were more common than any other beaked whale signal recorded in this monitoring period and peaked in January 2014.*

*Cuvier's beaked whales were infrequently detected during the winter months, while Baird's beaked whale detections occurred intermittently throughout the monitoring period.*

*Killer whale detections predominantly occurred at site CE and peaked in August 2013. Unidentified porpoises were detected in low numbers at site CE in July 2013.*

*Anthropogenic sound- Three anthropogenic sounds were detected in the recordings: mid-frequency active (MFA) and low-frequency active (LFA) sonars, and explosions. Mid-frequency active (MFA) sonar was rare, with only a single detection occurring in January 2014. Low-frequency active (LFA) (500 Hz-1 kHz) sonar events were also relatively rare, and were detected on three separate occasions.*

*Explosions, most likely from fishery-related seal bombs, were detected throughout the deployment at site CE, with a peak in detections in August 2013.*

Major observations from Rice et al. 2015 [**Seasonality of killer whale (*Orcinus orca*) ecotypes in the Northwest Training Range Complex**] include:

*“Three different killer whale (*Orcinus orca*) ecotypes are known to inhabit the Northeastern Pacific: Residents, Transients and Offshores. These ecotypes are distinguished by morphological, genetic, behavioral and acoustic differences. Killer whales of each ecotype produce distinct, stereotypic pulsed calls that can be used as acoustic indicators of presence, making passive acoustic monitoring (PAM) a useful method for assessing intraspecies differences in spatial and temporal patterns.*

*Since 2004, PAM using High-frequency Acoustic Recording Packages (HARPs) has been conducted at two sites in the Navy's Northwest Training Range Complex; one offshore in Quinault Canyon (site QC) and the other closer inshore near Cape Elizabeth (site CE). For this report, killer whale signals were analyzed for periods of deployment from January 2011 – April 2014 in order to determine the seasonal occurrence and distribution of different killer whale ecotypes at these sites.*

*Site CE had an overall higher percent of days with presence than site QC. A peak in relative daily presence occurred in July at site CE, with 17.6% of days having killer whale encounters. Site QC had overall lower relative presence of killer whale encounters, with peaks in March (8.9%) and December (9.2%). Residents were encountered in spring and early summer at both sites and in October 2011 at site CE.*

*Transients had the highest relative presence of all ecotypes at both sites. Transients were detected most months but mainly from spring until early summer at site QC and from late spring until early fall at site CE. The lack of Transient seasonality has been noted in previous PAM efforts and suggests this area is an important habitat for Transients year-round.*

*Offshores were encountered during most months at site QC but only during August and September at site CE.”*

#### 4.0 OTHER NAVY FUNDED MONITORING IN ADDITION TO CURRENT NWTRC METRICS

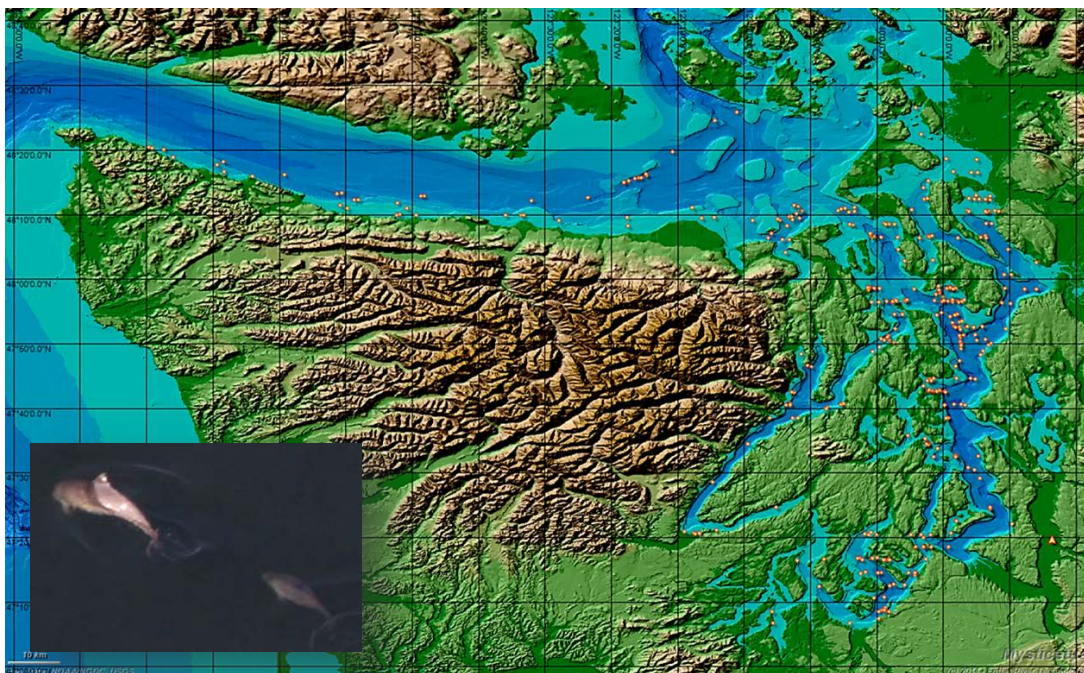
During the period covered by this annual report (2 May 2014 to 1 May 2015) another opportunistic study was funded by the Navy to help gather additional Puget Sound marine mammal occurrence data. This study continues to contribute new scientific information useful to future Navy environmental analysis, as well as regional NMFS.

##### **Marine Mammal Aerial Surveys Conducted in the Pacific Northwest, Inland Puget Sound Waters (2013-2015)**

*(M. Smultea, Smultea Environmental Sciences)*

The purpose of this Navy-funded survey was to 1) collect data to estimate densities and abundance of marine mammals in the inland Puget Sound waters for species with sufficient sightings, 2) Document the distribution and habitat use of each species observed; and 3) Document and describe behaviors seen without performing focal follows.

Based on a successful survey in 2013 (Smultea et al. 2014), the Navy funded an additional four similar aerial surveys from 2014-2015. Reporting from this effort is still in preparation.



**Figure 2-5. Harbor porpoise sightings from fall 2014 aerial survey in Puget Sound**  
**Inset shows harbor porpoise mother-calf pair photographed from survey plane.**  
(Graphic courtesy of M. Smultea)

## 4.0 CONCLUSION

The Navy met or exceeded all NMFS-Navy agreed to compliance monitoring metrics within the NWTRC from 2011 to May 2015.

Essentially, this concludes the Navy's monitoring under the Phase I NWTRC permit. Continued monitoring will be proposed in separate negotiation with NMFS for the upcoming Phase II NWTT permit.

Long-term fixed passive acoustic monitoring is an effective way to determine seasonal species-specific occurrence of vocalizing and potentially foraging animals. It does not account for non-vocalizing animals. Passive acoustic monitoring can also be used to record natural and anthropogenic sounds leading to better assessment of ambient noise conditions. Passive acoustic monitoring has potential via expanded analysis to begin addressing possible impacts of anthropogenic sources on marine mammal vocalization and echolocation, with the assumptions that changes in vocalizations and echolocation rates are indicative of behavioral changes. However, this kind of analysis is better suited for those areas where the Navy in-water training occurs more frequently such as Southern California or Hawaii vice the more limited Navy in-water training within the NWTRC.

Satellite tracking tags can be an effective indicator of marine mammal distribution and movement patterns at short (days-weeks) and long (months-year) time scales. Longer term tag tracks are needed in order to better determine baleen whale distributions in terms of bathymetric features, and to determine what percentage of time individuals spend within the NWTRC and outside of the NWTRC.

Finally, the Navy is beginning to transition NWTRC compliance monitoring away from strictly metric-based accomplishments (i.e., number of devices deployed, # of tags attached), to a more region-specific and species-specific format.

To that end two new ecological based studies have been initiated in 2014 and continuing beyond 2015:

- One study using passive acoustic tools, satellite tagging, and advanced modeling will attempt to refine predictions of offshore occurrence and locations for Southern Resident killer whales (Hanson et al. 2015);
- Another new study using satellite location tags and advanced modeling will detail long-term blue and fin whale occurrence, migration, and local residency patterns along the U.S. West Coast including within and outside of NWTRC (Mate et al. 2015).

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Annual Report 2 May 2014 to 1 May 2015  
July 2015

