APPENDIX L Preliminary Report for monk seal habitat and monitoring

Preliminary Report Period: February – August 2010

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Title: Habitat Use and Behavioral Monitoring of Hawaiian Monk Seals in Proximity to the Navy Hawaii Range Complex

Introduction

Hawaiian monk seal abundance is falling from a 2007 estimate of 1,146 individuals. Most monk seals reside in the remote Northwestern Hawaiian Islands (NWHI) where the decline is approximately 4% yr^{-1}, while fewer seals occupy the main Hawaiian Islands (MHI). It is generally believed that the population in the MHI has greater survival rates and the total number of seals is increasing. Estimated survival from weaning to age 1 yr is 77% in the MHI, much higher than recent NWHI estimates ranging from 42% to 57%. Moreover, MHI females begin reproducing at a younger age and attain higher birth rates than those observed in the NWHI. The estimated MHI intrinsic rate of population growth is 1.13 compared to a range from 0.89 to 0.98 in the NWHI. Assuming an initial abundance of 150 animals in the MHI, projections indicate that if current demographic trends continue, abundance in the NWHI and MHI will equalize in approximately 9 years.

While this increasing population in the MHI provides some hope for the species' continued existence, it opens up a new host of potential management concerns. There are a variety of natural and anthropogenic threats that exist in the MHI including human-interactions (i.e. fisheries, beach disturbance, boat activities, pollution etc.) and disease exposure (from both domestic and feral sources). Very little is known about the behavior and ecology of these MHI seals. Telemetry studies to understand their foraging behaviors and habitat use are one of the first critical steps to help inform management actions for the species.

Tag Capability

The Hawaiian Monk Seal Research Program has begun utilizing new technology to better understand the foraging behavior and habitat use of main Hawaiian Island monk seals. The Sea Mammal Research Unit (SMRU) has developed a novel telemetry tag using global position system (GPS), GSM modem (cellular phone) and standard behavior recording technologies in order to increase the quality and amount of data researchers obtain in marine mammal telemetry studies. This telemetry tag contains a hybrid GPS system that is capable of acquiring GPS pseudo-range data within a snapshot window of only 0.2 s. The pseudo-range data is transmitted to researchers and processed with separately downloaded GPS ephemeris data to produce high-quality GPS fixes

(with a horizontal error radius of about 55m). In addition, the tag also collects and stores detailed *individual* dive behavior and haul-out information as well as temperature up-cast profiles. To transmit data to researchers, the tag utilizes a GSM modem to relay stored data via existing commercial cell phone networks. The advantages of using a GSM data relay over standard transmissions are low running costs and vastly increased energy efficiency and data bandwidth. While the tag must be within approximately 20 km of a GSM base station for a data call to be established, data can be stored for up to six months in between calls, allowing animals to move large distances from base stations while still collecting detailed behavioral data.

Historical Findings

Very few studies have been conducted on MHI movements and habitat use. The ones that have been done did not determine precise diving locations and were unable to examine the entire dive record. These studies have shown that monk seals spend most of their time at sea in nearshore, neritic, marine habitats (Littnan et al. 2006). Land-based observations and volunteer sightings indicate that 35.6% of the MHI seals travel between islands throughout the year. There is high individual variability in monk seal foraging behavior; however, most foraging trips last from a few days to 1-2 weeks and seals tend to remain within the 200 m depth contour surrounding the MHI and nearby banks (Littnan et al. 2006).

Multiple telemetry studies have been conducted in the NWHI to monitor monk seal behavior, diet, and habitat use; however, like in the MHI, these studies used unreliable satellite locations and did not have access to the complete dive record. These studies were able to elucidate the general movements and behavior of monk seals in the NWHI and provide a baseline for future behavior studies. Seals were found to move extensively within the barrier reefs of the atolls, on the leeward slopes of reefs and islands at all NWHI colony sites, and along the Hawaiian Archipelago submarine ridge to nearby seamounts and submerged reefs and banks (Stewart et al. 2006). Most dives were less than 150 m deep, though dives of some seals exceeded 550 m. Movements and behavior were highly variable between age and sex classes and between the different colonies.

Activities and Findings

Objectives

1) Deploy 15 cell phone tags on monk seals in the main Hawaiian Islands
2) Monitor monk seal habitat use and behavior: determine home range sizes, foraging areas, and identify potential foraging hot spots of seals in the MHI.
3) Identify potential changes in monk seal behavior in relation to Navy activities in the MHI

Objective 1

Eleven cell phone tags (Fig. 1) were deployed on adult and sub-adult monk seals between February and August 2010. Three, week-long trips were made to Kauai where we deployed 4 instruments, two trips were made to Molokai with 4 instruments deployed, and 3 instruments were deployed opportunistically on Oahu (Table 1). Seals were captured, sampled, and handled following the methods of Baker and Johanos (2002). After capture, seals were sedated, biomedical samples were taken, and cell phone tags were attached to each animal. Tags were attached along

the dorsal midline of the seal using 10 min epoxy. They were set to record data continuously and to transmit data via the GSM cell phone network whenever the seal was within range of a GSM base station. Seals from Molokai have not made regular trips within range of a GSM base station so limited data has been collected for those animals; however, where possible, tags from these individuals will be recovered and the full data record downloaded.

Biomedical sampling included taking eye, oral, nasal, fecal, and genital swabs for parasitology testing, taking blubber biopsies for fatty acid and toxicology analysis, taking fecal samples which are cultured for microbiology, and drawing whole blood. CBCs and serum chemistries are run and whole blood is tested for biotoxins and heartworm. Blood serum is run through a suite of tests including: Morbilliviruses, Brucella, herpesvirus, Toxoplasmosis, Leptospirosis, Chlamydia, Adenovirus, Calicivirus, Parvovirus, and toxicology. Any remaining samples are archived. To date, no abnormalities have been found in the seals included in this study.

Objective 2

Data is downloaded periodically using Google Earth to view the current location and recent movements of the instrumented animals. As of 8/1/2010 seven tags were still recording data (Figs. 2-6). Most of the seals made regular trips to sea to forage and returned to land within 1-2 weeks. However, one adult male (R012) that was tagged on Oahu made an oceanic voyage, which lasted about 1 month (Fig. 5). This type of trip is very uncharacteristic for monk seals because they are benthic foragers and typically travel to and from foraging areas or breeding beaches. This animal traveled over 2000 miles, round trip, in waters over 5000 m deep. Throughout the trip he spent the majority of time diving near the surface, which is not characteristic of monk seal foraging. Further analysis of his diving behavior may elucidate whether he was using different foraging tactics during this trip or performing other activities while out at sea.

Location and movement data will be analyzed after all tags have stopped transmitting. Fixed kernel density home range estimates will be used to determine home range sizes and foraging locations for seals that retained their tags for more than 2 months. Foraging hot spots will be identified if multiple seals are observed foraging repeatedly in the same location.

Objective 3

Analyses correlate monk seal behavior and Navy training activities in the MHI will begin in early 2011, once the tags have ceased transmission, or have been recovered.

Discussion

It should be noted that at the time of writing this report NMFS has been unable to deploy all 15 cell phone tags. While this was in small part due to an initial delay in receiving funds it is primarily a result of the unpredictability of field work. During multiple field trips, NMFS was presented with an unprecedented lack of seals on the beaches, particularly on Kauai. In three, week-long trips to Kauai, only 4 instruments were deployed. Of the seals that were encountered on those trips, most were pregnant females, young of the year, or animals that were not suitable candidates for instrumentation due to some sort of injury or molt status. NMFS is still striving to complete the necessary number of deployments and tagging will continue throughout August to complete all 15 deployments.

During the first field trip to Kauai in February 2010 three cell phone tags were deployed. All of these tags fell off within a few weeks of deployment. This malfunction was due to a bad batch of epoxy that was used to secure the tags to a neoprene base. New epoxy was used on all subsequent deployments to prevent similar issues. Due to their feeding behavior, following the sea floor and flipping over large rocks in search of prey, monk seals are notoriously hard on instruments. Most tags are not recovered because the seals scrape them across rocks while foraging. This type of abuse causes the epoxy to stress and break apart and the tag eventually falls off its base. Some animals do retain their tags until they molt the following year, but a large portion are lost at sea, which is what occurred with an adult male that was tagged for this study on Molokai (RI13).

Tables and Figures

Table 1. Hawaiian monk seals captured and instrumented in the Main Hawaiian Islands

Seal ID	Tag #	Age	Sex	Deploy Site	Deploy Date	Most Recent Location Date	Comments
R012	11393	Adult	M	Oahu	3.1.2010	7.31.2010	
R018	11478	Adult	M	Kauai	6.9.2010	7.17.2010	
R4DI	11337	SubAdult	M	Kauai	2.9.2010	2.25.2010	tag fell off
RE70	11420	Adult	M	Molokai	3.27.2010	5.19.2010	
RI11	11419	Adult	M	Molokai	3.26.2010	7.30.2010	
RI13	11392	Adult	M	Molokai	3.26.2010	Unk	tag fell off
RK05	11475	Adult	M	Kauai	2.10.2010	2.13.2010	tag fell off
RO28	11423	SubAdult	F	Kauai	2.11.2010	2.14.2010	tag fell off
RR70	11396	Adult	M	Oahu	6.29.2010	7.30.2010	
unk	11170	Adult	M	Molokai	3.28.2010	5.20.2010	No permanent ID
R4DF	11476	SubAdult	F	Oahu		7.30.2010	

Figure 1. Photo of R4DF with a cell phone tag attached. The instrument is attached to a neoprene base, which is glued to the pelage of the seal.

Figure 2a. Surface movements for RI11 from 26 March through 30 July 2010.

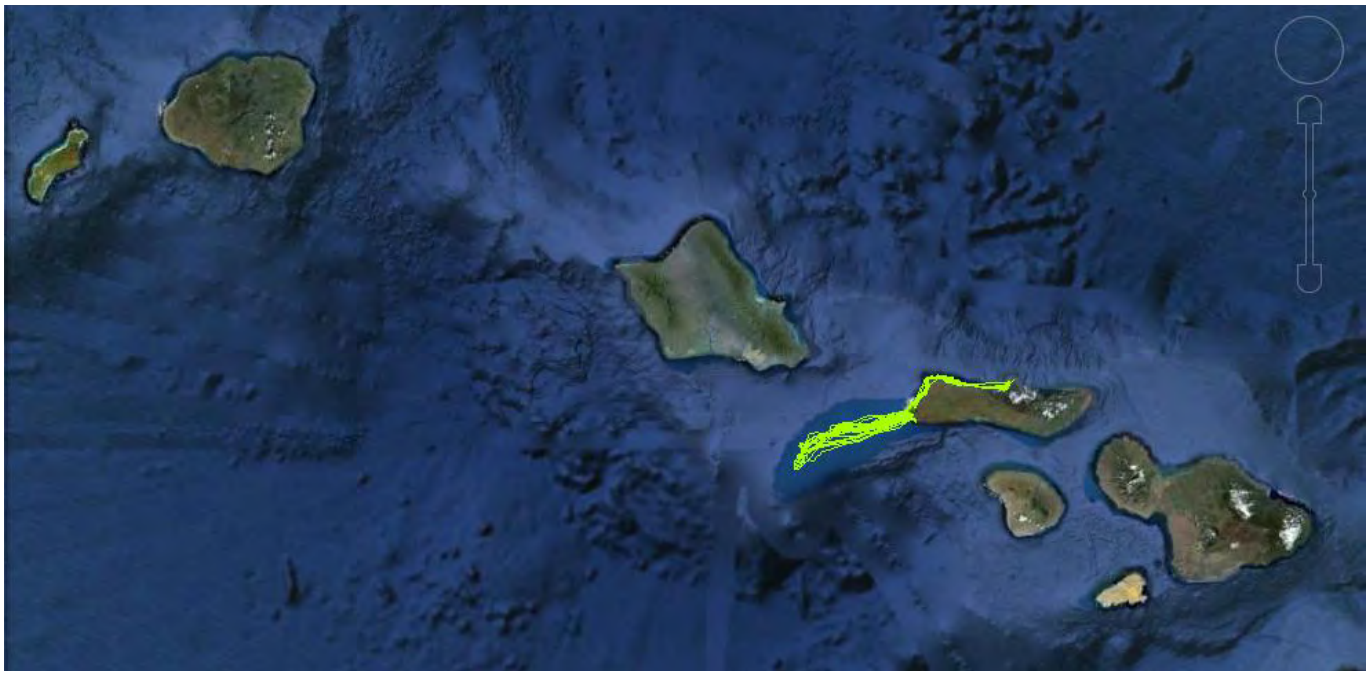

Figure 2b. A subset of dives for RI11 looking towards Molokai from Penguin Bank.

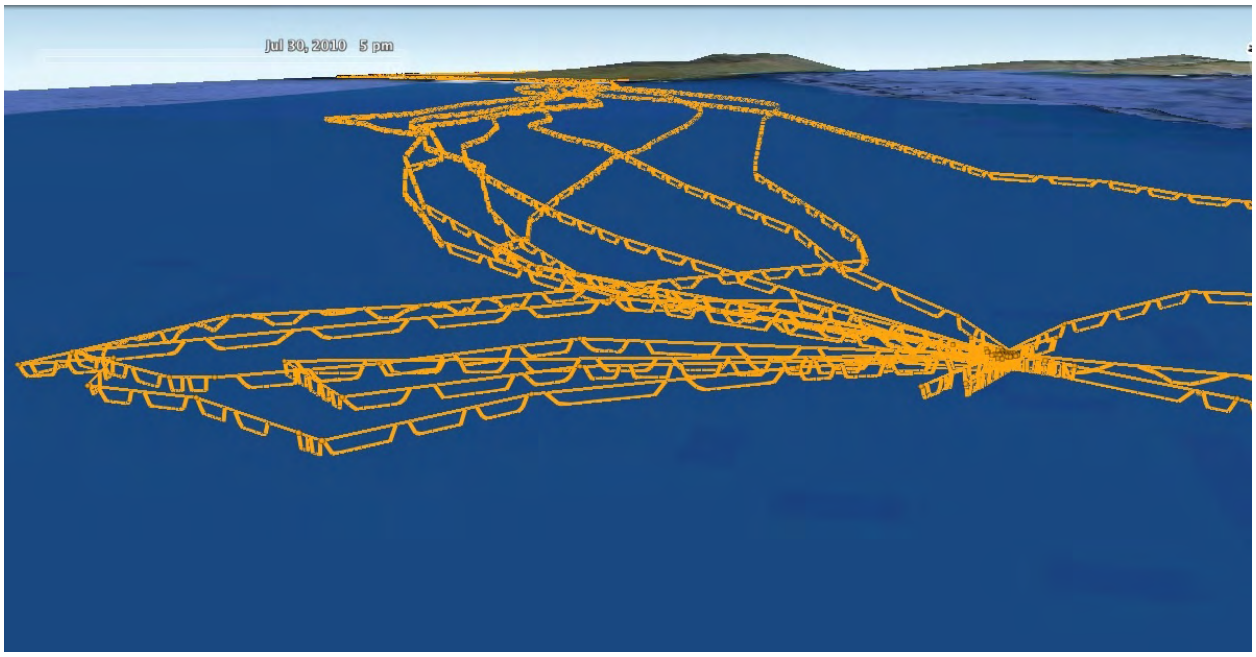

Figure 3a. Surface movements for R018 from 9 June through 17 July 2010.

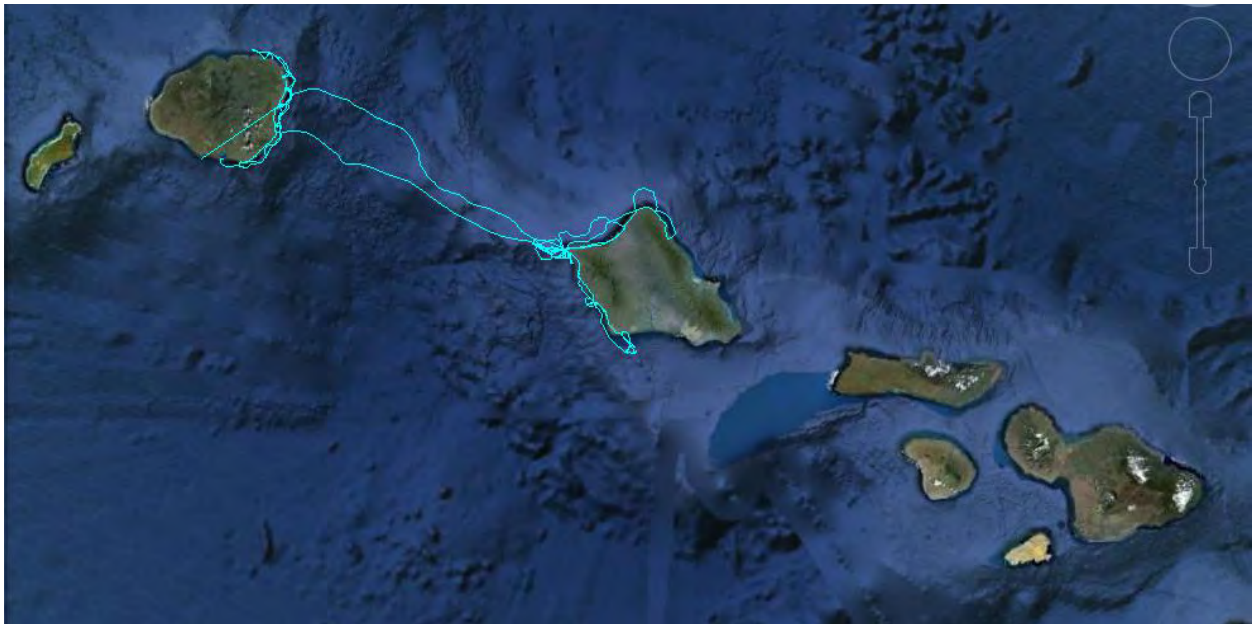

Figure 3b. A subset of dives for R018 looking east towards Kaena Pt on Oahu.

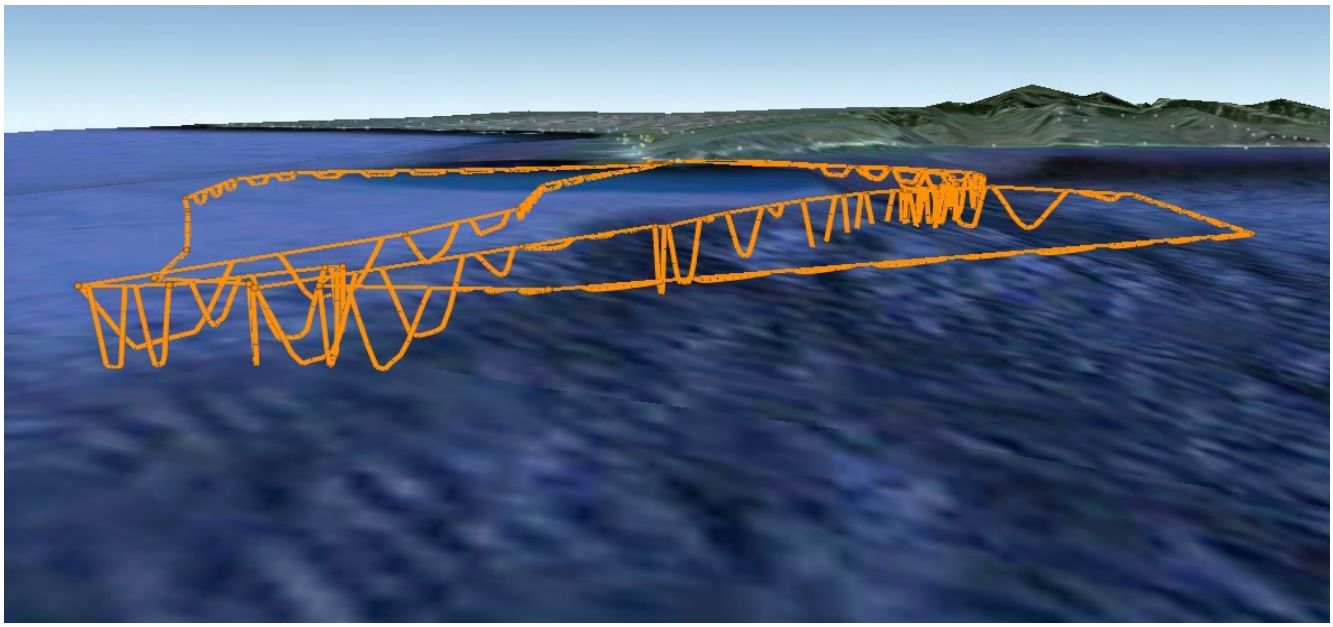

Figure 4a. Surface movements for RR70 from 29 June through 30 July 2010

Figure 4b. A subset of dives for RR70 while foraging near Pearl Harbor.

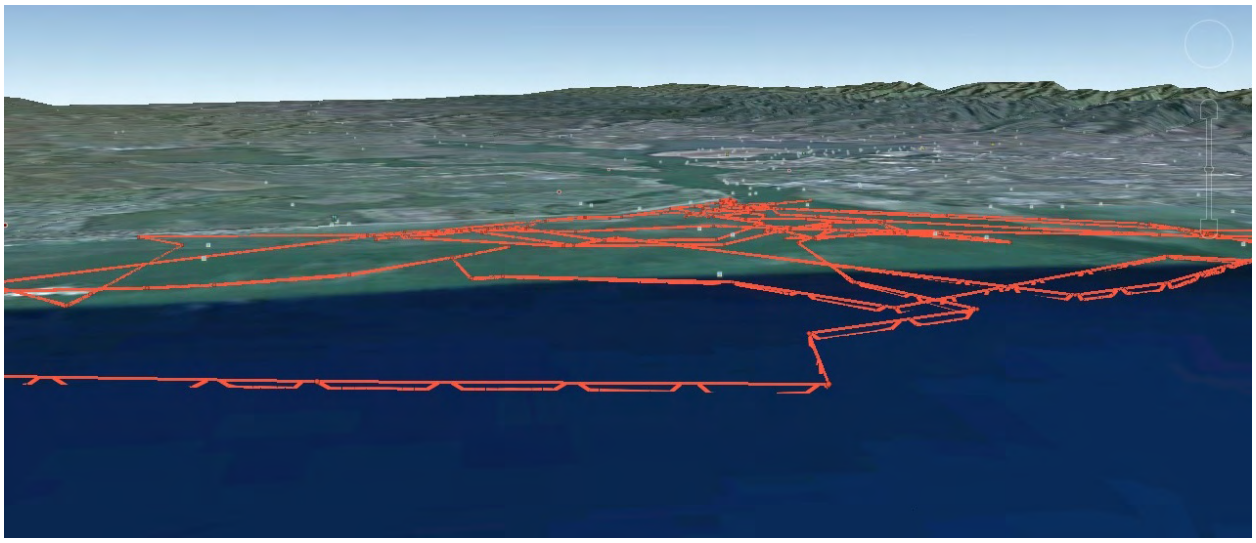

Figure 5a. Surface movements for R012 from 1 March to 31 July 2010.

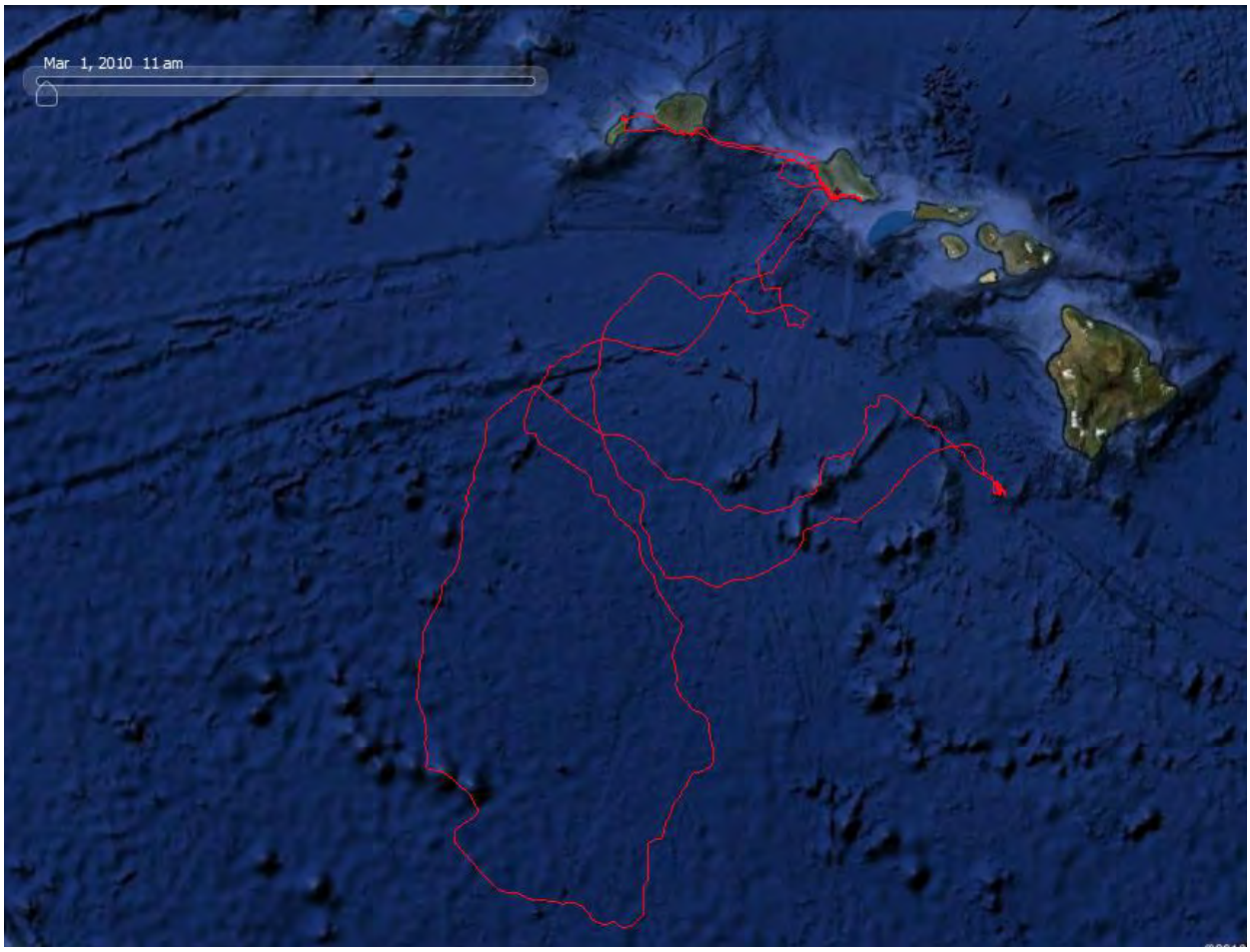

Figure 5a. A subset of dives for R012 while foraging off of White Plains Beach on Oahu.

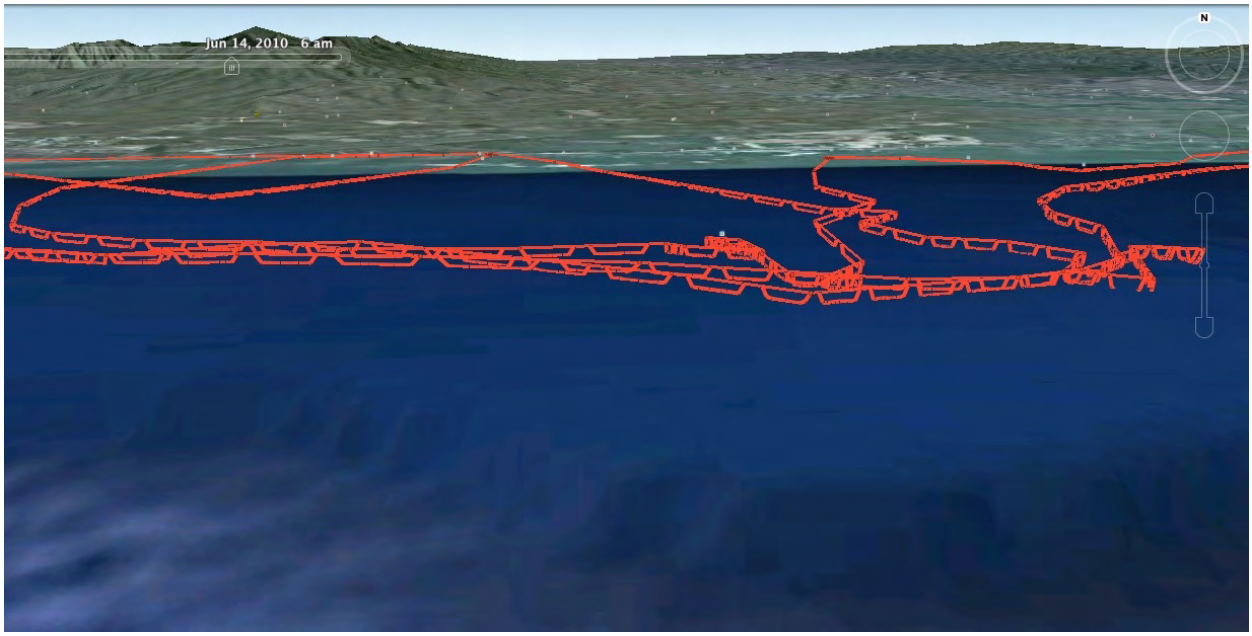

Figure 6a. Surface movements for R4DF from 9 June through 20 July 2010.

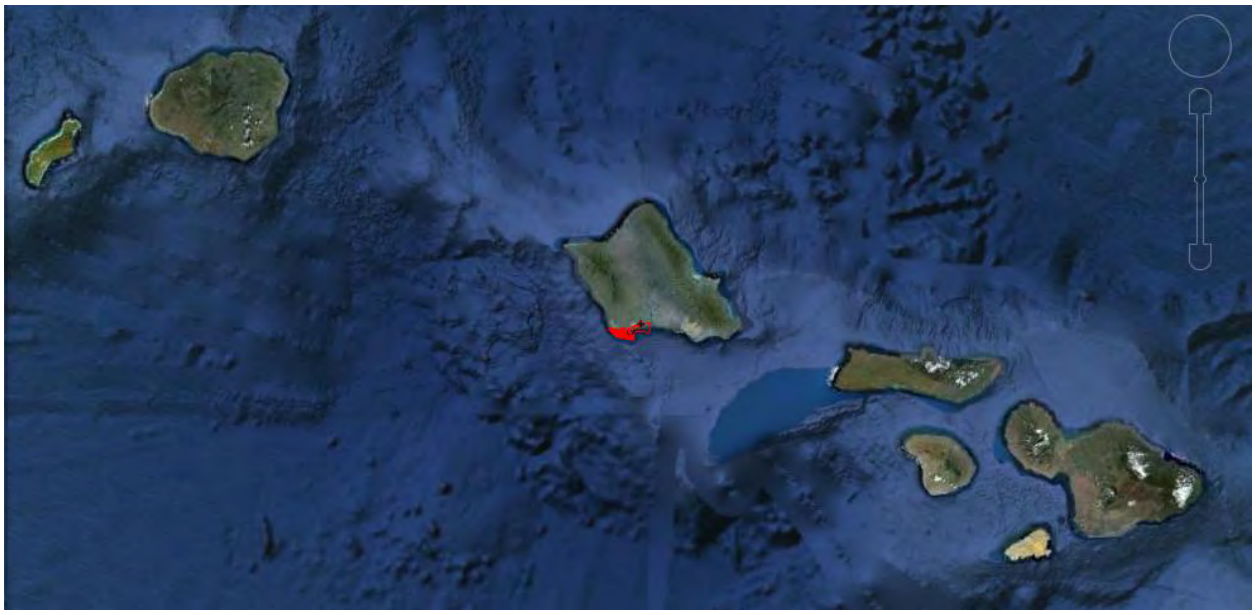

Figure 6b. One foraging trip for R4DF looking towards Barbers Pt on Oahu.