Aerial Survey Monitoring for Marine Mammals and Sea Turtles in the Hawaii Range Complex in Conjunction with a Navy Training Event

SCC OPS February 15 – 19, 2009

Final Field Report

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Cover Photo: Humpback whales (*Megaptera novaeangliae*) photographed with a telephoto lens from the aircraft during an aerial monitoring survey in Hawaii. Photograph by J. Mobley taken under NOAA Permit No. 642-1536-03 issued to Joseph R. Mobley, Jr. Graphic: K. Lomac-MacNair.

Table of Contents

List of Tables and Appendices

List of Figures

Section 1 Introduction

Aerial surveys to monitor for marine mammals and sea turtles (MM/ST) were conducted in conjunction with the February 2009 US Navy Submarine Commander's Course (SCC OPS) in the Hawaii Range Complex (HRC) on the Pacific Missile Range Facility instrumented range off Kauai and Niihau, Hawaii (Figure 1). Surveys occurred on five consecutive days from 15-19 February 2009 near the *USS Russell* involved with the event typically ~100 km (50 nm) west or northwest of Kauai. The survey methodology and sampling design were submitted and approved in advance, per the Statement of Work (SOW), to the NTR and followed previously established protocol implemented for monitoring of a SCC OPS off Kauai in August 2008 (Smultea and Mobley 2009).

Prior to the event the co-Principal Investigator (JM) and pilot (JW), along with Navy biologists, participated in a briefing to the *USS Russell* Commanding Officer as well as the pre-planning conference at Pearl Harbor, Honolulu, Oahu, Hawaii, to coordinate survey efforts with the SCC OPS February 09 training event.

Per the SOW, the goal of the aerial survey was to monitor and report the presence/absence, distribution/redistribution, reaction/no reaction, injury, and/or mortality of MM/ST during the SCC. This involved monitoring and reporting, in as detailed fashion as possible, the surface behavior of MM/ST. In particular, we were to monitor for any changes in the near-surface behavior, orientation, occurrence, and location of animals relative to the *Russell*'s activities using a systematic search and focal follow method. This included monitoring for any potentially dead, injured, distressed and/or unusually behaving animals.

As indicated in the SOW, it was recognized *a priori* that post-survey analyses were not expected to be completed under this task as sample size was expected to be limited in offshore survey waters based on previous regional survey data (e.g., Mobley et al. 2000, Barlow 2006, Smultea and Mobley 2009; also see review in Smultea 2008). Rather, survey data collected during this monitoring effort were to be compiled with previous (e.g., Smultea and Mobley 2009) and subsequent data, and interpreted over time by the Navy to facilitate increased sample size and thus data validity and relevance.

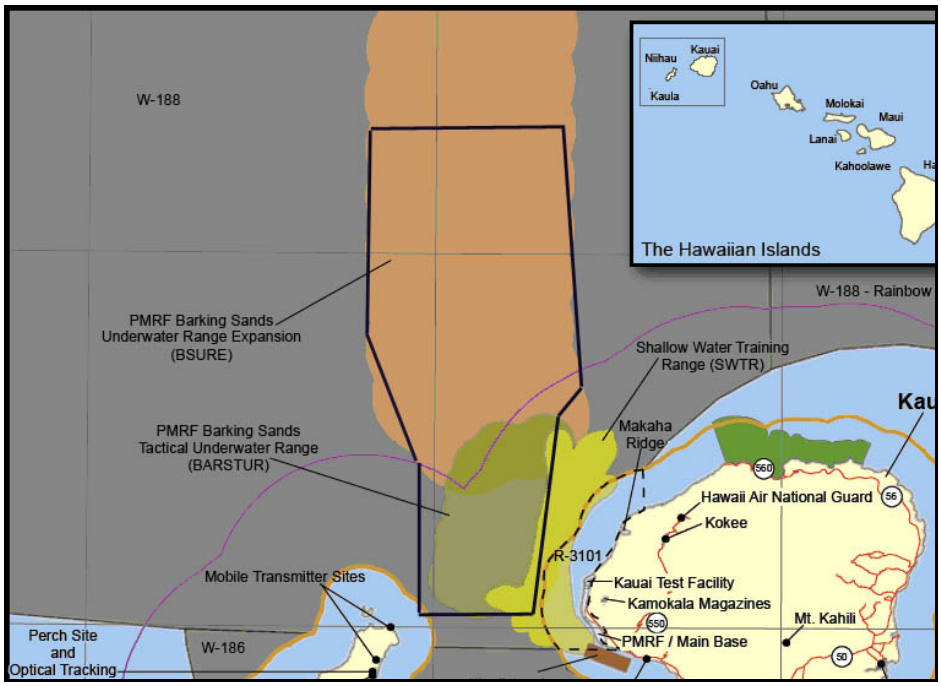

Figure 1. Location of the aerial survey monitoring area in and near the US Navy Pacific Missile Range Facility (PMRF) Range west and northwest of Kauai, Hawaii.

Section 2 Methods

Monitoring effort followed protocol first implemented in August 2009 for another SCC OPS (see Smultea and Mobley 2009 for details). The approach again involved flying elliptical-shaped patterns in advance of the Navy vessel (i.e., the *Russell*) that extended from the front of the ship (~200 yards [yd]) out to ~2500 yd) over a width of ~4 km (2 nm). When range and/or safety conditions precluded accompanying the *Russell*, focal follows were conducted opportunistically when target species were sighted off range.

Surveys were again conducted with a small fixed-wing Partenavia P68 Observer flying at 100 knots (kt) groundspeed and an altitude of ~800 ft (244 m), as stipulated under the terms of NOAA permit no. 642-1536 issued to the co-Principal Investigator (JM), unless the pilot was directed to fly at alternate altitudes by flight controllers for safety reasons. Observations from the monitoring aircraft involved four personnel including the pilot and three professionally trained marine mammal biologists, at least two with >10 years of related experience. One biologist was the data recorder/video camera operator and the other two were observers. Observers were not informed of the times and types of underwater transmissions during Navy activities, or the course of the *Russell*. Observers maintained contact with Navy biologists who monitored MM/ST from aboard the *Russell*.

During the first August 20089 SCC OPS aerial monitoring, sighting and behavioral data were handwritten on custom-made forms (see Smultea and Mobley 2009). However, during the Feb 2009 SCC OPS aerial monitoring, data-collection software (Handbase 4.0) was used on a Palm Pilot TX to collect basic sighting and environmental data (this same set-up was used during aerial monitoring surveys for the Navy off southern California in Oct-Nov 2008—see Smultea et al. 2009). SpectatorGo, a behavioral data collection program developed by Biobserve, was used for interval sampling of behavior. This program was later modified to work on the iPhone so that both GPS and altitude data could be incorporated with every data entry. An MMRC/SES team member (M. Deakos) worked closely with the developers to improve the software to match the project's needs. By customizing the program's configuration, behavioral states and events could be collected much more efficiently and accurately using the iPhone's touch screen.

Section 3 Results

Effort

The survey aircraft was able to accompany the *Russell* during 13.9 hours (hr) (51%) of the total 27.3 hr of flight time (Table 1). The remaining 13.4 hr (49%) while not with the *Russell* involved primarily transit time to and from the offshore location of the vessel (see Figures 2-6). In comparison, during similar MM/ST monitoring during the August 2009 SCC OPS off Kauai, the survey aircraft accompanied the Navy's USS *O'Kane* during 19.0 (67%) of the 28.5 hr of flight time.

Table 1. Summary of survey times by date and periods when the observer aircraft was accompanying and not accompanying the *Russell*.

Date 2009	Flight Periods (Wheels Up-Down)	Total Flight Time	Period not with *Russell*	Total hr	Beaufort Sea State	Period with *Russell*	Total hr	Bf Sea State	No. Sightings Near *Russell* (# indiv)	No. Sightings Away from *Russell* (# indiv)	Comments
15-Feb	16:00-16:30 17:26-18:16	1 h 20 min	17:26-18:16	1 h 20 min	NA NA	0	0		na	2 (7 HW)	Transit from Molokai Transit Honolulu to Lihue. *Russell* departed later during darkness.
16-Feb	7:45-11:44 13:00-16:42	7 h 41 min	7:45-8:24 10:36-11:44 13:00-13:28 16:07-16:42	2 h 51 min	6 6 6 6	8:25-10:35 13:29-16:06	4 h 50 min	6 6	1 (1 HW)	22 (1 ST & 39 HW)	1 HW focal follow for ~33 min, ~1.5-2 nm from *Russell* in Bf 5
17-Feb	08:00-08:50 10:10-11:00 11:35-16:09	6 h 24 min	11:35-12:13 15:01-16:09	3 h 38 min	6 6	12:14-15:00	2 h 46 min	6	0	11 (14 HW)	Gauge malfunction during check on runway; transit to/from Oahu for mechanical inspection. (resumed survey at 11:35)
18-Feb	07:50-11:47 13:07-15:48	6 h 38 min	07:50-08:21 11:21-11:47 13:07-13:43 14:17-15:48	3 h 7 min	5 5 3 3	8:22-11:20 13:44-14:16	3 h 31 min	6 3	0	20 (22 HW)	Conducted ~1 hr 15 min of HW focal observations in lee near Kekaha after persistent rain and low clouds precluded continued observations near *Russell*.
19-Feb	8:34-12:04 13:49-14:52 (*16:09-16:53 transit no observing Bf 7*)*	5 h 17 min (incl. transit)	8:34-8:57 11:41-12:04 13:49-14:14 14:21-14:52	2 h 30 min	6 6 6	08:58-11:40 14:15-14:20	2 h 47 min	6 6	8 (14 HW & 1 Unid. Dolph.)	4 (5)	Exercise unexpectedly ends at 08:00 (had been noon) & *Russell* headed to Kaualakahi Channel then S to refuel offshore. Conducted ~2 hr 21 min HW focal follows near *Russell*, some simultaneous to *Russell* observers. Attempted 2nd p.m. flight to *Russell* but Bf 7 & increasing distance (>40 nm) precluded observations. No observations during return transit to Oahu (Bf 7).*
			*(16:09-16:53)**		7						
TOTALS:		***27 h 20 min***		***13 h 26 min***			***13 h 54 min***		***9 (14 HW, 1 Unid. Dolph.)***	53 (92 HW/8 UW/1 ST	

Figure 2. Aerial survey tracks during visual observations February 15, 2009, and locations of marine mammal and sea turtle sightings. Straight-line tracks indicate transit periods, some of which were conducted along the Kauai shoreline. Corkscrew-shaped tracks indicate when the aircraft was accompanying the *Russell* or conducting an opportunistic focal follow.

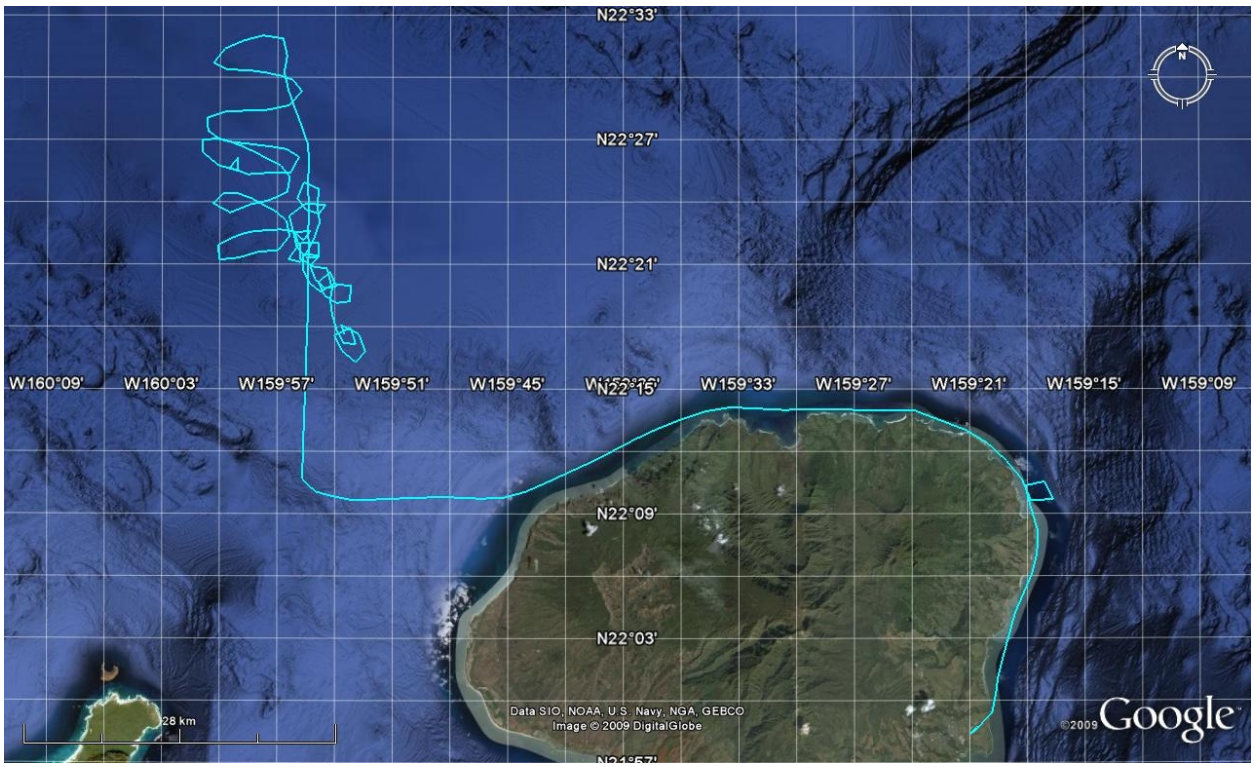

Figure 3. Aerial survey tracks during visual observations February 16, 2009, and locations of marine mammal and sea turtle sightings.

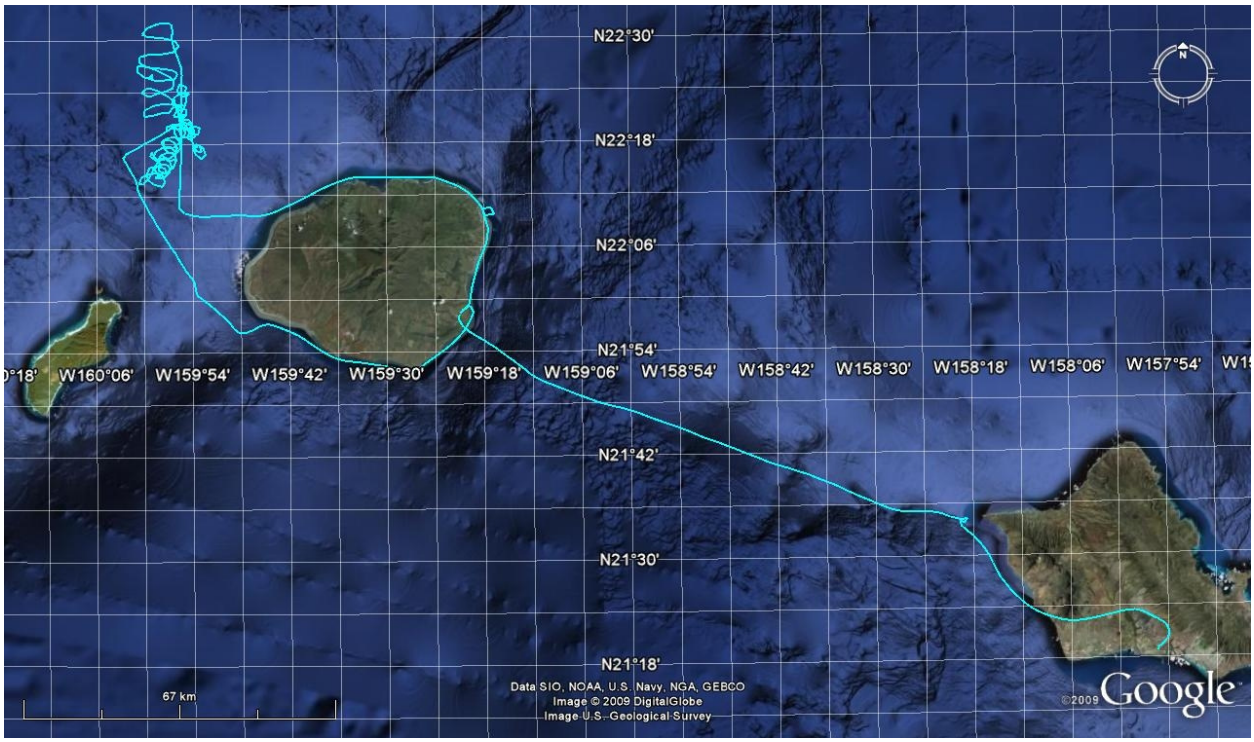

Figure 4. Aerial survey tracks during visual observations February 17, 2009, and locations of marine mammal and sea turtle sightings.

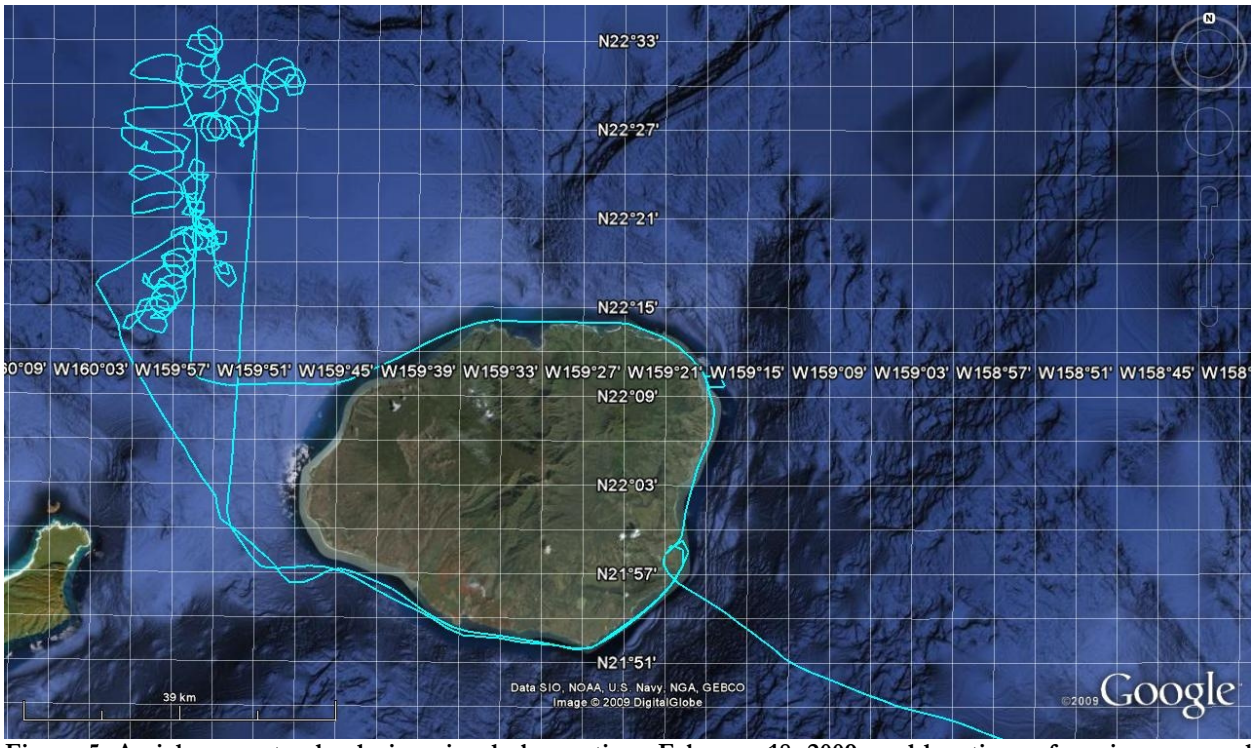

Figure 5. Aerial survey tracks during visual observations February 18, 2009, and locations of marine mammal and sea turtle sightings.

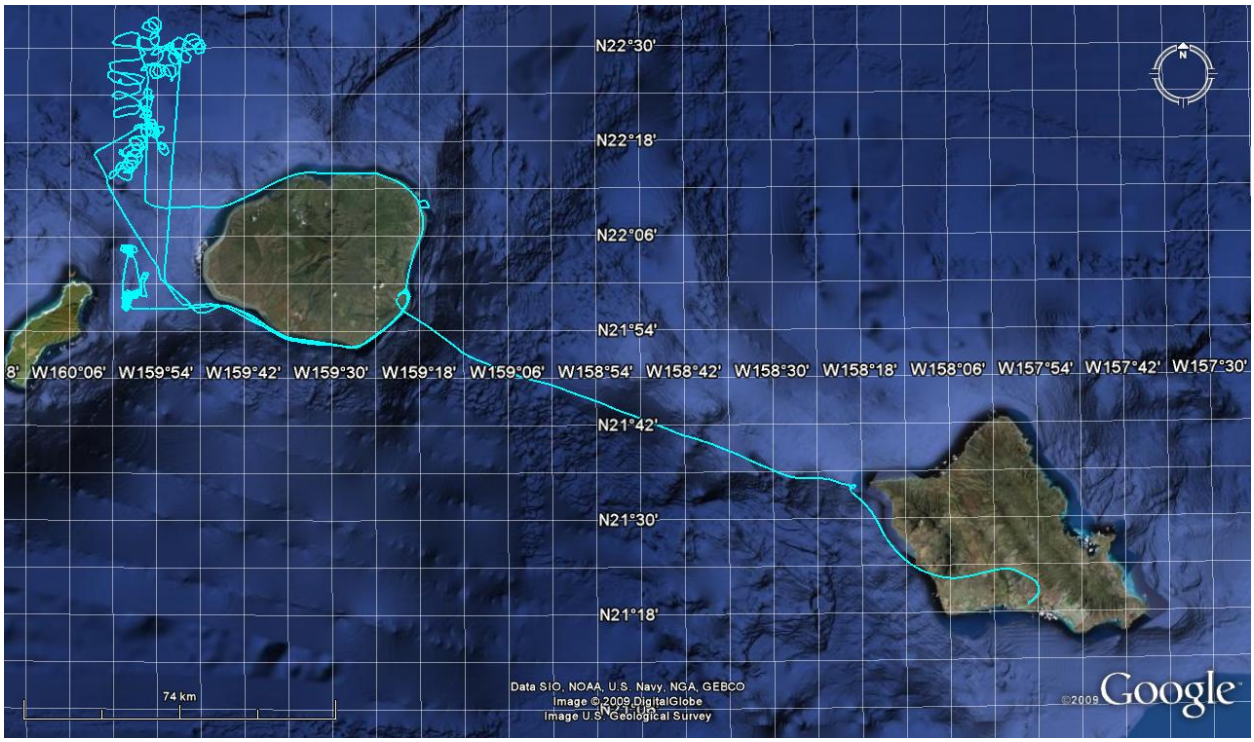

Figure 6. Aerial survey tracks during visual observations February 19, 2009, and locations of marine mammal and sea turtle sightings.

Effort with Respect to Beaufort Sea State

Similar to previous results (Smultea and Mobley 2009), observation conditions were predominantly poor near the *Russell* during the SCC in offshore Kauai waters (Bf >4 during 96% of 14.5 hr) (Figure 7). In comparison, during SCC OPS Aug 08 aerial monitoring, Beaufort was >4 during 80% of 19.0 hr of effort.

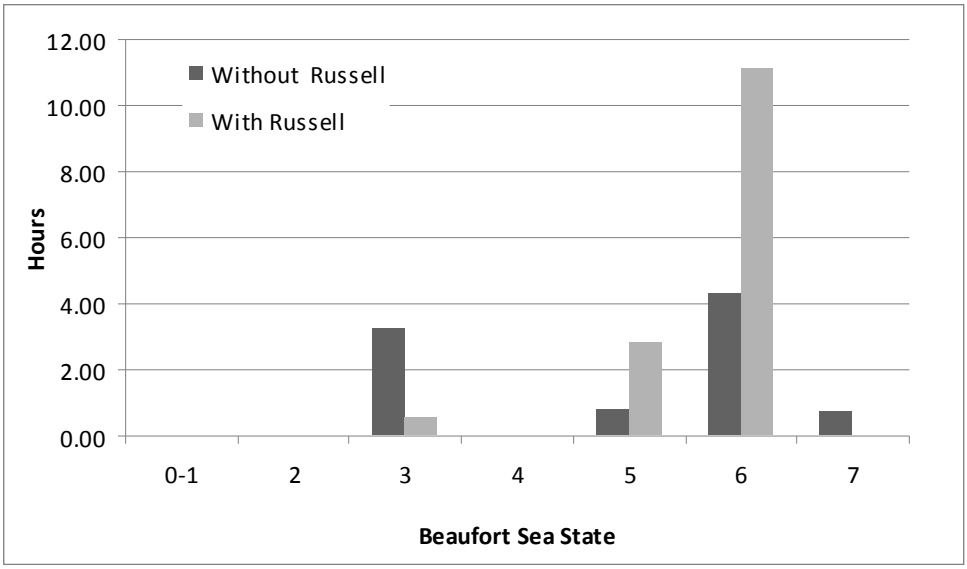

Figure 7. Beaufort sea state conditions during periods the observer aircraft was accompanying and not accompanying the *Russell*.

Sightings

A total of 63 sightings was made during the survey period. Most (85%) of these sightings were observed in shallow coastal waters near Kauai during transits to and from the *Russell*'s location, which was typically ~50 nm offshore north or northwest of Kauai (Figures 2-6, Table 2, Appendix A). Of this total, only one sighting (a single humpback whale) was seen while the aircraft circled in front of the *Russell* in deep offshore waters for ~11.5 hr over three days (Feb 16-18) during the SCC (Table 1); a focal follow was done on this whale (see *Focal Follows* below). An additional seven sightings were seen within view (~20-30 km) on the last survey day (Feb 19) after the training event had ended. All seven of these sightings were humpbacks and occurred over shallower, more protected lee waters between Kauai and Niihau in the Kaulakahi Channel while the *Russell* was stationary or in return transit through this channel (Figures 2-6 and Figure 8. Locations of sightings made during the 15-19 Feb 2009 SCC OPS aerial monitoring survey off Kauai, Hawaii. In addition, one probable bottlenose dolphin was seen with one of these humpback groups on Feb 19 (Appendix A).

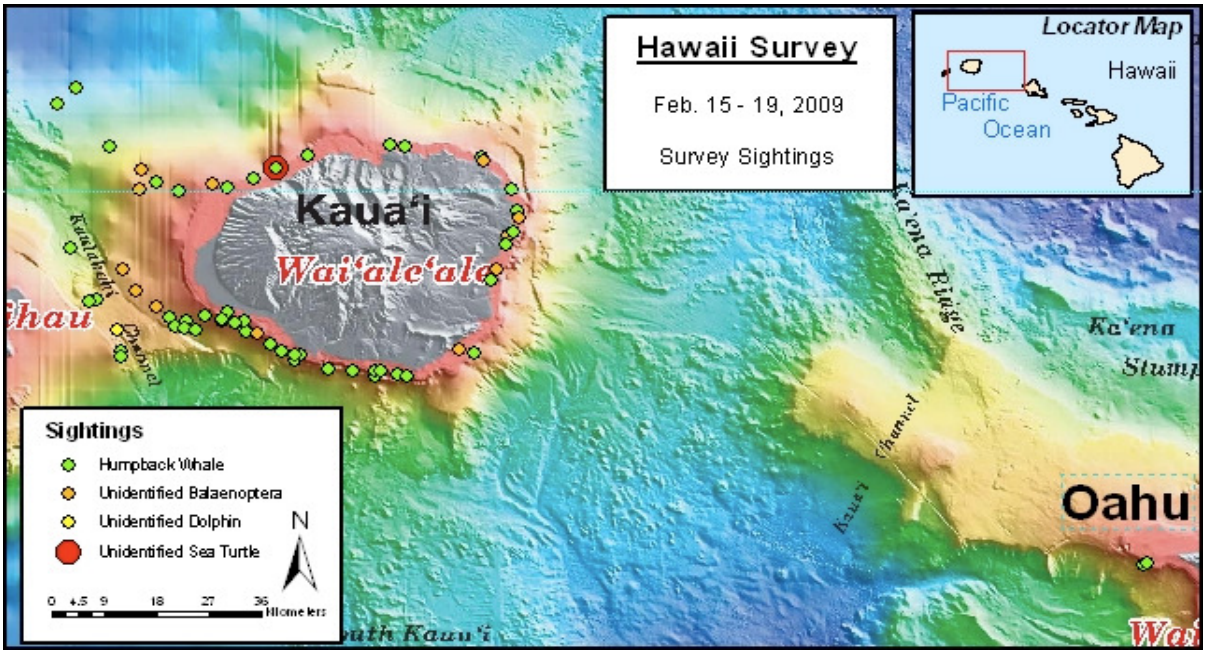

Figure 8. Locations of sightings made during the 15-19 Feb 2009 SCC OPS aerial monitoring survey off Kauai, Hawaii.

Of the total 63 sightings, most (53 groups or 84%) were humpback whales. The remaining sightings were 8 unidentified baleen whale groups, 1 probable bottlenose dolphin, and 1 unidentified sea turtle (Table 2). The unidentified baleen whales were likely humpback whales but the sightings were too far away to confirm species.

Table 2. Number of sightings by species and periods with and without the *Russell* in view (<20-30 km) during the February 2009 SCC OPS aerial survey monitoring. Only one of these sightings, a single humpback whale, was seen near (<2 km) the *Russell* while the aircraft circled in front of the *Russell* in deep offshore waters during the SCC training event from February 16-18, 2009.

	Within View (<20-30 km) of *Russell*		Away from *Russell* (i.e., Transit)		Total	
Species	**No. Grps**	**No. Indiv.**	**No. Grps**	**No. Indiv.**	**No. Grps**	**No. Indiv.**
Humpback Whale (*Megaptera novaeangliae*)	8	14	45	92	53	96 (incl 2 calves)
Unidentified Baleen Whale	-	-	8	8	8	8
Unidentified Dolphin (Probable Bottlenose Dolphin, *Tursiops truncatus*)	1	1	-	-	1	1
Unidentified Sea Turtle	-	-	1	1	1	1
TOTAL	**9**	**15**	**53**	**101**	**63**	**106**

Focal Follows

Only one focal behavioral follow was conducted while monitoring near the *Russell* during the training event period while MFAS may have been operating (Feb 16). After the SCC and the MFAS transmission period had ended on Feb 19, one focal follow was conducted near (<4 km) two Navy vessels (see below) (Table 2). The remaining 10 focal follows occurred during transits to and from the *Russell*'s location in protected lee areas near shore. Focal follows were conducted while circling at an altitude of ~1000-1500 ft and a lateral distance of ~1 km (summarized in Appendix B).

Focal sessions occurred on Feb 16 (n = 1), Feb 17 (n = 3), Feb 18 (n = 6), and Feb 19 (n = 5)(Appendix B). Session durations ranged from ~1 min (i.e., when a group affiliated with another group) to ~2+ hr (Feb 19), though most were <3-10 min long in duration. At least brief (a few min) digital video recordings were made on 13 of the 15 focal groups (Appendix B). The video camera did not have whales in continuous view because the animals dove, glare interfered with filming, observers lost track of the animals in high Bf, etc. Video was supplemented by data collected on the iPhone and/or handwritten behavioral notes including information on estimated distance to the *Russell* or other vessels, other nearby sightings, etc. Behavior state, frequency of conspicuous individual surface behaviors, dispersal distance between individuals within a group, respiration and dive times, and periods whales were visible below the surface were also noted as possible.

On 18 Feb we conducted "practice" focal follows on six humpback whale groups in the lee off the western side of Kauai to ascertain whether the newly developed behavioral software program adapted for the iPhone (BioSpectator Go) was useful and suited to our focal follow goals. One group was a humpback mother-calf pair. Other groups included several individuals or pairs that affiliated to form a

surface-active, social competitive group of ~5 humpbacks. A small vessel passed near some of these whales (Appendix B).

Post-SCC, on Feb 19, while the *Russell* was in transit from the SCC area,six focal sessions were conducted in the Kaulakahi Channel between Kauai and Niihau. The *Russell* and/or other similarly large Navy surface vessels were within view (~20-30 km) of the aircraft observers during 8 of the 12 sightings that occurred on Feb 19, including the six focal groups (Table 2). These focal sessions ranged in duration from a few minutes to ~1-2+ hr (n = 3). The first focal session occurred in Bf 5/6 on a single humpback whale for ~15 min. The biological observers aboard the *Russell* simultaneously tracked this whale as they transited through the area based on communications between aircraft and vessel observers with an aircraft radio. However, the high Bf conditions made it difficult to consistently track this whale.

Subsequent focal sessions started well-ahead of but within view (<20-30 km) of the *Russell* with the goal of trying to collect behavioral data before, during, and after the *Russell* and other Navy vessels were nearby. On only one occasion on Feb 19 was a group of three humpback whales tracked for a focal session near (<4 km) a Navy vessel. This group was followed for ~1 hr before, during, and after two large Navy vessels approached, slowed down, stopped, then continued past the whales in the lee of the Kaualakahi Channel. The group had been exhibiting relatively consistent dive times and number of blows per surfacing for several surfacing sequences before the two Navy vessels were within several km. As the two Navy vessels approached to within ~0.5-2 km of this group, the whales appeared to change their behavior state, increase their dive times, and reduce the number of blows per surfacing sequence (Appendix B). It was later learned from Navy biologists aboard the *Russell* that MFAS was not being transmitted at this time. Reactions/avoidance of this type by some humpback whales to vessels has been documented previously, including in the Hawaiian Islands (e.g., reviewed in Richardson et al. 1995).

Communications

The most convenient and reliable means of direct communications between the *Russell* and aircraft observers *in situ* was usually satellite phone, or a VHF radio, although connection errors were often experienced. In addition, communications between the observer aircraft pilot and the Navy biologists aboard the *Russell* were sometimes facilitated through radio communications with PMRF. Daily locations of the *Russell* and thus daily survey locations were usually communicated via cell phone from Navy POCs to the co-PI (JM) before the observer aircraft left the Lihue airport and/or once in the air via the PMRF flight tower. Daily communications with Navy biologists aboard the *Russell* and the NTR were also conducted via cell phone before and/or after each daily flight while on land to communicate any changes in schedules and training, etc.

Section 4 Discussion

It is not possible herein to assess the effects or lack thereof of the Feb 2009 SCC OPS on MM/ST as observed during this aerial survey monitoring effort, as recognized in the SOW. Thus, this section is meant to summarize key relevant results and limitations, and provide a "lessons learned" review of the monitoring effort. Per the SOW, the data obtained in this study are meant to contribute to a growing baseline of information on the distribution, occurrence, and behavior of MM/ST near Navy training events in the HRC per the HRC marine species monitoring plan (DoN 2008). Key relevant results are summarized below.

Relevance of Key Results

Overall, the Feb 2009 SCC OPS aerial monitoring survey effort demonstrated the successful implementation and utility of a number of key issues as summarized below.

Logistics and Planning

Search and behavioral observations of MM/ST from a civilian observer aircraft were conducted safely and successfully for the second time (e.g., see Smultea and Mobley 2009 re Aug 2008 SCC OPS monitoring) with minimal interference with at-sea naval training involving multiple large vessels and aircraft (both fixed-wing and helicopters). On some occasions, up to three aircraft were observed from the observation aircraft at one time. Key to this ability was attending pre-planning meetings and maintaining pre- and during-survey communications with Navy biologists aboard the *Russell*, the NTR and other Navy POCs. This included the project PIs and pilot attending a pre-planning meeting with CPF biologist and operational staff, P-3 pilots, and PMRF range control in Honolulu and speaking with them in person about logistical details including obtaining contact numbers and radio communication frequencies. It is recognized that Navy personnel must coordinate complicated logistics to assure smooth and safe observer aircraft operations near Navy surface vessels and aircraft to avoid interference with Navy training events and maintain safe operations.

Communications

Efficient and timely communications are key to safe and successful surveys. Given the complexity and rapidly changing nature of the project logistics (e.g., *Russell* and other SCC location and activities, etc.) it is critical to have a consistent Navy POC (e.g., the NTR) available on a daily basis to ensure smooth communications and logistics. Use of an aircraft VHF radio by the Navy biological observers aboard the *Russell* to communicate with the aircraft observers *in situ* was also key to maintaining real-time communications regarding planning logistics, sighting locations, etc. Maintaining frequent communications with the PMRF flight tower and Navy POCs via cell phone each day was also integral. The observer aircraft pilot was also key in responding quickly and efficiently to Navy flight tower requests to change altitude, headings, etc., to avoid interfering with Navy training events, primarily in air space but also near operating vessels.

Protocol Approach Feasibility

Results indicate that these are feasible methods that can be used to monitor cetaceans near an active Navy vessel. Survey results successfully demonstrated for the second time (see Smultea and Mobley 2009) that a Navy destroyer could be accompanied by the civilian observer aircraft while it flew elliptical-shaped patterns ~200-2500 yd in front of the vessel. For the first time a sighting was made during and near the Navy destroyer (*Russell*) during the training period. In addition, eight humpback whale sightings and six focal behavioral follows were made within view of the *Russell* and other Navy surface vessels (during the *Russell*'s return transit through a shallower and thus more densely populated humpback area). Although the sample size was small, the survey protocol approach facilitated the collection of behavioral data,

including video and detailed behavioral notes, *before*, *during* and *after* the *Russell*'s close passing of a group of focal humpback whales (on Feb 19). The latter periods are an important aspect and requirement of the Navy's HRC marine species monitoring plan (DoN 2008). Observing groups before, during and after exposure to a stimulus is the ideal observation protocol to minimize variability in data across subjects, thereby increasing the statistical value of the observations (reviewed in Smultea and Mobley 2009).

Tracking Cetaceans Below the Water Surface

Humpback whales were tracked and videotaped using focal follow protocol for extended periods of time below the water surface in the vicinity of the *Russell* and other Navy vessels during this survey (on Feb 16 and 19—see Appendix B). These efforts further demonstrate preliminary results of the August 2008 SCC OPS aerial monitoring that small to large marine species can be tracked underwater in the clear tropical water conditions of the HRC during amenable Bf conditions. However, under poor Bf conditions, the ability to continuously track objects is compromised by the rough sea-surface conditions.

Limitations

- One limitation of the usefulness of the implemented approach specifically for waters offshore of Kauai/Niihau (and other similar regions) is that the predominant Bf 5-6+ sea conditions severely limit the ability of aircraft observers to sight and consistently track MM/ST. This was expected based on previous studies and documented typical sea conditions in this region (e.g., Buckland et al. 2001, Barlow 2006, Smultea and Mobley 2009, see review in Smultea 2008).
- Another limitation of the HRC location for monitoring of the SCC OPS is the relatively low documented density of MM/ST sightings in the deep offshore waters characterizing the main training areas used for both the Feb 2009 and Aug 2008 SCC OPS. This severely limits the ability to collect statistically meaningful and valid sample sizes, even over a long period and multiple such monitoring efforts. However, if training events are conducted in or near shallower more coastal waters, particularly during the winter humpback residency, the ability to obtain larger sample sizes would be significantly increased as evidenced by the eight sightings and six focal sessions with humpbacks made within view of the *Russell* as it passed and stopped for a period between Kauai and Niihau in transit after the SCC.
- A serious limitation of this approach with respect to Navy monitoring is the potential for airspace conflict with naval aircraft operations. During both the Feb 2009 and the Aug 2008 SCC OPS monitoring, windows within which the observer aircraft could fly without potential airspace conflict were limited to relatively short periods and could be interrupted on short notice. However, early groundwork laid by CPF, protocol developed during the pre-sail meeting, and continued effective communications between the aircraft pilot, the *Russell*, the PMRF air tower (range control) and the P-3 pilots allowed observers to maximize the periods they could fly safely. In addition, the aircraft observer team operated on standby as practicable, and could adapt to short-notice changes in airspace schedules.

In general, the approach described herein is optimally suited to conditions where predominant expected sea states are <5-6 and where MM/ST densities are scientifically documented to be higher. Further recommendations are summarized below under *Recommendations*.

Section 5 Recommendations

Following are recommendations for future similar MM/ST aerial monitoring efforts during training events. See Smultea and Mobley (2009) for further details and recommendations specifically for SCC OPS monitoring in the HRC. Also see Smultea et al. (2009) for additional relevant recommendations

based on results of aerial monitoring during Major Training Events (MTE) in the SOCAL based on aerial surveys conducted there in fall 2008 and summer 2009.

- It is not possible to assess whether the paucity of sightings by aircraft observers while with the *Russell* in offshore deep waters was associated with the *Russell*'s presence and/or activities. Available studies indicate that baseline density in this region is very low. Furthermore, sighting conditions were predominantly poor. These factors suggest that aircraft observers were unlikely to sight MM/ST near the *Russell* whether or not the *Russell* was present.
- In general, the predominant environmental conditions and estimated MM/ST densities in the deep offshore waters of the area are not conducive to effective monitoring for these species.
- It is highly recommended that this SCC OPS protocol approach be implemented in the Navy SOCAL operating area during a training event. Sighting rates and density of marine mammals are significantly higher throughout the year and the environmental conditions are significantly better for collecting pertinent data in the SOCAL vs. HRC. For example, the sighting rate was ~5-6 sightings per hour of aerial effort in the primary SOCAL range vs. <1 sighting per hour in the offshore waters of the primary HRC SCC OPS area used in 2008-2009. Furthermore, the Bf was >4 for >75% of the SCC OPS aerial monitoring during Aug 2008 and Feb 2009 vs. Bf <4 for >50% of the SOCAL fall 2008 and summer 2009 MTE aerial survey (see Smultea and Mobley 2009; Smultea et al. 2009).
- The sample size collected during this study is too small to allow statistically meaningful quantification and interpretation of potential baseline behavior or potential effects of Navy vessels and training, as anticipated in the SOW.
- More detailed analyses on baseline data and relative to the locations and activities of the *Russell* and other Navy vessels involved in the Feb 2009 SCC OPS are possible and recommended to further explore existing and future data. This includes calculation of respiration and dive rates, rates of surface-active behavioral events, orientation rates, dispersal distance between individuals within a group, spatial distribution and orientation of sightings relative to SCC locations and activities, etc. The utility, value, and integrity of the more detailed behavioral data to address the five main questions identified in the HRC marine monitoring plan should also be assessed (DoN 2008).
- Focal follows should be conducted at altitudes of at least ~1200-1500 ft and radial distances of at least ~1 km (0.5 nm) to avoid and minimize the potential for focal animals to react to the aircraft. This is based on results of the limited available studies of a few cetacean species (mostly whales) as well as preliminary observations during this study and also the recent related results of aerial survey monitoring for the Navy in SOCAL (Smultea et al. 2009). We recommend that the latter protocol be followed unless it can be statistically demonstrated that particular species do not exhibit detectable reactions to the aircraft at closer distances.
- Data collected during this study contribute to baseline data important in developing and implementing effective marine mammal monitoring for future planned Navy activities identified for the HRC in the Navy's associated monitoring plans (DoN 2008).

Section 6 Acknowledgements

We are grateful to Navy personnel from US Pacific Fleet Environmental and Naval Facilities Engineering Command Pacific for their support, coordination and facilitation in the implementation of these surveys. Many thanks to the hard working survey and analysis crew consisting of Mark Deakos and co-pilot/GIS specialist/observer Stu Smith. Thank you to Jenelle Black for assistance with document preparation. Also we thank pilot John Weiser.

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Appendices

Appendix A. Locations of Marine Mammal and Sea Turtle Sightings Made off Kauai and Niihau during the February 2009 SCC OPS during Aerial Monitoring Surveys.

Date	Time	Count	# Calves	Species Common	Species Latin	Lat ºN	Long ºW
2/15/09	17:42:36	3	0	Humpback Whale	*Megaptera novaeangliae*	21.5576	158.3257
2/15/09	17:43:40	4	0	Humpback Whale	*Megaptera novaeangliae*	21.5626	158.3193
2/16/09	8:04:00	1	0	Unidentified sea turtle	Unidentified sea turtle	22.2007	159.6586
2/16/09	8:04:00	3	0	Humpback Whale	*Megaptera novaeangliae*	22.2007	159.6586
2/16/09	8:05:00	2	0	Humpback Whale	*Megaptera novaeangliae*	22.1839	159.6960
2/16/09	8:06:00	3	0	Humpback Whale	*Megaptera novaeangliae*	22.1677	159.7345
2/16/09	8:08:00	1	0	Humpback Whale	*Megaptera novaeangliae*	22.1634	159.8106
2/16/09	9:59:00	1	0	Humpback Whale	*Megaptera novaeangliae*	22.2352	159.9155
2/16/09	11:04:00	2	0	Humpback Whale	*Megaptera novaeangliae*	22.3303	159.9678
2/16/09	11:11:00	4	0	Humpback Whale	*Megaptera novaeangliae*	22.3042	159.9963
2/16/09	11:35:00	3	0	Humpback Whale	*Megaptera novaeangliae*	22.2166	159.3441
2/16/09	11:37:00	2	0	Humpback Whale	*Megaptera novaeangliae*	22.1650	159.2971
2/16/09	11:38:00	3	0	Humpback Whale	*Megaptera novaeangliae*	22.1298	159.2888
2/16/09	11:41:00	1	0	Humpback Whale	*Megaptera novaeangliae*	22.0191	159.3298
2/16/09	13:05:00	1	0	Unidentified Balaenoptera	Balaenoptera	22.0910	159.3026
2/16/09	13:06:00	1	0	Unidentified Balaenoptera	Balaenoptera	22.1194	159.2855
2/16/09	13:12:30	1	0	Humpback Whale	*Megaptera novaeangliae*	22.2388	159.4839
2/16/09	13:15:20	3	0	Humpback Whale	*Megaptera novaeangliae*	22.2209	159.6118
2/16/09	13:19:00	1	0	Unidentified Balaenoptera	Balaenoptera	22.1731	159.7576
2/16/09	16:30:52	2	0	Humpback Whale	*Megaptera novaeangliae*	21.8888	159.6312
2/16/09	16:32:10	1	0	Humpback Whale	*Megaptera novaeangliae*	21.8759	159.5796
2/16/09	16:34:00	2	0	Humpback Whale	*Megaptera novaeangliae*	21.8629	159.5078
2/16/09	16:35:12	1	0	Humpback Whale	*Megaptera novaeangliae*	21.8655	159.4731
2/16/09	16:39:00	1	0	Humpback Whale	*Megaptera novaeangliae*	21.8999	159.3544
2/17/09	11:41:00	1	0	Humpback Whale	*Megaptera novaeangliae*	21.8647	159.4581

Appendix B (cont'd)

Date	Time	Count	# Calves	Species Common	Species Latin	Lat ºN	Long ºW
2/17/09	11:45:00	1	0	Humpback Whale	*Megaptera novaeangliae*	21.8971	159.6234
2/17/09	11:48:00	2	0	Humpback Whale	*Megaptera novaeangliae*	21.9457	159.7139
2/17/09	11:52:00	1	0	Humpback Whale	*Megaptera novaeangliae*	21.9581	159.8242
2/17/09	11:53:00	1	0	Unidentified Balaenoptera	Balaenoptera	21.9755	159.8451
2/17/09	11:56:00	1	0	Unidentified Balaenoptera	Balaenoptera	22.0356	159.8969
2/17/09	15:11:00	2	1	Humpback Whale	*Megaptera novaeangliae*	22.1769	159.8444
2/17/09	15:22:00	1	0	Humpback Whale	*Megaptera novaeangliae*	21.9534	159.7973
2/17/09	15:23:00	1	0	Humpback Whale	*Megaptera novaeangliae*	21.9608	159.7695
2/17/09	15:35:00	2	0	Humpback Whale	*Megaptera novaeangliae*	21.9665	159.7345
2/17/09	15:55:00	1	0	Humpback Whale	*Megaptera novaeangliae*	21.9040	159.6523
2/18/09	7:57:00	2	0	Humpback Whale	*Megaptera novaeangliae*	21.8715	159.5064
2/18/09	8:00:00	1	0	Humpback Whale	*Megaptera novaeangliae*	21.8989	159.6320
2/18/09	8:00:00	2	0	Humpback Whale	*Megaptera novaeangliae*	21.8989	159.6320
2/18/09	8:01:00	2	0	Humpback Whale	*Megaptera novaeangliae*	21.9163	159.6696
2/18/09	8:02:00	1	0	Humpback Whale	*Megaptera novaeangliae*	21.9341	159.7065
2/18/09	8:02:00	2	0	Humpback Whale	*Megaptera novaeangliae*	21.9341	159.7065
2/18/09	8:03:00	1	0	Humpback Whale	*Megaptera novaeangliae*	21.9518	159.7429
2/18/09	7:58:00	1	0	Unidentified Balaenoptera	Balaenoptera	22.1976	159.8685
2/18/09	8:12:00	1	0	Unidentified Balaenoptera	Balaenoptera	22.1655	159.8710
2/18/09	11:40:00	1	0	Unidentified Balaenoptera	Balaenoptera	22.2121	159.3396
2/18/09	11:44:00	1	0	Humpback Whale	*Megaptera novaeangliae*	22.0766	159.3059
2/18/09	11:45:00	1	0	Unidentified Balaenoptera	Balaenoptera	22.0374	159.3213
2/18/09	13:14:00	1	0	Humpback Whale	*Megaptera novaeangliae*	22.0970	159.2943
2/18/09	13:26:00	2	0	Humpback Whale	*Megaptera novaeangliae*	22.2348	159.4605
2/18/09	14:36:00	1	0	Unidentified Balaenoptera	Balaenoptera	22.0013	159.8757
2/18/09	14:39:00	2	0	Humpback Whale	*Megaptera novaeangliae*	21.9431	159.8156
2/18/09	14:39:30	2	0	Humpback Whale	*Megaptera novaeangliae*	21.9401	159.8000
2/18/09	14:40:00	2	0	Humpback Whale	*Megaptera novaeangliae*	21.9376	159.7835

Date	Time	Count	# Calves	Species Common	Species Latin	Lat ºN	Long ºW
2/18/09	14:42:00	1	0	Humpback Whale	*Megaptera novaeangliae*	21.9558	159.7440
2/18/09	15:00:00	2	1	Humpback Whale	*Megaptera novaeangliae*	21.9540	159.7079
2/19/09	8:38:00	1	0	Unidentified Balaenoptera	Balaenoptera	21.9059	159.3778
2/19/09	8:41:00	2	0	Humpback Whale	*Megaptera novaeangliae*	21.8710	159.4983
2/19/09	8:42:00	1	0	Humpback Whale	*Megaptera novaeangliae*	21.8731	159.5416
2/19/09	8:46:00	1	0	Unidentified Balaenoptera	Balaenoptera	21.9327	159.6895
2/19/09	8:47:00	1	0	Humpback Whale	*Megaptera novaeangliae*	21.9497	159.7234
2/19/09	9:00:00	1	0	Humpback Whale	*Megaptera novaeangliae*	22.0711	159.9770
2/19/09	9:27:00	3	0	Humpback Whale	*Megaptera novaeangliae*	21.9886	159.9368
2/19/09	9:34:00	1	0	Humpback Whale	*Megaptera novaeangliae*	21.9840	159.9474
2/19/09	10:43:00	3	0	Humpback Whale	*Megaptera novaeangliae*	21.9368	159.9047
2/19/09	10:50:00	1	0	Unidentified Dolphin (Probable Bottlenose Dolphin)	Unidentified Small Delphinid (Probable *Tursiops truncatus*)	21.9386	159.9061
2/19/09	10:58:00	4	0	Humpback Whale	*Megaptera novaeangliae*	21.9028	159.8983
2/19/09	11:29:00	1	0	Humpback Whale	*Megaptera novaeangliae*	21.8961	159.8983

Appendix B. Summary of Behavioral Observations of All Marine Mammal and Sea Turtle Sightings made during the February 2009 SCC OPS aerial monitoring survey off Kauai, Hawaii. (Grp=group, Beh=behavior, Hdg=heading, Min=minimum, Max=maximum, mg=magnetic, BL=body lengths, HW=humpback whale, Trav=travel, SAC= surface-active, unid=unidentified, Unk. = Unknown, alti=altitude, Bf=Beaufort sea state.)

2009 Date	Time	Grp #	Focal Follow?	Group Size	# Calf	Species	Reaction/ Change in Behavior?	Init Beh State	Behav. States	Anim Hdg (mg)	Min Disp (BL)	Max Disp (BL)	Indiv Beh Event	Photos ?	Video ?	Comments
15-Feb	17:42:36	1	No	3	0	HW	None seen	Trav	Trav	220	1	2		No	No	circled once, slow travel
15-Feb	17:43:40	2	No	4	0	HW	None seen	Trav	Trav	220	1	2		No	No	slow travel
16-Feb	8:04:00	3	No	1	0	Unidentified sea turtle	None seen	Rest	Logging/ Resting					No	No	logging at surface
16-Feb	8:04:00	4	No	3	0	HW	None seen	Unk.	Unk.		1	3		No	No	
16-Feb	8:05:00	5	No	2	0	HW	None seen	Trav	Trav	135				No	No	
16-Feb	8:06:00	6	No	3	0	HW	None seen	Trav	Trav					No	No	
16-Feb	8:08:00	7	No	1	0	HW	None seen	Unk.	Unk.					No	No	
16-Feb	9:59:00	9	Yes	1	0	HW	Unknown, pilot saw unidentified large splash then saw whale	Trav	SAC Trav				unid. splash	No	Yes	first seen <3 km USS *Russell*, first saw unidentified large splash at 09:59 then blow and swimming underwater at 10:00 & 10:02; aircraft turned and began circling at 1000 ft alt & 1000 m radial distance, difficult to track in Bf 5 so we don't feel confident we saw all blows & behavior
16-Feb	10:00:00	9	(Yes-same as above)			*same HW as above*	Saw 1 humpback blow then saw it swimming underwater (can see through water surface)		SAC Trav	180			blow			
16-Feb	10:02:00	9	(Yes-same as above)			*same HW as above*	Change in behavior state: no longer SAC travel, just travel		Trav	180			under-water swim			resighting, seen traveling S underwater, we are not seeing all behaviors as difficult to track whale consistently in Bf 5-6
16-Feb	10:05:00	9	(Yes-same as above)			*same HW as above*	Unknown		Unk.	unk			blow			resighting

Appendix B (cont'd)

2009 Date	Time	Grp #	Focal Follow?	Group Size	# Calf	Species	Reaction/ Change in Behavior?	Init Beh State	Behav. States	Anim Hdg (mg)	Min Disp (BL)	Max Disp (BL)	Indiv Beh Event	Photos ?	Video ?	Comments
16-Feb	10:11:00	9	(Yes-same as above)			*same HW as above*	Change in behavior state: now SAC travel = breached twice, heading now different than last sighting at 10:02		SAC Trav	unk			breach			resighting, second sighting at 10:11 did 2 breaches, seen again underwater at 10:13 , <1.5 nm from *Russell*
16-Feb	10:13:00	9	(Yes-same as above)		0	*same HW as above*	Still SAC travel	Unk.	SAC Trav	unk			breach			resighting
16-Feb	10:20:00	9	(Yes-same as above)			*same HW as above*	Now traveling, change in behavior state from surface-active travel to travel; also change in heading		Trav	90			under-water swim			resighting
16-Feb	10:26:00	9	(Yes-same as above)			*same HW as above*	None seen, still traveling E		Trav	90			blow			resighting, blows seen, traveling E
16-Feb	10:28:27	9	(Yes-same as above)			*same HW as above*	Last seen traveling E		Trav	90			blow			resighting, traveling slowly to E underwater can see below surface of water, departed whale location at 10:33 because we had been with whale for >30 min and because did not resight a
16-Feb	11:04:00	10	No	2	0	HW	None seen	Unk.	Trav	270				No	No	seen in transit
16-Feb	11:11:00	11	No	4	0	HW	Change in Behavior State	Unk.	Trav	270			blow	No	No	seen in transit
16-Feb	11:35:00	12	No	3	0	HW	None seen	Trav	Trav	270				No	No	seen in transit
16-Feb	11:37:00	13	No	2	0	HW	None seen	Trav								seen in transit
16-Feb	11:38:00	14	No	3	0	HW	None seen	Trav								seen in transit

Appendix B (cont'd)

2009 Date	Time	Grp #	Focal Follow?	Group Size	# Calf	Species	Reaction/ Change in Behavior?	Init Beh State	Behav. States	Anim Hdg (mg)	Min Disp (BL)	Max Disp (BL)	Indiv Beh Event	Photos ?	Video ?	Comments
16-Feb	11:41:00	15		1	0	HW	None seen	SAC Trav	SAC mill							outside Lihue harbor
16-Feb	13:05:00	16	No	1	0	Unknown Balaenoptera	None seen	Unk.								
16-Feb	13:06:00	17	No	1	0	Unknown Balaenoptera	None seen	Unk.								
16-Feb	13:12:30	18	No	1	0	HW	None seen	Trav								
16-Feb	13:15:20	19	No	3	0	HW	None seen	Trav								
16-Feb	13:19:00	20	No	1	0	Unknown Balaenoptera	None seen	Trav	Trav	45						
16-Feb	16:30:52	21	No	2	0	HW	None seen	Trav	Trav	90						
16-Feb	16:32:10	22	No	1	0	HW	None seen	Trav								
16-Feb	16:34:00	23	No	2	0	HW	None seen	Trav								
16-Feb	16:35:12	24	No	1	0	HW	None seen	Trav								
16-Feb	16:39:00	25	No	1	0	HW	None seen	Trav								
17-Feb	11:41:00	26	No	1	0	HW	None seen	SA Trav	SAC Trav				breach	No	No	
17-Feb	11:45:00	27	No	1	0	HW	None seen			210				No	No	
17-Feb	11:48:00	28	No	2	0	HW	None seen	Trav		270				No	No	
17-Feb	11:52:00	29	No	1	0	HW	None seen			180				No	No	
17-Feb	11:53:00	30	No	1	0	Unknown Balaenoptera	None seen							No	No	
17-Feb	11:56:00	31	No	1	0	Unknown Balaenoptera	None seen							No	No	
17-Feb	15:11:00	32	Yes	2	1	HW	None seen initially	Trav		180	0.5	1		No	Yes	focal pod
17-Feb	15:22:00	33	No	1	0	HW	None seen initially;	SAC	Trav				breach	No	No	
17-Feb	15:23:00	34	Yes	1	0	HW	None seen initially	Mill	Trav		1	5		No	Yes	focal pod

Appendix B (cont'd)

2009 Date	Time	Grp #	Focal Follow?	Group Size	# Calf	Species	Reaction/ Change in Behavior?	Init Beh State	Behav. States	Anim Hdg (mg)	Min Disp (BL)	Max Disp (BL)	Indiv Beh Event	Photos ?	Video ?	Comments
17-Feb	15:35:00	35	No	2	0											
17-Feb	15:55:00	36	Yes	1	0	HW	None seen initially	Trav	slow Trav		0.5	1		No	Yes	focal pod,
18-Feb	7:57:00	37	No	2	0	HW	None seen	Trav			1	0		No	No	
18-Feb	8:00:00	38	No	1	0	HW	None seen							No	No	
18-Feb	8:00:00	39	No	2	0	HW	None seen	Trav		90				No	No	
18-Feb	8:01:00	40	No	2	0	HW	None seen			180				No	No	
18-Feb	8:02:00	41	No	1	0	HW	None seen			360				No	No	
18-Feb	8:02:00	42	No	2	0	HW	None seen							No	No	
18-Feb	8:03:00	43	No	1	0	HW	None seen	Trav		180				No	No	
18-Feb	8:12:00	44	No	1	0	Unknown Balaenoptera	None seen							No	No	
18-Feb	8:13:00	45	No	1	0	Unknown Balaenoptera	None seen							No	No	
18-Feb	11:40:00	46	No	1	0	Unknown Balaenoptera	None seen							No	No	
18-Feb	11:44:00	47	No	1	0	HW	None seen	SA Trav						No	No	
18-Feb	11:45:00	48	No	1	0	Unknown Balaenoptera	None seen	SA Trav						No	No	
18-Feb	13:14:00	49	No	1	0	HW	None seen			180				No	No	
18-Feb	13:26:00	50	No	2	0	HW	None seen			90				No	No	
18-Feb	14:36:00	51	Yes	1	0	Unknown Balaenoptera	None seen							No	No	focal pod
18-Feb	14:39:00	52	Yes	2	0	HW	None seen	Trav		90				No	Yes	focal pod

Appendix B (cont'd)

2009 Date	Time	Grp #	Focal Follow?	Group Size	# Calf	Species	Reaction/ Change in Behavior?	Init Beh State	Behav. States	Anim Hdg (mg)	Min Disp (BL)	Max Disp (BL)	Indiv Beh Event	Photos ?	Video ?	Comments
18-Feb	14:39:30	53	Yes	2	0	HW	None seen	Trav	Trav	0	1	2		No	Yes	Did focal and video on pair of adult humpbacks off Kekaha in lee; circled at 1500 ft alt and ~1 km radial distance; this pod affiliated with the single hw sighting 19 and sighting 18 and formed a competitive group of 5 adults; video taped this group and did focal session; circled at 1500 ft and radial distance ~1 km
18-Feb	14:40:00	54	Yes	2	0	HW	None seen	Trav	Trav	0				No	Yes	short focal session
18-Feb	14:42:00	55	Yes	1	0	HW	None seen	Trav	Trav	270				No	Yes	single humpback near focal humpback of two whales that appeared to affiliate with our focal 2 whales sighting 17
18-Feb	15:00:00	56	Yes	2	1	HW	None seen	Trav	Trav		0.5	1			Yes	focal pod of mother calf, vessel stopped to watch for short period, N of Kekaha in lee, circled at 1500 ft alt and ~1 km radial distance
19-Feb	8:38:00	57	No	1	0	Unknown Balaenoptera	None seen	SA Trav		0	0	0	breach	No	No	
19-Feb	8:41:00	58	No	2	0	HW	None seen			90	1	1		No	No	
19-Feb	8:42:00	59	No	1	0	HW	None seen			90	0	0		No	No	
19-Feb	8:46:00	60	No	1	0	Unknown Balaenoptera	None seen			0	0	0		No	No	
19-Feb	8:47:00	61	No	1	0	HW	None seen			200	0	0		No	No	
19-Feb	9:00:00	62	Yes	1	0	HW	None seen	Trav		270	0	0		No	No	focal pod; initially sighted by Russell observers then we followed it

Appendix B (cont'd)

2009 Date	Time	Grp #	Focal Follow?	Group Size	# Calf	Species	Reaction/ Change in Behavior?	Init Beh State	Behav. States	Anim Hdg (mg)	Min Disp (BL)	Max Disp (BL)	Indiv Beh Event	Photos ?	Video ?	Comments
19-Feb	9:27:00	63	Yes	3	0	HW	Changed respiration rate (fewer blows per surfacing), dive time, and behavior state and heading as two large Navy vessels approached then passed them			variab.				No	Yes	focals and videotaped
19-Feb	9:34:00	64	No	1	0	HW	None seen						SS			seen while w/focal 6
19-Feb	10:43:00	65	Yes	3	0	HW	Changed behavior state		SAC, social, competitive, Trav, SAC Trav					No	Yes	focals & videotaped
19-Feb	10:50:00	66	No	1	0	Unid Dolphin, Prob Bottlenose	None		Trav, mill with humpbacks in Pod 9 <1 whale BL from humpbacks					No	Yes	this light-colored probable bottlenose dolphin was seen with we believe the 2 humpbacks whales of Pod 9 briefly as we were leaving to rejoin the Russell.
19-Feb	10:58:00	67	Yes	4	0	HW	Changes in behavior state and heading		SAC, social, competitive, Trav, SAC Trav					Yes	Yes	focal pod: circled at 1500 ft al & ~1 km radial distance
19-Feb	11:29:00	68	Yes	1	0	HW	Unknown		Trav, social					No	Unk.	this humpback appeared to affiliate with Pod 11 to make a total group size of 5 adult humpbacks