

APPENDIX E RIMPAC PAM Deployment and Vessel-Based Monitoring Survey

PASSIVE ACOUSTIC MONITOR DEPLOYMENT
AND SMALL VESSEL-BASED MONITORING SURVEYS,
17-15 JULY 2010
FINAL REPORT



Hawaii Range Complex, 2010; NOAA permit #14451

15 SEPTEMBER 2010

ACRONYMS AND ABBREVIATIONS

ASW	anti-submarine warfare
EAR	ecological acoustic recorder
ESA	Endangered Species Act
ft	foot
HDR e ² M	engineering-environmental Management, Inc., an HDR company
HIMB	Hawai'i Institute of Marine Biology
HRC	Hawaii Range Complex
kHz	kilohertz
km	kilometer(s)
m	meter(s)
MMPA	Marine Mammal Protection Act
nm	nautical mile(s)
NOAA	National Oceanic and Atmospheric Administration
PAM	passive acoustic monitor
RIMPAC	Rim of the Pacific
SPUE	sightings per unit effort
W-186	Warning Area 186
XBT	expendable bathythermograph

Section 1 Introduction

During 23 June through 1 August 2010, the 22nd Rim of the Pacific (RIMPAC 2010) exercise was conducted in the Hawaii Range Complex (HRC). RIMPAC is a biennial, multinational exercise designed to strengthen regional partnerships and improve interoperability. It is an exercise designed to bring multinational military assets together to train towards bettering the Navy's capabilities. Anti-submarine warfare (ASW) was the exercise's main feature.

As part of compliance requirements with the Marine Mammal Protection Act (MMPA) of 1972 and the Endangered Species Act (ESA) of 1973, the Navy developed the HRC Monitoring Plan to provide marine mammal and sea turtle monitoring (DoN 2008). In order to effectively meet the goals outlined in this Plan, it was determined that one example of training events recommended for monitoring should contain one or more surface combatants conducting ASW during a regularly scheduled training event. Research elements of that Plan include visual surveys and passive acoustic monitoring.

The results of marine mammal monitoring reported here for RIMPAC 2010 represent the first monitoring effort under the U.S. Navy's Marine Species Monitoring Program (Contract # N62470-10-D-3011) issued to engineering-environmental Management, Inc., an HDR company (HDR|e²M).

The monitoring effort for RIMPAC 2010 consisted of the following:

- Vessel-based line transect surveys to assess the diversity, distribution, and behavior of target species (e.g., marine mammals and sea turtles)
- Installation of one shallow- and one deep-water passive acoustic monitors (PAMs) in waters off Ni'ihau.

Section 2 Methods

Study Area

The Navy's Hawaiian Islands Operating Area includes the eight main Hawaiian Islands, as well as Kaua'i and Ni'ihau. Protected marine species monitoring for RIMPAC 2010 focused in Warning Area 186 (W-186), which spans waters south of Kaua'i and Ni'ihau (see **Figure 1**). Bottom depth in W-186 ranges from 100 to 4,000 meters (m) (328 to 13,123 feet [ft]). Kaulakahi Channel is a 15-nautical mile (nm) (28-kilometer [km])-wide channel between Kaua'i and Ni'ihau.

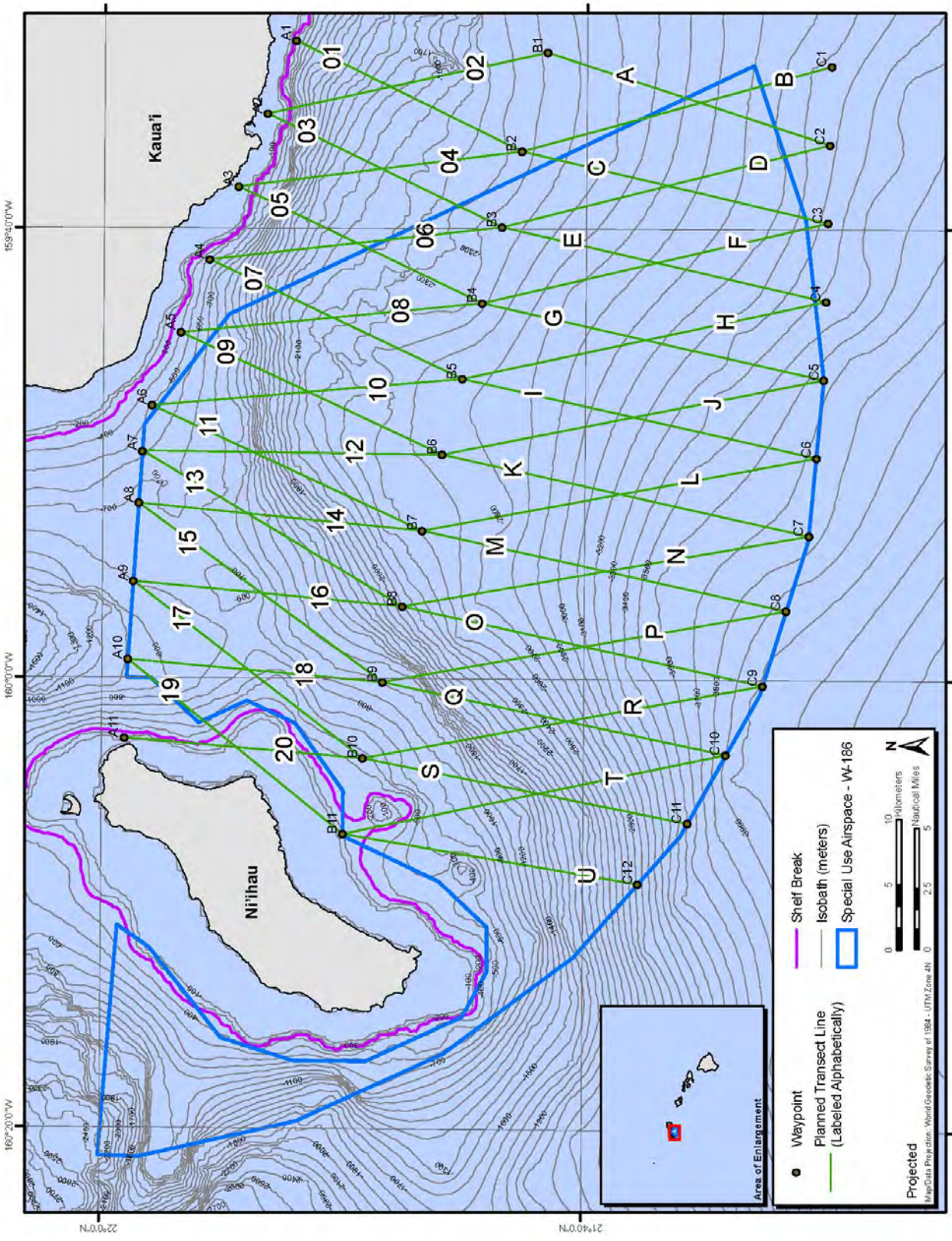


Figure 1. Predetermined Tracklines for the Survey Effort for RIMPAC 2010

Vessel-Based Monitoring

Vessel-based monitoring effort was performed over an 8-day period from 18 through 25 July 2010 (see **Tables 1** and **2**). Survey methods were consistent with current accepted Distance Sampling theory (Buckland et al. 2001) and similar to those used in an earlier RIMPAC (RIMPAC 2008) vessel-based monitoring effort (Smultea 2008).

Table 1. Summary of RIMPAC 2010 Monitoring Effort

Date	Description	Time Out *	Time In *	Total Hours
July 18	Transect survey	0700	1500	8
July 19	Transect survey	0630	1430	8
July 20	Transect survey	0600	1230	6.5
July 21	Transect survey	0600	1600	10
July 22	Transect survey	0630	1300	6.5
July 23	Transect survey	0530	1330	8
July 24	Transect survey	0530	1500	9.5
July 25	Transect survey	0530	1500	9.5
Total				66.0

Table 2. Summary of RIMPAC Monitoring Effort by Trackline Coverage

Date	On-Effort nm (km)	Off-Effort nm (km)	Total Daily Effort nm (km)
18 July	23.19 (42.98)	1.45 (2.68)	24.64 (45.66)
19 July	36.58 (67.79)	9.57 (17.74)	46.15 (85.52)
20 July	23.71 (43.94)	0.64 (1.19)	24.35 (45.13)
21 July	66.26 (122.80)	8.74 (16.19)	75.00 (138.99)
22 July	26.65 (49.39)	6.88 (12.75)	33.53 (62.13)
23 July	45.01 (83.41)	7.35 (13.62)	52.35 (97.03)
24 July	33.12 (61.38)	24.06 (44.58)	57.17 (105.96)
25 July	74.31 (137.72)	4.78 (8.86)	79.09 (146.58)
Totals	328.82 (609.39)	63.46 (117.60)	392.28 (726.99)

The observation platform for the 8-day period was a 38-ft (11.6 m) Bertram charter vessel, the *Kai Bear*, operated out of Port Allen Harbor located on the south-central shore of Kaua'i. The ship went into harbor every night. Survey effort was based on three tiers of equally spaced waypoints approximately 5 km (2.7 nm) apart so that effort was stratified into a nearshore area and an offshore area (see **Figure 1**). Stratification was used to allow for shorter transect lines during higher sea states, thereby allowing greater survey effort. Sawtooth transect lines were used to connect the waypoints, with choice of lines dependent upon prevailing weather conditions. When Beaufort sea state reached 6 or higher, effort was curtailed and the survey vessel returned to harbor.

All six marine mammal observers (see **Table 3**) were experienced with line-transect survey methodology; had experience in identification of subtropical Pacific marine mammal and sea turtle species; were knowledgeable of marine mammal biology and behavior; and had previous experience conducting marine mammal observations from vessels. Each observer rotated through three stations at 30-minute intervals: left observer, data recorder, and right observer, followed by a 1.5-hour rest break. Observers scanned from directly in front to 90 degrees on each side using 7x reticled binoculars or naked eye (when ocean swells rendered hand-held binoculars impractical). When a sighting occurred, the observer noted the approximate horizontal angle to the sighting and the number of reticles down from the horizon as well as the sighting cue. The number of corresponding to the reticle was used to calculate the distance to the animal based on the height of the platform (4 m; 13 ft). These were recorded by the data recorder using WinCruz software (available from the National Oceanic and Atmospheric Administration [NOAA]) and on data sheets. Species identity and diagnostic cues were also recorded and digital photographs obtained when possible. Once a sighting occurred, all three observers on duty were assigned the task of projecting independent estimates of group composition using a minimum, maximum, and best estimate approach. The average of the “best” estimates from the three observer team was then recorded for group size.

Table 3. Observers and Roles

Observer	Role(s)
Greg Fulling	Chief Scientist / Observer
Joe Mobley	Survey Coordinator / Observer
Michael Richlen	Observer / PAM deployment
Alexis Rudd	Observer / PAM deployment
Jeff Foster	Observer
Aliza Milette	Observer

The expendable bathythermograph (XBT) device did not function properly; therefore, no temperature profile for the water column could be collected.

Passive Acoustic Monitor (PAM) Deployments

Two PAM deployments were made during 12 hours of monitoring effort on July 17 in the vicinity of the island of Ni‘ihau (see **Table 4** and **Figure 1**). The two PAMs were ecological acoustic recorders (EARs; Lammers et al. 2008), designed by Whitlow Au of the Hawai‘i Institute of Marine Biology (HIMB). Both PAMs were hand-deployed from the *Kai Bear*: one PAM in shallow water (17 m; 56 ft) and one in deep water (732 m; 2,402 ft). The duty cycle on both EARs were set to record every 300 seconds for 30-second sampling durations at a sampling rate of 80 kilohertz (kHz). The original plan is that EARs will be

retrieved for downloading of acoustic data during the timeframe of September–October 2010.

Table 4. Summary of PAM (EAR) Deployments

EAR location	Depth (m)	Date Deployed	Sampling Rate	Latitude	Longitude
Shallow-water, South Ni'ihau	17	7/17/2010	80 kHz	21° 47.306'N	160° 11.964'W
Deep-water, North Ni'ihau	732	7/17/2010	80 kHz	21° 59.613'N	160° 12.167'W

Section 3 Results

Survey effort

Observers visually surveyed 392.28 nm (726.99 km) of trackline during 8 days for a total of approximately 66 hours during the RIMPAC 2010 survey. Beaufort sea states ranged from 1 to 6 and followed a trend of building from low sea state to high by mid-day, this forced survey effort to typically end in the early afternoon due to concerns for observer safety. All sightings were made in Beaufort sea states between 2 and 5 (see **Table 5**). Sightings per unit effort (SPUE) were calculated as the total number of marine mammal sightings divided by the total effort (hours/nm/km). For this monitoring exercise, the SPUE was equal to 1 sighting per 7.34 hours, 43.59 nm, and 80.78 km.

Sightings

Nine marine mammal sightings were recorded during approximately 66 hours of effort (see **Table 5** and **Figure 2**). No sea turtles were sighted during the entire survey. Marine mammal sightings consisted of three groups of short-finned pilot whales (*Globicephala macrorhynchus*); two groups of spinner dolphins (*Stenella longirostris*); one mixed-species aggregation of spinner dolphins with pilot whales; one group of rough-toothed dolphins (*Steno bredanensis*); a single Hawaiian monk seal (*Monachus schauinslandi*); and one sighting of unidentified cetaceans (see **Figure 2** and **Table 5**).

Behavior

No evidence of distress or unusual behavior was observed during this RIMPAC monitoring effort. The team was able to conduct two focal follows of pilot whales, both on 21 July (Sightings 5 and 6). The first focal follow was a period of 20 minutes spent with 13 individuals, while the other was 45 minutes with 70 individuals. Detailed behavioral observations made during the focal follows are presented in **Appendix A**. Photographs of suitable quality for photo-identification purposes were collected during focal follows.

PAMs

As noted earlier, PAMs were deployed as close to the original position as possible (see **Figure 1**). Depth and slope of the area necessitated minor position changes (see **Figure 2**). The original plan is that the EARs will be retrieved during the timeframe of September–October 2010 to download collected acoustic data.

Table 5. Summary of Sightings for RIMPAC 2010

Sighting No.	Date	Species	Group Size Best/High/Low			Calves	Time	Beaufort Sea State	Latitude	Longitude	Bottom Depth (m)	Behavioral Summary
1	7/19/10	SL	17	15	20	-	07:08	3	21° 53.66'N	159° 35.41'W	100	Slow travel; no calves
2	7/19/10	Unid	2	2	2	-	10:14	2	21° 52.76'N	159° 39.04'W	1,000	(large splashes seen; no resight)
3	7/19/10	GM/SL	16	20	14	-	11:05	5	21° 51.21'N	159° 39.40'W	1,200	Milling, slow travel; during mid-observation period saw SL likely traveling with GM, but difficult to track animals due to conditions. SL within 10 m of GM
4	7/20/10	GM	1	1	1	-	08:26	2	21° 52.91'N	159° 49.16'W	1,200	Fast travel with quick 180-degree turn; possibly chasing prey
5	7/21/10	GM	14	16	10	2-3	07:31	3	21° 42.78'N	159° 35.41'W	1,700	Focal follow details in Appendix A. Somewhat spread out; slow travel and logging; animals spread out then coalesced, though not tightly; 2-3 calves; stayed with group for 20 mins with no change in behavior
6	7/21/10	GM	64	86	49	2-3	13:28	3	21° 49.48'N	159° 45.85'W	2,400	Focal follow details in Appendix A. Slow travel; turned into 3 large groups; approached boat; several spyhopped; rolled and fluke slapped; stayed with group for approximately 45 mins
7	7/22/10	SL	8	10	5	-	06:23	3	21° 53.64'N	159° 35.58'W	100	Observed when leaving harbor; traveling in clumps, some surface active others traveling different speeds; approached boat briefly

Sighting No.	Date	Species	Group Size			Calves	Time	Beaufort Sea State	Latitude	Longitude	Bottom Depth (m)	Behavioral Summary
			Best	High	Low							
8	7/23/10	SB	9	16	6	-	08:49	3	21° 54.21'N	159° 51.46'W	900	Very spread apart in deep water; several individuals approached boat; no more than 2 seen in a given subgroup
9	7/24/10	MS	1	1	1	-	12:09	3	21° 54.06'N	159° 54.86'W	800	Individual swimming

Key:

GM = short-finned pilot whale (*Globicephala macrorhynchus*)

GM/SL = mixed-species aggregation of short-finned pilot whale and spinner dolphin

MS = Hawaiian monk seal (*Monachus schauinslandi*)SB = rough-toothed dolphin (*Steno bredanensis*)SL = spinner dolphin (*Stenella longirostris*)

Unid = unidentified cetacean

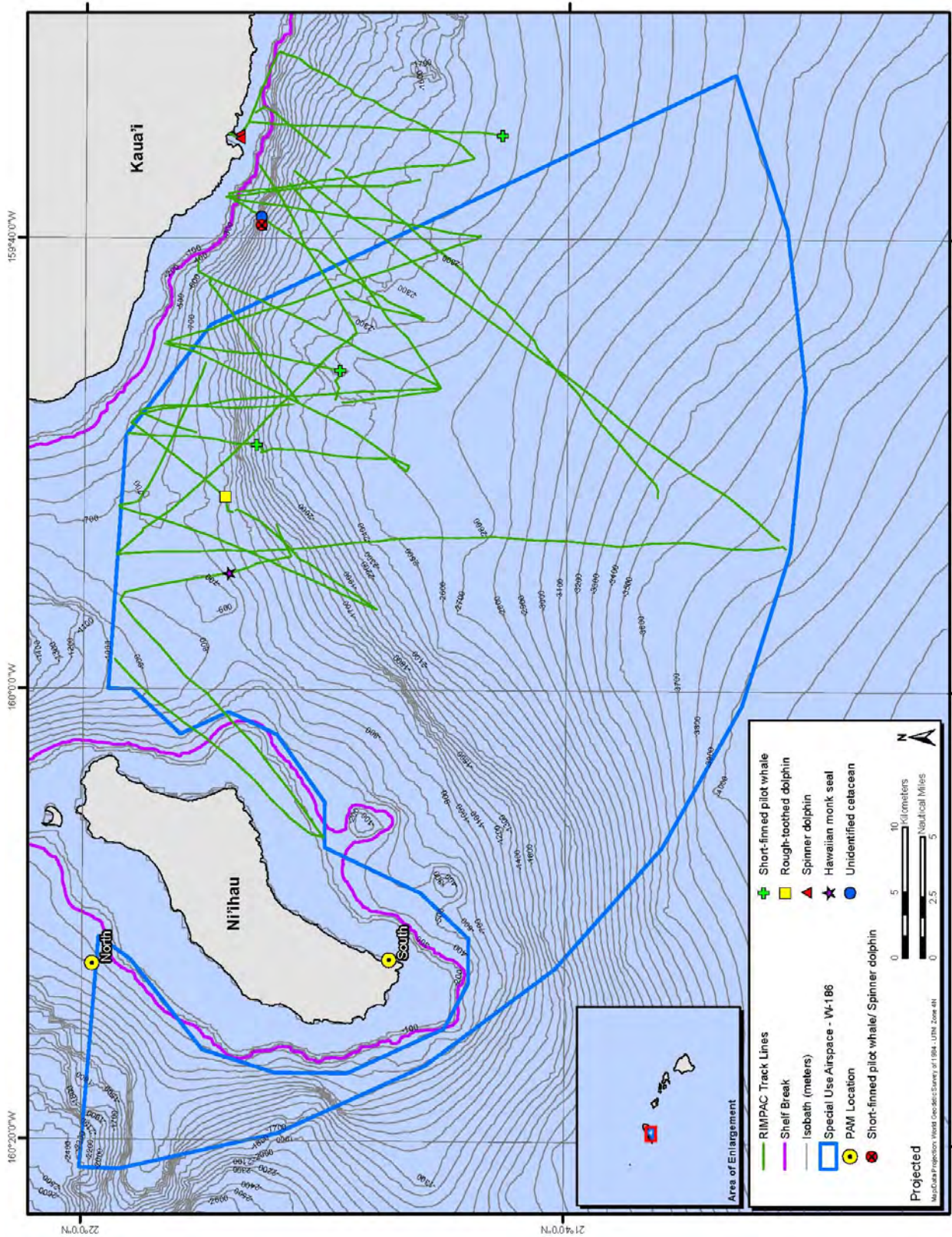


Figure 2. Location of PAMs and Marine Mammal Sightings

Section 4 Recommendations

1. Sea states combined with use of a small vessel precluded surveys of the offshore waters. For future monitoring efforts, we suggest either using a larger vessel with live-aboard capabilities or flying aerial surveys. Aerial surveys would allow greater success for sighting sea turtles. Use of a live-aboard vessel provides two major advantages over a small vessel:
 - a. A live-aboard ship is capable of having mounted Big Eye binoculars. Use of Big Eyes would have allowed greater visibility not available on the smaller survey vessel. Hand-held binoculars were not effective in the high sea states due to lack of stability.
 - b. The observation team could have surveyed offshore regions during early morning hours, when the sea states were more calm (as noted earlier, sea conditions worsen throughout the day) and worked in the near-shore waters, in the lee of the island (where there is protection from winds and rough sea states) in the afternoon.
2. The Navy has a safety requirement of a 30-day lead time for review of dive plan. Because this project was developed on a short time frame, this requirement obviated the deployment of the shallow-water PAM by divers. Hand deployment of the shallow-water PAM was successful, but in shallower water than anticipated, to allow confirmation of substrate and to allow retrieval by divers in the future.
3. Future surveys may benefit from use of a directional hydrophone on the vessel to potentially increase the number of focal follows. This method would allow greater use of time periods when winds are calm and sighting conditions are more optimal, to possibly visually locate those animals detected acoustically.
4. When this task order was created, the contract between HDR|e²M was recently established; this short time frame allowed little time for pre-planning the field work. Although the work for this Task Order was accomplished, the challenges of executing the survey using limited options highlights the need for as long a timeframe as possible between notification by the Navy and implementation of the monitoring efforts (in this case, the vessel survey and PAM placement).
5. Future monitoring events would be enhanced with the addition of satellite tagging surveys 2-3 months in advance of the vessel survey. This will allow more opportunity to establish movement patterns of the animals in the region before, during, and after the training exercise per the goals of the HRC Monitoring Plan.

Section 5 Acknowledgements

We would like to thank Captain Frank Chaney of the *Kai Bear*, and the ship's deckhand, Chance Dean, for their able assistance during this survey effort. These data were obtained under NOAA permit no. 14451 issued to Joseph R. Mobley, Jr., Ph.D.

Section 6 Literature Cited

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Appendix A

Focal Follow Data

Table A-1 shows the focal follow behavioral data from the RIMPAC 2010 monitoring efforts. The two focal follow events were conducted on 21 July 2010; both were of groups of short-finned pilot whales (*Globicephala macrorhynchus*).

Table A-1. Focal Follow Behavior Data

Record Number	Time	Date	Latitude	Longitude	Recorded Behavior
Sighting Number 5					
<i>Species: Globicephala macrorhynchus</i>					
1	73738	72110	N21:42.57	W159:35.61	Animals slow travel and logging at surface - group was initially spread out and seems to be coming closer together
2	73958	72110	N21:42.55	W159:35.72	Animals coming within 20m of vessel with little to no reaction
3	74219	72110	N21:42.53	W159:35.84	At least 2-3 calves - no change in behavior - still slow travel - logging at surface
4	74740	72110	N21:42.47	W159:36.11	Tail slapping from smaller animal
5	75213	72110	N21:42.44	W159:36.30	Stayed with group ~20 mins with no change in behavior - leaving group to go back to transect
Sighting Number 6					
<i>Species: Globicephala macrorhynchus</i>					
1	133424	72110	N21:49.49	W159:46.01	Initial behavior is slow travel
2	133442	72110	N21:49.49	W159:46.02	Clumping together and milling
3	133828	72110	N21:49.46	W159:46.10	Direction change
4	134048	72110	N21:49.50	W159:46.12	2-3 individuals broke off main group
5	134254	72110	N21:49.55	W159:46.16	Animals spread out, 1 bigger, loose group and some further out
6	134436	72110	N21:49.60	W159:46.23	Turned 180 degrees
7	134626	72110	N21:49.61	W159:46.27	Groups are spread out again
8	134919	72110	N21:49.64	W159:46.27	3 animals diving
9	135020	72110	N21:49.66	W159:46.30	One animal tail slap and roll by boat
10	135118	72110	N21:49.65	W159:46.32	Overall behavior: started out slow travel, changed to milling
11	140156	72110	N21:49.51	W159:46.65	Most dove at 13:50 and then came back up at 14:01
12	140908	72110	N21:49.57	W159:46.82	Navy ship coming through Ni'ihau- Kaua'i Channel
13	140932	72110	N21:49.58	W159:46.83	Pilot whales dispersing
14	141112	72110	N21:49.59	W159:46.87	Socializing
15	141403	72110	N21:49.58	W159:46.96	End sighting
16	141915	72110	N21:49.65	W159:47.12	Animals last seen doing fast travel