Final Report

**Analysis of Historical Passive Acoustic Monitoring Recordings in
Hawaii Range Complex**

by

Whitlow W. L. Au, Ph.D.
Maria Andujar Applied
Research Laboratory At the
University of Hawaii
&
Hawaii Institute of Marine Biology
P.O. Box 1106
Kailua, HI 96734

Julie N. Oswald, Ph.D.
Bio-waves Inc.
517 Cornish Drive
Encinitas, CA 92024

Submitted to

July 11, 2011

Introduction

Ecological acoustic recorders (EARs) have been deployed around the islands of Oahu and Kauai in a project sponsored by the Office of Naval Research. Detailed information on the EAR was published by Lammers et al. (2008). EARs have been deployed from February, 2009 to the present time around Oahu and from February, 2009 until April, 2011 around Kauai. From April, 2011 four EARs in the waters of Kauai have been deployed along the southern coast starting at the SW locations shown in Figure 1 and extending towards the SE location, spaced approximately 5 miles apart and moored at a depth of approximately 750 m.
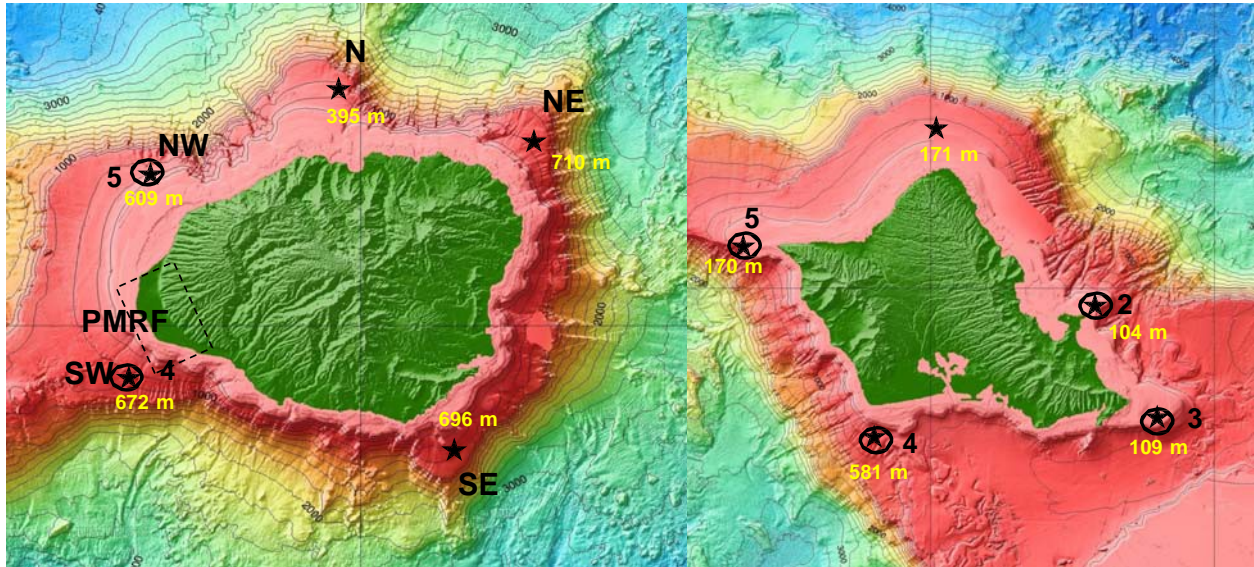

Figure 1. Approximate locations of EARs (shown as stars) deployed around Kauai and Oahu as a part of an ONR program to monitor marine mammals in high Navy activity locations in the Hawaii Range Complex. The circled stars are EARs in which data during specified times were analyze. The number next to the circled stars correspond to the numbers in Table 2.

The specific GPS locations of the circled EARs shown in Figure 1, along with the depth of the EARs are given in Table 1. The EARs around Oahu were deployed at relatively shallow depths except for the one off Barber's Point which was at 581 m. All the Oahu EARs operated at a data acquisition rate of 64 kHz and had a duty cycle of 30 seconds on every 5 minutes. The EARs around Kauai were deployed in deeper waters and operated at a data acquisition rate of 80 kHz and had the same turn-on and sleep duty cycle as the EARs off Oahu. The depth and sample rate has a bearing on what animals will likely be detected. Deep diving odontocetes that use their biosonar to forage on prey will not be detected by EARs in shallow waters. Baleen whales with the exception of humpback whales are not likely to be detected by sensors in shallow waters. Whistle signals used by dolphins would be more difficult to detect for EARs in deep waters. For deep diving echolocators, the higher the sample rate the more likely that some of them could be identify to species. For that reason, a sample rate of 80 kHz was chosen to be used off Kauai. The deep EAR off Kauai should probably have used an 80 kHz sample rate, but that would mean a shorter deployment time compared to the other EARs in shallow water off Oahu. Therefore, a trade-off had to be made.

Acoustic data recorded by EARs deployed at various locations (see Table 2) around the island of Oahu and Kauai were analyzed for various type of sounds including ambient noise, boat sounds, mid-frequency sonar emissions, dolphins and whales. These locations and dates were chosen by personnel of the Naval Facilities Engineering Command, Pearl Harbor, Hawaii.

Table 1. Location and depth of the circled EARs shown in Figure 1.

Oahu			
Kaena Point	21.34.091 N	158.19.883 W	170 m
Barbers Point	21.13.656 N	158.05.391 W	581 m
Makapuu	21.17.703 N	157.33.362 W	109 m
Mokapu	21.28.946 N	157.41.280 W	104 m
Kauai			
SW	21 55.973 N	159 47.556 W	672 m
NW	22 11.221 N	159 50.298 W	609 m

Table 2. Historical EAR data

Oahu Locations	Dates of Historical Training Events	Priority
2 - Mokapu	3-4 October 2009	1
3 – Makapuu	23 August 2009	1
	2-4 October 2009	3
4 – Barber's Pt.	9 & 18 February 2010	2
	30-31 March 2010	2
5 – Kaena Pt.	17-18 November 2009	1
	18 February 2010	2
Kauai Locations	Dates of Historical Training Events	Priority
4 SW	16-19 February 2009	1
	5 May 2009	2
5 NW	16-19 February 2009	1
	27-29 August 2009	1
	13, 18, & 21 September 2009	1
	17-19 February 2010	1

Approach

1. Example Spectrograms

Various software were used to analyze the acoustic data. These include the long term spectrogram algorithm (LTSA) developed at Scripps Oceanographic Institute (UCSD), the real time odotonocete call classification algorithm (ROCCA) developed by Oswald et al. (2007) and custom **Matlab** programs developed at the Hawaii Institute of Marine Biology. ROCCA is the most advanced algorithm for classifying dolphin phonation, however, it only operate on whistles.
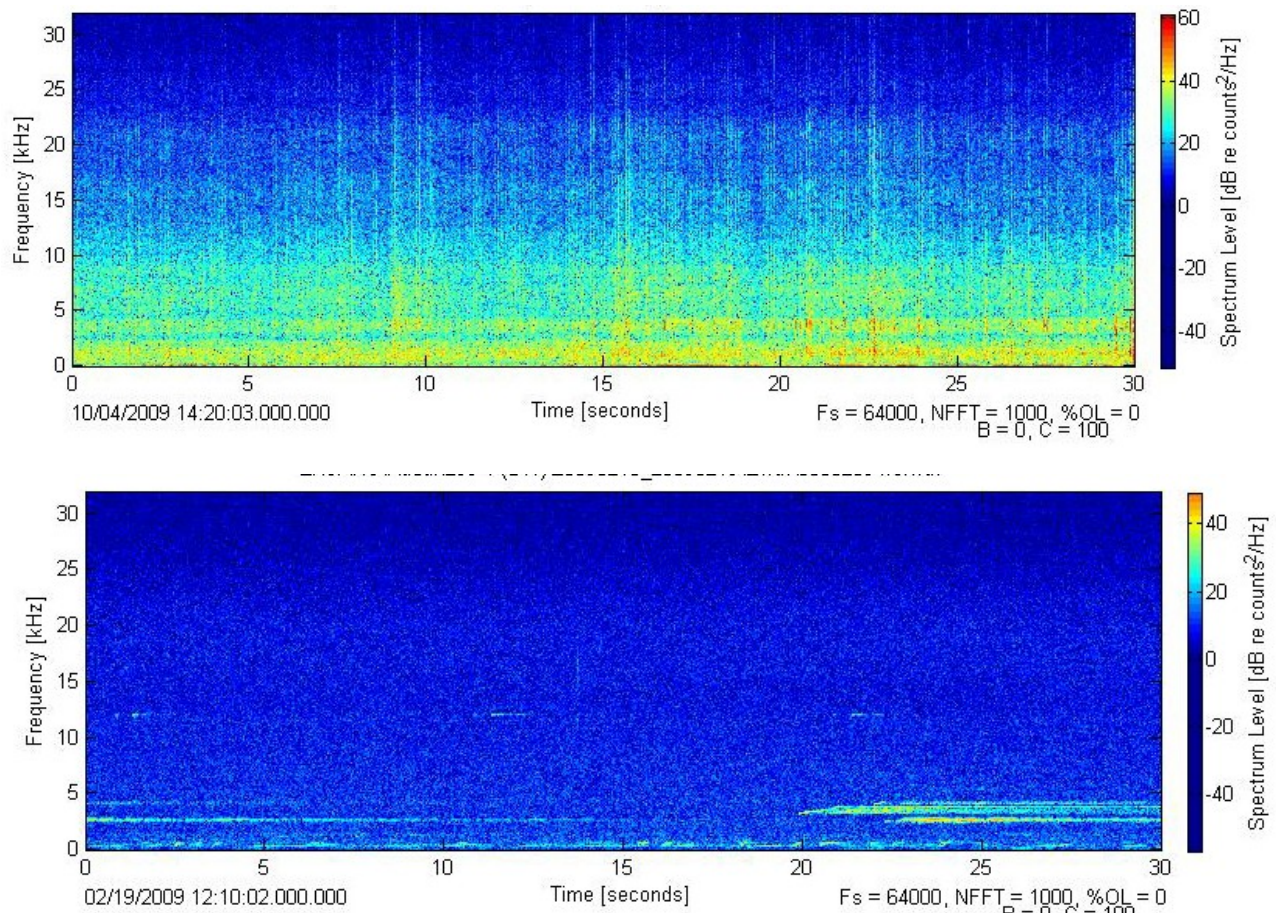

Figure 2. Top panel: Example of a boat passing by an EAR, bottom panel: Example of a mid-frequency transmission.

Examples of spectrograms for a boat passing close to an EAR and a mid-frequency sonar transmission are shown in Figure 2. The boat sound is represented by the broad fundamental band across the spectrogram at about 2 kHz with a second harmonic at about 4 kHz and a third harmonic at about 6 kHz. The mid-frequency sonar emission has several narrow bands between 2.5 and 4 kHz. The sonar signal may have been emitted by AN/SQS-53 mid-frequency sonar on a Naval destroyer or cruiser. This signal was recorded by the EAR at the SW location off Kauai (see Figure 1).

Dolphin whistles recorded in the Hawaiian Islands tend to be separable by the frequency range of the whistles. ROCCA can classify whistles produced by 9 dolphin species that frequent Hawaiian waters. These are spinner dolphins (*Stenella longirostris*), pan-tropical spotted dolphins (*Stenella attenuata*), melon-headed whales (*Peponocephala electra*), common dolphins (*Delphinus delphis*), rough toothed dolphins (*Steno bredanensis*) which tend to emit whisles with components above 12 kHz ("high frequency" dolphins). Also included are short-finned pilot whales (*Globicephala macrorhynchus*), false killer whales (*Pseudorca crassidens*), and Pacific bottlenose dolphins (*Tursiops gilli*) which tend to emit whistles with frequency components below 12 kHz ("low frequency" dolphins). However, *T. truncatus* can also produce whistles with components above 12 kHz. Examples of whistles produced by "high-frequency" dolphins are shown in the top panel of Figure 3, and for "low-frequency" dolphins in the bottle panel of Figure 3.
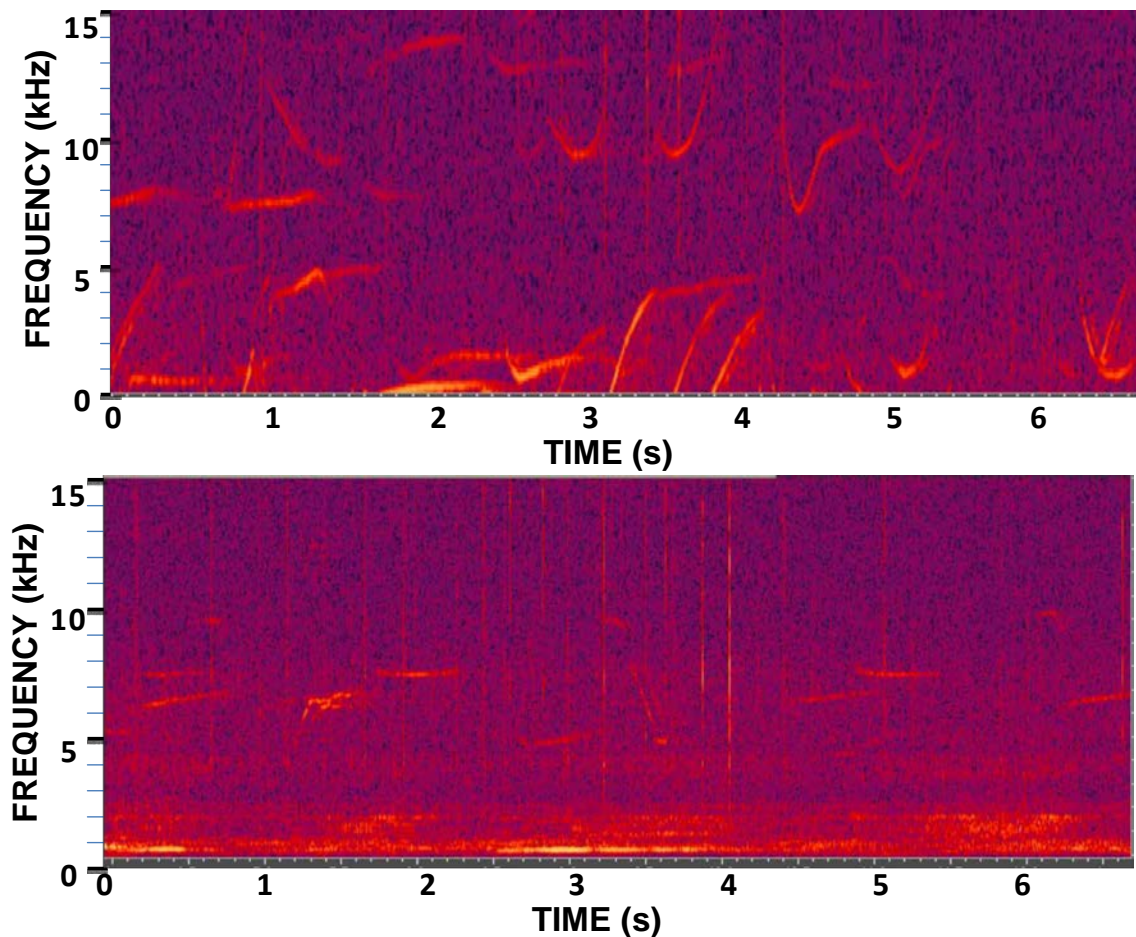

Figure 3. Top panel: An example of high-frequency whistles. Although there are some lower frequency components below 12 kHz, the high frequency fm-sounds are also clearly present. Bottom panel: An example of some low-frequency whistles. These tend to be more tonal with very little frequency modulation and are usually below 12 kHz.

2. Brief Description of ROCCA (Real-Time Odontocete Call Classification Algorithm)

ROCCA is a computer algorithm that classifies 9 species of odontocetes based on characteristics of received whistle signals. This algorithm was developed by Julie Oswald as part of her Ph.D. dissertation at Scripps Institution of Oceanography (Oswald et al., 2003, 2007) and is the only algorithm for multi-species identification of dolphins based on their whistles. The characteristics of a dolphin whistle are determined by computing the spectrogram of the signal which provides the instantaneous frequency of the signal as a function of time. The time-frequency contour of the whistle is then extracted from the spectrogram and various features are extracted from the contour. Some of these features include: the starting, ending, minimum, maximum, center frequencies, time of the peak frequency, number of steps (discontinuities), duration of the signal, number of inflection points and so on. Up to fifty six different parameters are used by ROCCA to characterize a whistle signal. A library of signal characteristics from different dolphin species is then constructed and used to determine the identity of any recently detected whistles (Oswald et al., 2003, 2007). An extensive library of dolphin whistles collected during many Southwest Fisheries Science Center cruises in the Pacific over a minimum of 10 years is a part of ROCCA. All the library signals are ground-truth by visual observation of the sound producing animals, and that is perhaps one of the most important features of the ROCCA library.

When a new whistle signal is input to ROCCA the characteristics of the signal are extracted and compared with characteristics of signals in the library. The original version of ROCCA used a multivariate discriminate function analysis (DFA) and a classification and regression tree analysis (CART). The latest version uses a Random Forest analysis which has significantly increased the classification accuracy (Oswald et al., 2011). A Random Forest analysis is an extension of CART in which many decision trees are used with the order and position of the 56 parameters randomly assigned for each tree. We used 800 decision trees with each providing a "vote" on the specie producing a given whistle sound. Although the performance of ROCCA is not perfect, the results are significantly better than chance and it is the best available analysis program at this time. The effectiveness of ROCCA in classifying dolphins based on their whistles can be seen in the confusion matrix of table 3. The best performance was for the false killer whale where the classification accuracy was 70%, while the worst performance was with spinner dolphins where the classification accuracy was 20%, still above the 12.5% chance level. It is also important to note that striped dolphin, spotted dolphin and spinner dolphin whistles (dolphins from the genus *Stenella*) are often misclassified as being produced by short-finned common dolphins. In this study, we eventually excluded the short-finned common dolphins as a possible specie because they are not typically sighted in Hawaiian waters. One of the major reasons for classification inaccuracy is the wide variability in the characteristics of whistles from smaller dolphins and the overlap in frequencies used by these species.

3. Acoustic Events

Acoustic events were identified by manually and visually examining the data using the long-term spectrogram algorithm (LTSA). A number of files over consecutive time periods of interest are concatenated and then the long term spectrogram is perused to find areas containing

acoustic energy. The operator then zooms in on those areas and if dolphin whistles are found they are saved in a separate file for further analysis. The characteristics of the whistles are determined using another algorithm developed at HIMB to determine the parameters of each whistles. These parameters are then run through ROCCA for species identification. Not all dolphin whistles are identifiable using ROCCA and those sounds are merely stated as "dolphins". Boat and sonar occurrence are notated as to time of the events.

Table3. Confusion matrices in percentages for individual whistles. Percent of whistles correctly classified are in bold. Eight-species random forest model consists of 800 trees and 56 variables. Chance performance is 12.5% (from Oswald et al. 2011).

	% classified as								
	Bottlenose dolphin	Short-beaked common dolphin	False killer whale	Spotted dolphin	Pilot whale	Rough-toothed dolphin	Striped dolphin	Spinner dolphin	n
Bottlenose dolphin	**51**	4	3	20	2	7	5	8	74
S-Beaked common dolphin	8	**40**	2	11	0	11	7	21	63
F-killer whale	1	2	**70**	0	21	4	0	2	98
Spotted dolphin	16	20	3	**42**	0	1	4	14	81
Pilot whale	1	1	49	1	**37**	3	5	3	98
Rough-toothed dolphin	3	3	13	0	10	**65**	3	3	68
Striped dolphin	0	18	3	5	0	6	**58**	10	73
Spinner dolphin	12	18	5	17	3	12	13	**20**	76

Results

1. Acoustic Detections

Spreadsheets indicating the type of events noted in the EAR records are included as appendices in Table A1 to A11. (The first column of each spreadsheet indicate file name of files containing either dolphin whistles or biosonar clicks. The second and third columns indicate the type of dolphin sounds, either whistles or clicks. The fourth column indicates the start and stop times of boat and mid-frequency sonar emissions given in local time (Hawaiian Standard Time, GMT -10). The various spreadsheets are found in the following tables:

Table A1 Mokapu, October 3-4, 2009
Table A2 Makapuu, August 23, 2009
Table A3 Makapuu, October 2-4, 2009
Table A4 Barber's Point, February 9, 2010
Table A5 Barber's Point, February 18, 2010
Table A6 Barber's Point, March 30-31, 2010
Table A7 Kaena Point, November 17-18, 2009
Table A8 Kaena Point, February 18, 2010
Table A9 Kauai Location 4 (SW), February 16-19, 2009
Table A10 Kauai, Location 4 (SW), May 5, 2009
Table A11 Kauai, Location 5 (NW), September 13-21, 2009
Table A12 Humpback whale detections on Oahu and Kauai

Acoustic events were categorized as boat sounds, sonar emission, biosonar (which are echolocation clicks emitted by odontocetes), dolphin whistles plus biosonar emissions and whistles only. In the information given below, the local time of occurrence of each type of events is listed along side the designation of the events were extracted from Tables A1-A11. The information in Tables A1-A11 is summarized in Table 4. Not much emphasis was placed on humpback whales since in the winter months they are everywhere and constitute more of an acoustic interference in detecting other more interesting sounds. The pervasiveness of humpback whale sounds and songs has been reported by Au, et al. (2000). Nevertheless, a table of detections of humpback whales is given in Table A12.

2. Noise Analysis

Ambient noise received by the EARs at the different locations were calculated for typical files that were recorded at midnight, 6:00 A.M., noon and 6:00 pm. The spectral density of the received noise was calculated by Fourier transforming the entire 30 second file and then averaging the results in 200 Hz bands throughout the spectrum. Signal-to-noise ratio was not calculated for different marine mammal detection because the information can be easily misused. Signal-to-noise can vary from being very high if an animal is within tens of meters of an EAR or very low if the same animal is hundred of meters away from an EAR. Since there is no way of determining the distance of an animal from an EAR, signal-to-noise ratio is essentially meaning-less. However, knowing the noise at the different locations can be meaningful since it would allow for estimation of detection range of any sound source with a known source level, provided

Table 4. Locations and dates as well as summarized information extracted from Tables A1-A12. Dolphin species were identified with ROCCA. All other events were observed visually using LTSA. For the dolphin species identification results, the first set of numbers refer to the file numbers used in Tables A1-A12, the second is the time of the file, the identified species is given next and the percentage in parenthesis next to species is the percentages of tree that voted for the species and represent the species with the largest number of votes.

_____

Mokapu
      October 3, 2009
      Boat: 6:15 - 6:35
      Sonar: 21:50 and 22:15 – 22:25
      Biosonar: 1:00, 1:10 – 1:15, 1:40, 3:15, 3:30, 3:40, 4:15, 4:50, 16:55, 20:00 and 20:35
      Dolphin whistles & biosonar: 15:50 -16:10
      Dolphin whistles: 12:40 and 20:45

      Dolphin species in ewav files:
          7737: *Stenella attenuata* (41%)

      October 4, 2009
      Boat: 09:25-09:35, 10:35, 12:15 – 12:25 and 13:55 – 14:00.
      Sonar: None
      Biosonar: 4:30, 13:00, 13:25, 13:55, 23:00 and 23:50
      Dolphin whistles & biosonar: 1:05
      Dolphin whistles: None

Makapuu
      August 23, 2009
      Boat: 6:10 – 6:20, 17:30 – 17:40 and 20:10 – 20:20
      Sonar:14:00 – 14:05, 17:30 – 18:00 and 18:55 – 19:10
      Biosonar: 12:55 – 13:00, 19:45 and 20:05
      Dolphin whistles & biosonar: 10:50, 11:10, 12:35 – 12:40, 17:40, 17:50 – 17:55, 19:00,
                           19:55, 20:25, 20:35, 21:00 – 21:05, 22:00, 22:15, 22:40,
                           22:55, 23:00, 23:15 and 23:40
      Dolphin whistles: 10:40, 11:00 and 21:40

      Dolphin species in files:
          20887, 3:35 AM, *Stenella attenuata* (34%)
          20895, 4:15 AM, *Pseudorca crassidens* (50%)
          20907, 5:15 AM, *Stenella longirostris* (33%)
          20911, 5:35 AM, *Pseudorca crassidens* (31%)
          20925, 6:45 AM, *Steno bredanesis* (43%)
          20976, 11:00 AM, *Stenella coeruleoalba* (29%)
          21104, 9:40 PM, *Steno bredanensis* (24%)

      October 2, 2009

Boat: 3:55 – 4:05 and 17:45 – 18:00
Sonar: 17:55 – 18:00, 18:50, and 20:05, 22:30 and 22:40
Biosonar: 1:10, 1:45, 3:05 and 450 – 4:55,
Dolphin whistles & biosonar: 1:35, 3:35 and 3:45
Dolphin whistles: None

October 3, 2009
Boat: 1:25, 3:55, 7:20 – 7:40, 9:55 – 10:20, 12:35 – 12:40, 14:10 – 14:15, 14:45 – 14:50,
16:00 – 16:10, 19:30 – 19:40 and 19:45 – 20:05
Sonar: 6:55 and 7:30
Biosonar: 1:40 – 1:45, 3:10, 4:00, 4:15, 4:35, 4:40, 14:05 and 17:00 – 17:10
Dolphin whistles & biosonar: 2:45 and 2:55
Dolphin whistles: 1:30, 2:15, 3:15, 3:30,

October 4, 2009
Boat: 3:40 – 3:55, 11:25 – 11:35, 14:10 – 14:30 and 20:30 – 20:45
Sonar: None
Biosonar: None alone
Dolphin whistles & biosonar: 19:00, 19:55 and 20:00
Dolphin whistles: 19:35 and 19:45

Dolphin species in files:
 8370, 1:30 AM, *Globicephala macrorhynchus* (33%)
 8379, 2:15 AM, *Tursiops gilli* (33%)
 8391, 3:15 AM, *Tursiops gilli* (30%)
 8394, 3:30 AM, *Tursiops gilli* (34%)
 8875, 9:35 PM, *Stenella longirostris* (32%)
 8877, 9:45 PM, *Tursiops gilli* (42%)

Barber's Point
 February 9, 2010
 Boat: 0:50 – 1:05, 1:25 – 1:50, 2:10 – 2:35, 3:50 – 4:10, 6:00 – 6:20, 6:30 – 6:45, 7:15-
  7:50, 11:15 – 11:55, 14:20 – 14:40, 1735 – 17:45 and 18:55 – 19:25
 Sonar: 7:35 – 7:40, 8:15 – 8:20, 16:55 – 17:05 and 17:20 – 17:50
 Biosonar: 2:30, 2:45, 2:55, 3:00 – 3:10 and 3:45
 Dolphin whistles & biosonar: 22:55, 23:15 – 23:20 and 23:30
 Dolphin whistles: 22:35 and 22:45

 Dolphin species in ewav files:
  271, 10:35 PM, *Tursiops gilli* (34%)
  273, 10:45 PM, *Tursiops gilli* (30%)

 Humpback whales – continuous, non-stop chorusing

 February 18, 2010

Boat: 5:25 – 5:50, 7:45 – 8:05, 9:40 – 10:15, 12:05 – 12:35, 14:35 – 14:55, 15:30 –
    15:45, 18:50 – 19:30 and 22:55 – 23:20
Sonar: 12:45 – 13:10, 15:30 – 15:40, 15:55 – 16:20 and 16:35 – 17:00
Biosonar: 10:35, 20:50 – 21:05 and 21:50 – 21:55
Dolphin whistles & biosonar: 0:20
Dolphin whistles: 0:40 and 4:30

Dolphin species in ewav files:
    2600, 12:45 AM, *Stenella coeruleoalba* (25%)
    2646, 4:30 AM, *Steno bredanensis* (34%)

Humpback whales – continuous, non-stop chorusing

March 30, 2010
Boat: 3:25 – 3:30, 3:50 – 4:00, 5:40 – 5:55, 8:00 – 8:20 and 22:15 – 22:25
Sonar: 13:05 – 13:15, 18:25, 7:20 – 7:25
Biosonar: 0:20, 0:40, 0:50, 3:25 – 3:30 and 22:15
Dolphin whistles & biosonar: None
Dolphin whistles: 2:25

March 31, 2010
Boat: 3:40 – 3:50, 5:35 – 5:55, 7:40 – 7:50, 8:25 – 8:35, 9:30 – 9:40, 11:15, 11:30,
    15:15 – 17:15 and 19:05 -19:10
Sonar: 7:20 – 7:25 and 7:50
Biosonar: 1:25, 1:35, 1:45, 3:20, 3:30, 20:25 and 21:55
Dolphin whistles & biosonar: None
Dolphin whistles: 2:30

Dolphin species in ewav files:
    14141: *Tursiops truncatus* (38%)

Kaena Point
    November 17, 2009
    Boat: 15:40 – 16:10, 16:30 – 16:35, 17:10 – 17:20, 19:55 – 20:00
    Sonar: 21:55 – 22:05 and 23:25 – 23:40
    Biosonar: 2:40, 2:50, 19:05, 19:35, 19:55, 20:45, 20:55, 21:00, 21:15 and 21:25
    Dolphin whistles & biosonar: 18:20, 18:25 – 18:30 and 20:00
    Dolphin whistles: None

    November 18, 2009
    Boat: None
    Sonar: None
    Biosonar: 2:15, 2:20, 2:25 and 19:35
    Dolphin whistles & biosonar: None
    Dolphin whistles: None

Dolphin species in ewav files:
> 21532, 6:20 PM, *Stenella longirostris* (31%)
> 21533, 6:25 PM, *Stenella longirostris* (60%)
> 21534, 6:30 PM, *Globicephala macrorhynchus* (25%)

February 18, 2010
Boat: None
Sonar: None
Biosonar: 12:15 – 12:25, 2:40 – 2:45, 3:30, 5:00, 5:10, 6:20 – 6:25 and 6:45
Dolphin whistles & biosonar: 1:10
Dolphin whistles: None
Humpback whales – continuous, non-stop chorusing

SW Kauai (Loc 4)
February 16, 2009
Boat: 5:05 – 5:45
Sonar: 9:25 – 9:45, 10:50 – 11:50, 1:00 – 1:25 and 5:35 – 5:40
Biosonar: 2:50 and 10:50
Dolphin whistles & biosonar: 10:55
Dolphin whistles: 6:20 – 6:25 and 10:15

February 17, 2009
Boat: 1"20 – 1:30, 3:25 – 3:35 and 5:45 – 5:55
Sonar: 3:45 – 3:50, 4:05, 4:25, 10:55 – 11:50, 14:20 – 14:25, 15:50 – 16:50,
> 18:15 – 19:00, 19:25 – 19:50 and 23:25 – 23:50
Biosonar: None
Dolphin whistles & biosonar: None
Dolphin whistles: None

February 18, 2009
Boat: 1:15 – 1:30, *:25, 8:30 – 8:40, 10:00 – 10:05, 10:20 – 10:30, 11:10 – 11:20,
> 12:45 – 13:00 and 3:15 – 3:25
Sonar: 0:00 – 0:50, 2:05 – 3:35, 5:35 – 5:55, 8:15 - 9:00, 13:10 – 13:25 and 18:35 – 19:05
Biosonar: 0:35, 0:45,18:25 – 18:30, 19:05, 19:25, 19:35, 21:25, 21:35, 22:25 and 22:40
Dolphin whistles & biosonar: 0:30, 6"30, 6:40 – 6;45, 21:30, and 22:10
Dolphin whistles: 7:05, 7:50 and 11:40

February 19, 2009
Boat: &:15 – 7:258:25 – 8:55, 10:30, 11:00 – 11:10 and 15:15 – 15:30
Sonar: 1:35 – 2:25, 4:00 – 5:50, 11:40 – 12:00, 12:05 – 12:15 and 1:05 – 1:10
Biosonar: 1:35, 6:15, 6:25, 6:40, 22:50 - 22:55 and 23:00 – 23:10
Dolphin whistles & biosonar: 1:30
Dolphin whistles: None

Dolphin species in ewav files:
> 1804, 6:20 PM, *Stenella longirostris* (35%)

1805, 6:25 PM, *Tursiops gilli* (25%)
1807, 6:35 PM, *Stenella longirostris* (28%)
2245, 7:05 AM, *Stenella attenuata* (44%)
2254, 8:30 AM *Tursiops gilli* (40%)

May 5, 2009
Boat: 6:10 – 6:40, 7:20 – 7:40, 10:00 – 10:10, 11:00 – 11:05, 11:15 – 11:25,
    13:10 – 13:35 and 15:10 – 15:30
Sonar: None
Biosonar: 0:00 – 0:05, 3:05, 4:00 and 4:15
Dolphin whistles & biosonar: 3:50 – 3:55
Dolphin whistles: 1:30, 8:05, 8:15 and 8:30

Dolphin species in files:
    24150: *Tursiops gilli* (21%)

NW Kauai (Loc 5)
    September 13, 2009
    Boat: None
    Sonar: None
    Biosonar: 21:45 – 21:55 and 22:05 – 22:10
    Dolphin whistles & biosonar: 22:00
    Dolphin whistles: 18:45

September 18, 2009
    Boat: None
    Sonar: None
    Biosonar: None
    Dolphin whistles & biosonar: None
    Dolphin whistles: 10:45 – 11:15 and 17:15 – 17:20

September 21, 2009
    Boat: None
    Sonar: 11:25
    Biosonar: 2:45 – 2:55
    Dolphin whistles & biosonar: 0:25 and 0:35
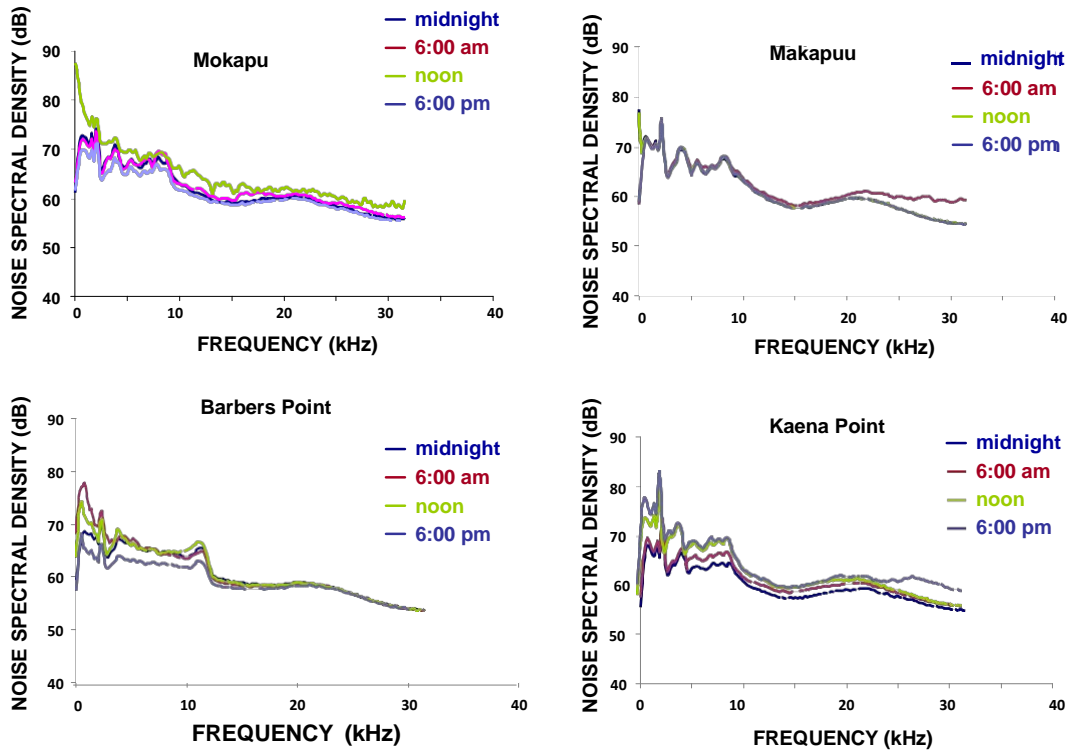   Dolphin whistles: 0:55
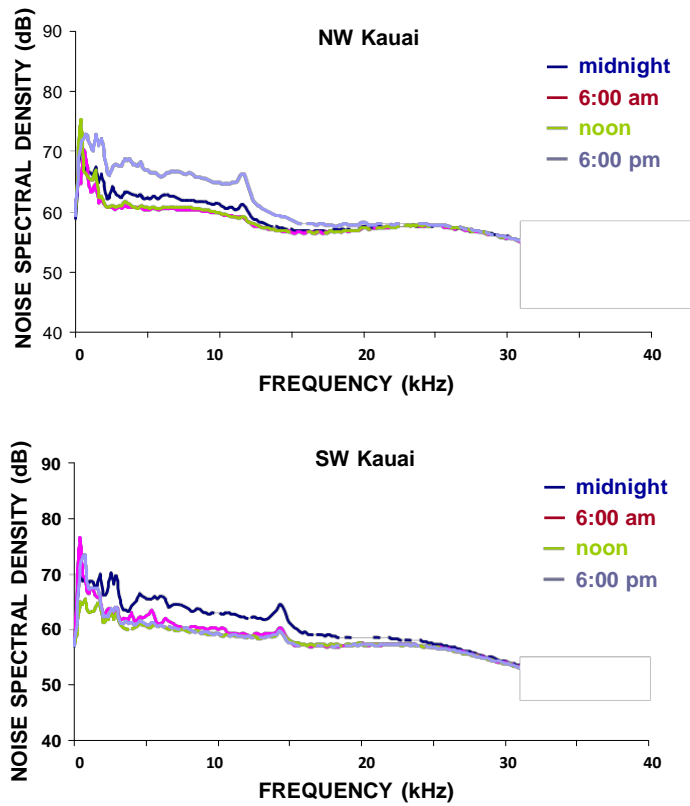
Figure 4. Noise received by EARs off Oahu.

Figure 5. Noise received by EARs off Kauai.

transmission beam pattern is known.

The noise received by the different EARs deployed off Oahu are shown in Figure 4. The different locations exhibited different noise conditions and the noise were dependent on time of dependency is not the same for the four sites. At Mokapu and perhaps at Makapuu, the noise is highest at noon but at Barber's Point it is highest at 6:00 A. M. and at Kaena Point at 6:00 P. M. The noise at Makapuu showed the smallest dependency with time of day and started to diverse beyond 20 kHz. All the noise spectra show a similar general shape decreasing as frequency Increased and with a low frequency peak close to 2 kHz which is probably caused by snapping shrimp and a mild frequency hump at about 10 - 22 kHz. The dependency was not the same at the two sites. At the NW Kauai location, the noise was highest at 6:00 pm contrast to the SW Kauai location where the noise was highest a midnight except for the lowest frequencies.

The noise received the EAR off SW Kauai and NW Kauai are shown in Figure 5. As with the shallower EARs off Oahu, the noise spectral density had a time of day dependency but the dependency was not the same at the two sites. At the NW Kauai location, the noise was highest at 6:00 pm contrast to the SW Kauai location where the noise was highest a midnight except for the lowest frequencies.

Discussion and Conclusions

The presence of dolphins at the locations of the EARs can be detected by their whistles and biosonar clicks. In general, there seemed to be many more instances in which biosonar clicks were detected than whistles. There also instances in which both biosonar clicks and whistles were detected. Unfortunately, biosonar clicks are highly variable, especially from the smaller dolphins, and at this time there is not a way to do any species identification with them. The biosonar clicks detected by bottom mounted EARs in deep waters ($> 400 – 500$) can be used to identify a small number of species emitting the clicks if the sample rate is high enough, on the order of 80 kHz. Unfortunately, for the historical data examined, the deep EARs off Kauai had a sampling rate of only 64 kHz. In the spring of 2009, the sampling rates for these EARs was increased to 80 kHz.

Dolphin species that detected were spinner dolphins (*Stenella longirostris*), pan-tropical spotted dolphins (*Stenella attenuata*), rough toothed dolphins (*Steno bredanensis*), stripped dolphins (*Stenella coeruleoalba*), short-finned pilot whales (*Globicephala macrorhynchus*), false killer whales (*Pseudorca crassidens*), and Pacific bottlenose dolphins (*Tursiops gilli*). Spinner and pan-tropical spotted dolphins were detected the most followed by bottlenose dolphins. Since data was analyzed for specific days, it was not possible to determine any pattern in the animal detections. The only pattern found was that most of the dolphin whistles were detected during the dawn-dusk and night time hours.

Dolphin species identification was achieved by the analyzing whistles with the ROCCA algorithm. In the first pass of ROCCA, the species *Delphinus delphis* was left in the list of possible species and in several situations, whistling species were classified as being generated by

short-beaked common dolphins. However, to the best of our knowledge common dolphins have never or very rarely been sighted in near-shore Hawaiian waters. This does not leave out the possibility of common dolphins never entering waters immediately adjacent to the Hawaiian Islands. However, in order to take a conservative approach, the data was reanalyzed by ROCCA with common dolphins removed from the possible species list. The ROCCA results shown in Table 4 are with common dolphins not included in the species list.

This study certainly indicate that we need to expand our knowledge of dolphin species associated with the Hawaiian Islands which suggest that more basic research needs to be done. There is a possibility that the whistle signals from certain dolphin species around Hawaii may have some special characteristics. The performance of ROCCA to perform more accurate identification of dolphin species around Hawaii would be greatly enhanced by recording whistle signals in concert with obtaining positive visual and photo observations. Furthermore, the library in ROCCA can stand to have more whistle signals from some certain species of dolphins, especially from melon headed whale (*Peponocephala electra*), pygmy killer whale (*Feresa attenuata*), fraser's dolphin (*Lagenodelphis hosei*), and false killer whales (*Pseudorca crassidens*).

Most of the sonar signals detected were probably from the U.S. Navy mid-frequency sonar such as AN/SQS-53 destroyer or cruiser. There were many instances in which the source was close enough to the EARs to saturate the electronics.

A tremendous amount of information can be obtained by passively recording sounds emitted in conjunction with Naval operations. The results of Table 4 summarized all the acoustic detections as best as possible. Dolphin species were identified when possible using whistle signals and ROCCA. Further interpretation of the results would not add much information that has already been extracted from the data. It is difficult to perform a general analysis without having some specific event to look for and a specific time at which these events occur. Nevertheless, we are confident that most of the major acoustic events that occurred within range of our EARs were detected and analyzed appropriately. In closing, it is important to understand that passive acoustics have many distinct advantages to detect the presence of whale, dolphins, ships, sonar and any other entities that produce noise on a 24 hour basis and for many months on end. However, there are also some serious limitations. Analysis of data is an extremely intensive process and better automatic algorithms are needed and useful data can only be obtained if the sound producing entities enter within the range of the recorders. Nevertheless passive acoustic monitoring is still the best technique available at this time to obtain general, long term information on noise producing entities in the ocean.

Reference

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Table A1 Mokapu, October 3-4, 2009

Mokau-10-03009

Input file	Source	Call type	Start time	End time	Comments
LTSAout.ltsa	Event Category	Clicks only	10/3/09 1:00		
00007502.e.wav	Clicks	Sonar only >1/2 rec	10/3/09 1:10		
00007503.e.wav	Clicks	Sonar only >1/2 rec	10/3/09 1:15		
00007508.e.wav	Clicks	Sonar only <1/2 rec	10/3/09 1:40		
LTSAout.ltsa	Event Category	Clicks only	10/3/09 3:00		
00007527.e.wav	Clicks	Sonar only <1/2 rec	10/3/09 3:15		
00007530.e.wav	Clicks	Sonar only <1/2 rec	10/3/09 3:30		
00007532.e.wav	Clicks	Sonar only >1/2 rec	10/3/09 3:40		
LTSAout.ltsa	Event Category	Clicks only	10/3/09 4:00		
00007539.e.wav	Clicks	Sonar only <1/2 rec	10/3/09 4:15		
00007546.e.wav	Clicks	Sonar only <1/2 rec	10/3/09 4:50		
LTSAout.ltsa	other		10/3/09 6:15	10/3/09 6:35	BOAT
LTSAout.ltsa	Event Category	LF Whistles only	10/3/09 12:00		
00007640.e.wav	Whistles	1-5	10/3/09 12:40		
LTSAout.ltsa	Event Category	HF Whistles & Clicks	10/3/09 15:00		
00007677.e.wav	Whistles	1-5	10/3/09 15:45		
00007678.e.wav	Whistles & Clicks	1-5 & sonar or BP	10/3/09 15:50		
00007679.e.wav	Whistles & Clicks	6-10 & sonar or BP	10/3/09 15:55		
LTSAout.ltsa	Event Category	HF Whistles & Clicks	10/3/09 16:00		
00007681.e.wav	Whistles & Clicks	>10 & sonar or BP	10/3/09 16:05		
00007682.e.wav	Whistles & Clicks	1-5 & sonar or BP	10/3/09 16:10		
00007691.e.wav	Clicks	Sonar only <1/2 rec	10/3/09 16:55		

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LTSAout.ltsa	Event Category	HF Whistles & Clicks	10/3/09 20:00		
00007728.e.wav	Clicks	Sonar only >1/2 rec	10/3/09 20:00		
00007735.e.wav	Clicks	Sonar & BP <5	10/3/09 20:35		
00007737.e.wav	Whistles	6-10	10/3/09 20:45		
00007750.e.wav	other		10/3/09 21:50		SONAR
LTSAout.ltsa	other		10/3/09 22:15	10/3/09 22:25	SONAR
LTSAout.ltsa	Event Category	HF Whistles & Clicks	10/4/09 1:00		
00007789.e.wav	Whistles & Clicks	1-5 & sonar or BP	10/4/09 1:05		
LTSAout.ltsa	Event Category	Clicks only	10/4/09 4:00		
00007830.e.wav	Clicks	Sonar only <1/2 rec	10/4/09 4:30		
Mokau-10-03009					
LTSAout.ltsa	other		10/4/09 9:25	10/4/09 9:35	BOAT
LTSAout.ltsa	other		10/4/09 10:35		BOAT
LTSAout.ltsa	other		10/4/09 12:15	10/4/09 12:25	BOAT
LTSAout.ltsa	other		10/4/09 13:55	10/4/09 14:00	BOAT
LTSAout.ltsa	Event Category	Clicks only	10/4/09 13:00		
00007937.e.wav	Clicks	Sonar only <1/2 rec	10/4/09 13:25		
00007943.e.wav	Clicks	Sonar only >1/2 rec	10/4/09 13:55		
LTSAout.ltsa	Event Category	Clicks only	10/4/09 23:00		
00008052.e.wav	Clicks	Sonar only >1/2 rec	10/4/09 23:00		
00008062.e.wav	Clicks	Sonar only <1/2 rec	10/4/09 23:50		

Table A2 Makapuu, August 23, 2009

Makapuu08-23-09

Input file	Source	Call type	Start time	End time	Comments
LTSAout.ltsa	Event Category	HF Whistles & Clicks	8/23/09 12:00 AM		
00020851.e.wav	Whistles	1-5	8/23/09 12:35 AM		
00020854.e.wav	Whistles & Clicks	1-5 & sonar or BP	8/23/09 12:50 AM		
00020855.e.wav	Whistles & Clicks	1-5 & sonar or BP	8/23/09 12:55 AM		
LTSAout.ltsa	Event Category	HF Whistles & Clicks	8/23/09 1:00 AM		
00020856.e.wav	Whistles & Clicks	>10 & sonar or BP	8/23/09 1:00 AM		
00020858.e.wav	Whistles & Clicks	1-5 & sonar or BP	8/23/09 1:10 AM		
00020861.e.wav	Whistles	1-5	8/23/09 1:25 AM		
LTSAout.ltsa	Event Category	HF Whistles & Clicks	8/23/09 2:00 AM		
00020871.e.wav	Whistles & Clicks	1-5 & sonar or BP	8/23/09 2:15 AM		
00020875.e.wav	Whistles & Clicks	1-5 & sonar or BP	8/23/09 2:35 AM		
00020876.e.wav	Whistles	1-5	8/23/09 2:40 AM		
LTSAout.ltsa	Event Category	HF Whistles & Clicks	8/23/09 3:00 AM		
00020886.e.wav	Clicks	Sonar only >1/2 rec	8/23/09 3:30 AM		
00020887.e.wav	Whistles	1-5	8/23/09 3:35 AM		
00020889.e.wav	Whistles	1-5	8/23/09 3:45 AM		
LTSAout.ltsa	Event Category	HF & LF Whistles & Clicks	8/23/09 4:00 AM		
00020895.e.wav	Whistles	6-10	8/23/09 4:15 AM		

File	Category	Description	Time	Time2	Flag
00020901.e.wav	Clicks	Sonar only <1/2 rec	8/23/09 4:45 AM		
00020902.e.wav	Clicks	Sonar & BP <5	8/23/09 4:50 AM		
LTSAout.ltsa	Event Category	HF Whistles & Clicks	8/23/09 5:00 AM		
00020907.e.wav	Whistles	>10	8/23/09 5:15 AM		
00020909.e.wav	Whistles & Clicks	>10 & sonar or BP	8/23/09 5:25 AM		
00020911.e.wav	Whistles	6-10	8/23/09 5:35 AM		
LTSAout.ltsa	other		8/23/09 6:10 AM	8/23/09 6:20	BOAT
LTSAout.ltsa	Event Category	HF Whistles only	8/23/09 6:00 AM		
00020923.e.wav	Whistles	6-10	8/23/09 6:35 AM		
00020925.e.wav	Whistles	1-5	8/23/09 6:45 AM		
00020926.e.wav	Whistles	1-5	8/23/09 6:50 AM		
LTSAout.ltsa	Event Category	HF Whistles & Clicks	8/23/09 9:00 AM		
00020958.e.wav	Clicks	Sonar only <1/2 rec	8/23/09 9:30 AM		
00020959.e.wav	Whistles & Clicks	1-5 & sonar or BP	8/23/09 9:35 AM		
Makapuu08-23-09					
LTSAout.ltsa	Event Category	HF Whistles & Clicks	8/23/09 10:00 AM		
00020972.e.wav	Whistles	1-5	8/23/09 10:40 AM		
00020974.e.wav	Whistles & Clicks	1-5 & sonar or BP	8/23/09 10:50 AM		
LTSAout.ltsa	Event Category	HF Whistles & Clicks	8/23/09 11:00 AM		
00020976.e.wav	Whistles	1-5	8/23/09 11:00 AM		
00020978.e.wav	Whistles & Clicks	1-5 & sonar or BP	8/23/09 11:10 AM		
LTSAout.ltsa	Event Category	HF Whistles & Clicks	8/23/09 12:00 PM		
00020995.e.wav	Whistles &	>10 & sonar or BP	8/23/09 12:35 PM		

File	Category	Detail	Start	End	Source
	Clicks				
	Whistles &				
00020996.e.wav	Clicks	>10 & sonar or BP	8/23/09 12:40 PM		
00020999.e.wav	Clicks	BP only <5	8/23/09 12:55 PM		
LTSAout.ltsa	Event Category	Clicks only	8/23/09 1:00 PM		
00021000.e.wav	Clicks	Sonar only >1/2 rec	8/23/09 1:00 PM		
00021013.e.wav	other		8/23/09 2:05 PM		SONAR
00021012.e.wav	other		8/23/09 2:00 PM		SONAR
00021029.e.wav	other		8/23/09 3:25 PM		SONAR
LTSAout.ltsa	other		8/23/09 5:30 PM	8/23/09 17:40	BOAT
LTSAout.ltsa	other		8/23/09 5:45 PM	8/23/09 18:00	SONAR
LTSAout.ltsa	Event Category	HF Whistles & Clicks	8/23/09 5:00 PM		
00021056.e.wav	Whistles & Clicks	6-10 & sonar or BP	8/23/09 5:40 PM		
00021058.e.wav	Whistles & Clicks	6-10 & sonar or BP	8/23/09 5:50 PM		
00021059.e.wav	Whistles & Clicks	6-10 & sonar or BP	8/23/09 5:55 PM		
LTSAout.ltsa	Event Category	HF & LF Whistles & Clicks	8/23/09 6:00 PM		
00021062.e.wav	Whistles & Clicks	1-5 & sonar or BP	8/23/09 6:10 PM		
00021066.e.wav	Whistles & Clicks	6-10 & sonar or BP	8/23/09 6:30 PM		
00021068.e.wav	Whistles & Clicks	6-10 & sonar or BP	8/23/09 6:40 PM		
LTSAout.ltsa	other		8/23/09 6:55 PM	8/23/09 19:10	SONAR
LTSAout.ltsa	Event Category	HF Whistles & Clicks	8/23/09 7:00 PM		
00021072.e.wav	Whistles & Clicks	>10 Sonar & BP	8/23/09 7:00 PM		

File	Type	Description	Time	Time 2	Note
00021081.e.wav	Clicks	Sonar only >1/2 rec	8/23/09 7:45 PM		
00021083.e.wav	Whistles & Clicks	1-5 & sonar or BP	8/23/09 7:55 PM		
LTSAout.ltsa	other		8/23/09 8:10 PM	8/23/09 20:20	BOAT
LTSAout.ltsa	Event Category	HF Whistles & Clicks	8/23/09 8:00 PM		
00021085.e.wav	Clicks	Sonar only >1/2 rec	8/23/09 8:05 PM		
Makapuu08-23-09					
00021089.e.wav	Whistles & Clicks	6-10 & sonar or BP	8/23/09 8:25 PM		
00021091.e.wav	Whistles & Clicks	>10 & sonar or BP	8/23/09 8:35 PM		
LTSAout.ltsa	Event Category	HF Whistles & Clicks	8/23/09 9:00 PM		
00021096.e.wav	Whistles & Clicks	1-5 & sonar or BP	8/23/09 9:00 PM		
00021097.e.wav	Whistles & Clicks	1-5 Sonar & BP	8/23/09 9:05 PM		
00021104.e.wav	Whistles	6-10	8/23/09 9:40 PM		
LTSAout.ltsa	Event Category	HF Whistles & Clicks	8/23/09 10:00 PM		
00021111.e.wav	Whistles & Clicks	6-10 & sonar or BP	8/23/09 10:15 PM		
00021116.e.wav	Whistles & Clicks	>10 & sonar or BP	8/23/09 10:40 PM		
00021119.e.wav	Whistles & Clicks	>10 & sonar or BP	8/23/09 10:55 PM		
LTSAout.ltsa	Event Category	HF Whistles & Clicks	8/23/09 11:00 PM		
00021120.e.wav	Whistles & Clicks	1-5 & sonar or BP	8/23/09 11:00 PM		
00021123.e.wav	Whistles & Clicks	6-10 & sonar or BP	8/23/09 11:15 PM		

	Whistles &		
00021128.e.wav	Clicks	>10 & sonar or BP	8/23/09 11:40 PM

Table A3 Makapuu, October 2-4, 2009

Makapuu10/02/09

Input file	Source	Call type	Start time	End time	Comments
LTSAout.ltsa	Event Category	HF Whistles & Clicks	10/2/09 1:00		
00008078.e.wav	Clicks	Sonar only <1/2 rec	10/2/09 1:10		
00008083.e.wav	Whistles & Clicks	1-5 & sonar or BP	10/2/09 1:35		
00008085.e.wav	Clicks	Sonar only <1/2 rec	10/2/09 1:45		
LTSAout.ltsa	Event Category	HF Whistles & Clicks	10/2/09 3:00		
00008101.e.wav	Clicks	Sonar only <1/2 rec	10/2/09 3:05		
00008107.e.wav	Whistles & Clicks	>10 & sonar or BP	10/2/09 3:35		
00008109.e.wav	Whistles & Clicks	1-5 & sonar or BP	10/2/09 3:45		
LTSAout.ltsa	Event Category	Clicks only	10/2/09 4:00		
00008122.e.wav	Clicks	Sonar only >1/2 rec	10/2/09 4:50		
00008123.e.wav	Clicks	Sonar only >1/2 rec	10/2/09 4:55		
LTSAout.ltsa	other		10/2/09 3:55	10/2/09 4:05	BOAT
LTSAout.ltsa	other		10/2/09 17:45	10/2/09 18:00	BOAT
LTSAout.ltsa	other		10/2/09 17:55	10/2/09 18:00	SONAR
00008290.e.wav	other		10/2/09 18:50		SONAR
00008305.e.wav	other		10/2/09 20:05		SONAR
LTSAout.ltsa	other		10/2/09 22:30	10/2/09 22:30	SONAR
LTSAout.ltsa	other		10/2/09 22:40	10/2/09 22:45	SONAR
LTSAout.ltsa	other		10/3/09 1:05	10/3/09 1:25	BOAT
LTSAout.ltsa	Event Category	HF Whistles & Clicks	10/3/09 1:00		
00008370.e.wav	Whistles	1-5	10/3/09 1:30		
00008372.e.wav	Clicks	Sonar only <1/2 rec	10/3/09 1:40		

File	Category	Detail	Start	End	Source
00008373.e.wav	Clicks	Sonar only <1/2 rec	10/3/09 1:45		
LTSAout.ltsa	Event Category	HF Whistles & Clicks	10/3/09 2:00		
00008379.e.wav	Whistles	1-5	10/3/09 2:15		
00008385.e.wav	Whistles & Clicks	1-5 & sonar or BP	10/3/09 2:45		
00008387.e.wav	Whistles & Clicks	6-10 & sonar or BP	10/3/09 2:55		
LTSAout.ltsa	Event Category	HF Whistles & Clicks	10/3/09 3:00		
00008390.e.wav	Clicks	Sonar only >1/2 rec	10/3/09 3:10		
00008391.e.wav	Whistles	>10	10/3/09 3:15		
00008394.e.wav	Whistles	6-10	10/3/09 3:30		
LTSAout.ltsa	other		10/3/09 3:45	10/3/09 3:55	BOAT
Makapuu10/02/09					
LTSAout.ltsa	Event Category	Clicks only	10/3/09 4:00		
00008403.e.wav	Clicks	Sonar only <1/2 rec	10/3/09 4:15		
00008407.e.wav	Clicks	Sonar only <1/2 rec	10/3/09 4:35		
00008408.e.wav	Clicks	Sonar only >1/2 rec	10/3/09 4:40		
LTSAout.ltsa	other		10/3/09 6:55	10/3/09 6:55	SONAR
LTSAout.ltsa	other		10/3/09 7:20	10/3/09 7:40	BOAT
00008442.e.wav	other		10/3/09 7:30		SONAR
LTSAout.ltsa	other		10/3/09 9:55	10/3/09 10:20	BOAT
LTSAout.ltsa	other		10/3/09 12:35	10/3/09 12:40	BOAT
LTSAout.ltsa	other		10/3/09 14:10	10/3/09 14:15	BOAT
LTSAout.ltsa	other		10/3/09 14:45	10/3/09 14:50	BOAT
LTSAout.ltsa	Event Category	Clicks only	10/3/09 14:00		
00008521.e.wav	Clicks	Sonar only <1/2 rec	10/3/09 14:05		
LTSAout.ltsa	other		10/3/09 16:00	10/3/09 16:10	BOAT
LTSAout.ltsa	Event Category	Clicks only	10/3/09 17:00		
00008556.e.wav	Clicks	Sonar only <1/2 rec	10/3/09 17:00		

File	Category	Detail	Start	End	Type
00008557.e.wav	Clicks	Sonar only <1/2 rec	10/3/09 17:05		
00008558.e.wav	Clicks	Sonar only <1/2 rec	10/3/09 17:10		
LTSAout.ltsa	other		10/3/09 19:30	10/3/09 19:40	BOAT
LTSAout.ltsa	other		10/3/09 19:45	10/3/09 20:05	BOAT
LTSAout.ltsa	other		10/4/09 3:40	10/4/09 3:55	BOAT
LTSAout.ltsa	other		10/4/09 11:25	10/4/09 11:35	BOAT
LTSAout.ltsa	other		10/4/09 14:10	10/4/09 14:30	BOAT
LTSAout.ltsa	Event Category	HF Whistles & Clicks	10/4/09 19:00		
00008875.e.wav	Whistles	1-5	10/4/09 19:35		
00008877.e.wav	Whistles	1-5	10/4/09 19:45		
00008879.e.wav	Whistles & Clicks	1-5 & sonar or BP	10/4/09 19:55		
LTSAout.ltsa	Event Category	HF Whistles & Clicks	10/4/09 20:00		
00008880.e.wav	Whistles & Clicks	1-5 & sonar or BP	10/4/09 20:00		
LTSAout.ltsa	other		10/4/09 20:30	10/4/09 20:45	BOAT

Table A4 Barber's Point, February 9, 2010

Barber's Pt 2-9-10

Input file	Source	Call type	Start time	End time	Comments
LTSAout.ltsa	other		2/9/10 0:50	2/9/10 1:05	BOAT
LTSAout.ltsa	other		2/9/10 1:25	2/9/10 1:50	BOAT
LTSAout.ltsa	other		2/9/10 2:10	2/9/10 2:35	BOAT
LTSAout.ltsa	Event Category	Clicks only	2/9/10 2:00		
00000030.e.wav	Clicks	Sonar only >1/2 rec	2/9/10 2:30		
00000033.e.wav	Clicks	Sonar only >1/2 rec	2/9/10 2:45		
00000035.e.wav	Clicks	Sonar only <1/2 rec	2/9/10 2:55		
LTSAout.ltsa	Event Category	Clicks only	2/9/10 3:00		
00000038.e.wav	Clicks	Sonar only <1/2 rec	2/9/10 3:10		
00000045.e.wav	Clicks	Sonar only <1/2 rec	2/9/10 3:45		
00000037.e.wav	Clicks	Sonar only <1/2 rec	2/9/10 3:05		
LTSAout.ltsa	other		2/9/10 3:50	2/9/10 4:10	BOAT
LTSAout.ltsa	other		2/9/10 6:00	2/9/10 6:20	BOAT
LTSAout.ltsa	other		2/9/10 6:30	2/9/10 6:45	BOAT
LTSAout.ltsa	other		2/9/10 7:15	2/9/10 7:50	BOAT
LTSAout.ltsa	other		2/9/10 7:35	2/9/10 7:40	SONAR
LTSAout.ltsa	other		2/9/10 8:15	2/9/10 8:20	SONAR
LTSAout.ltsa	other		2/9/10 11:15	2/9/10 11:55	BOAT
LTSAout.ltsa	other		2/9/10 14:20	2/9/10 14:40	BOAT
LTSAout.ltsa	other		2/9/10 16:55	2/9/10 17:05	SONAR
LTSAout.ltsa	other		2/9/10 17:20	2/9/10 17:50	SONAR
LTSAout.ltsa	other		2/9/10 17:35	2/9/10 17:45	BOAT
LTSAout.ltsa	other		2/9/10 18:55	2/9/10 19:25	BOAT
LTSAout.ltsa	Event Category	HF Whistles only	2/9/10 22:00		
00000271.e.wav	Whistles	>10	2/9/10 22:35		
00000273.e.wav	Whistles	>10	2/9/10 22:45		
00000275.e.wav	Whistles &	6-10 & sonar or BP	2/9/10 22:55		

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LTSAout.ltsa	Event Category	HF Whistles & Clicks	
		Clicks	
			2/9/10 23:00
00000279.e.wav	Whistles & Clicks	>10 & sonar or BP	2/9/10 23:15
00000280.e.wav	Whistles & Clicks	>10 & sonar or BP	2/9/10 23:20
00000282.e.wav	Whistles & Clicks	>10 & sonar or BP	2/9/10 23:30

Table A5 Barber's Point, February 18, 2010

Barber's Pt 2-18-10

Input file	Source	Call type	Start time	End time	Comments
LTSAout.ltsa	Event Category	HF Whistles & Clicks	2/18/10 0:00		
00002596.e.wav	Whistles & Clicks	6-10 & sonar or BP	2/18/10 0:20		
00002599.e.wav	Clicks	Sonar only >1/2 rec	2/18/10 0:35		
00002600.e.wav	Whistles	1-5	2/18/10 0:40		
LTSAout.ltsa	Event Category	HF Whistles only	2/18/10 4:00		
00002646.e.wav	Whistles	1-5	2/18/10 4:30		
LTSAout.ltsa	other		2/18/10 5:25	2/18/10 5:50	BOAT
LTSAout.ltsa	other		2/18/10 7:45	2/18/10 8:05	BOAT
LTSAout.ltsa	other		2/18/10 9:40	2/18/10 10:15	BOAT
LTSAout.ltsa	other		2/18/10 10:30	2/18/10 10:55	BOAT
LTSAout.ltsa	other		2/18/10 12:05	2/18/10 12:35	BOAT
LTSAout.ltsa	other		2/18/10 12:45	2/18/10 13:10	SONAR
LTSAout.ltsa	other		2/18/10 14:35	2/18/10 14:55	BOAT
LTSAout.ltsa	other		2/18/10 15:30	2/18/10 15:45	BOAT
LTSAout.ltsa	other		2/18/10 15:30	2/18/10 15:40	SONAR
LTSAout.ltsa	other		2/18/10 15:55	2/18/10 16:20	SONAR
LTSAout.ltsa	other		2/18/10 16:35	2/18/10 17:00	SONAR
LTSAout.ltsa	other		2/18/10 18:50	2/18/10 19:30	BOAT
LTSAout.ltsa	Event Category	Clicks only	2/18/10 20:00		
00002842.e.wav	Clicks	Sonar only >1/2 rec	2/18/10 20:50		
00002843.e.wav	Clicks	Sonar only >1/2 rec	2/18/10 20:55		
LTSAout.ltsa	Event Category	Clicks only	2/18/10 21:00		
00002845.e.wav	Clicks	Sonar only >1/2 rec	2/18/10 21:05		

00002854.e.wav	Clicks	Sonar only >1/2 rec	2/18/10 21:50		
00002855.e.wav	Clicks	Sonar only >1/2 rec	2/18/10 21:55		
LTSAout.ltsa	other		2/18/10 22:55	2/18/10 23:20	BOAT

Table A6 Barber's Point, March 30-31, 2010

Barber's Pt03/30/10

Input file	Source	Call type	Start time	End time	Comments
LTSAout.ltsa	Event Category	Clicks only	3/30/10 0:00		
00014116.e.wav	Clicks	Sonar only <1/2 rec	3/30/10 0:20		
00014120.e.wav	Clicks	Sonar only >1/2 rec	3/30/10 0:40		
00014122.e.wav	Clicks	Sonar only <1/2 rec	3/30/10 0:50		
LTSAout.ltsa	Event Category	HF Whistles only	3/30/10 2:00		
00014141.e.wav	Whistles	1-5	3/30/10 2:25		
LTSAout.ltsa	Event Category	Clicks only	3/30/10 3:00		
00014153.e.wav	Clicks	Sonar only >1/2 rec	3/30/10 3:25		
00014154.e.wav	Clicks	Sonar only <1/2 rec	3/30/10 3:30		
LTSAout.ltsa	other		3/30/10 3:25	3/30/10 3:30	BOAT
LTSAout.ltsa	other		3/30/10 3:50	3/30/10 4:00	BOAT
LTSAout.ltsa	other		3/30/10 5:40	3/30/10 5:55	BOAT
LTSAout.ltsa	other		3/30/10 8:00	3/30/10 8:20	BOAT
LTSAout.ltsa	other		3/30/10 13:05	3/30/10 13:15	SONAR
LTSAout.ltsa	other		3/30/10 14:25	3/30/10 14:40	BOAT
LTSAout.ltsa	other		3/30/10 16:15	3/30/10 16:30	BOAT
00014333.e.wav	other		3/30/10 18:25		SONAR
LTSAout.ltsa	Event Category	Clicks only	3/30/10 22:00		
00014379.e.wav	Clicks	Sonar only >1/2 rec	3/30/10 22:15		

LTSAout.ltsa	other		3/30/10 22:15	3/30/10 22:25	BOAT
LTSAout.ltsa	Event Category	Clicks only	3/31/10 1:00		
00014417.e.wav	Clicks	Sonar only >1/2 rec	3/31/10 1:25		
00014419.e.wav	Clicks	Sonar only >1/2 rec	3/31/10 1:35		
00014421.e.wav	Clicks	Sonar only <1/2 rec	3/31/10 1:45		
LTSAout.ltsa	Event Category	HF Whistles only	3/31/10 2:00		
00014430.e.wav	Whistles	1-5	3/31/10 2:30		
LTSAout.ltsa	Event Category	Clicks only	3/31/10 3:00		
00014440.e.wav	Clicks	Sonar only >1/2 rec	3/31/10 3:20		
00014442.e.wav	Clicks	Sonar only >1/2 rec	3/31/10 3:30		
LTSAout.ltsa	other		3/31/10 3:40	3/31/10 3:50	BOAT
LTSAout.ltsa	other		3/31/10 5:35	3/31/10 5:55	BOAT
LTSAout.ltsa	other		3/31/10 7:20	3/31/10 7:25	SONAR
Barber's Pt03/30/10					
LTSAout.ltsa	other		3/31/10 7:40	3/31/10 7:50	BOAT
00014494.e.wav	other		3/31/10 7:50		SONAR
LTSAout.ltsa	other		3/31/10 8:25	3/31/10 8:35	BOAT
LTSAout.ltsa	other		3/31/10 9:30	3/31/10 9:40	BOAT
LTSAout.ltsa	other		3/31/10 11:15	3/31/10 11:30	BOAT
LTSAout.ltsa	other		3/31/10 15:15	3/31/10 17:15	BOAT
LTSAout.ltsa	other		3/31/10 19:05	3/31/10 19:10	BOAT
LTSAout.ltsa	Event Category	Clicks only	3/31/10 20:00		

		Sonar only >1/2	
00014645.e.wav	Clicks	rec	3/31/10 20:25
LTSAout.ltsa	Event Category	Clicks only	3/31/10 21:00
00014663.e.wav	Clicks	Sonar only >1/2 rec	3/31/10 21:55

Table A7 Kaena Point, November 17-18, 2009

Kaena Pt11-17-09

Input file	Source	Call type	Start time	End time	Comments
LTSAout.ltsa	Event Category	Clicks only	11/17/09 2:00		
00021344.e.wav	Clicks	Sonar only <1/2 rec	11/17/09 2:40		
00021346.e.wav	Clicks	Sonar only <1/2 rec	11/17/09 2:50		
LTSAout.ltsa	other		11/17/09 15:40	11/17/09 16:10	BOAT
LTSAout.ltsa	other		11/17/09 16:30	11/17/09 16:35	BOAT
LTSAout.ltsa	other		11/17/09 17:10	11/17/09 17:20	BOAT
LTSAout.ltsa	Event Category	HF Whistles & Clicks	11/17/09 18:00		
00021532.e.wav	Whistles & Clicks	1-5 & sonar or BP	11/17/09 18:20		
00021533.e.wav	Whistles & Clicks	1-5 & sonar or BP	11/17/09 18:25		
00021534.e.wav	Whistles & Clicks	1-5 & sonar or BP	11/17/09 18:30		
LTSAout.ltsa	Event Category	Clicks only	11/17/09 19:00		
00021541.e.wav	Clicks	Sonar only >1/2 rec	11/17/09 19:05		
00021547.e.wav	Clicks	Sonar only >1/2 rec	11/17/09 19:35		
00021551.e.wav	Clicks	Sonar only >1/2 rec	11/17/09 19:55		
LTSAout.ltsa	other		11/17/09 19:55	11/17/09 20:00	BOAT
LTSAout.ltsa	Event Category	HF Whistles & Clicks	11/17/09 20:00		
00021552.e.wav	Whistles & Clicks	1-5 Sonar & BP	11/17/09 20:00		
00021561.e.wav	Clicks	Sonar only >1/2 rec	11/17/09 20:45		
00021563.e.wav	Clicks	Sonar & BP <5	11/17/09 20:55		
LTSAout.ltsa	Event Category	Clicks only	11/17/09 21:00		
00021564.e.wav	Clicks	Sonar & BP <5	11/17/09 21:00		
00021567.e.wav	Clicks	Sonar only >1/2 rec	11/17/09 21:15		

00021569.e.wav	Clicks	Sonar only >1/2 rec	11/17/09 21:25		
LTSAout.ltsa	other		11/17/09 21:55	11/17/09 22:05	SONAR
LTSAout.ltsa	other		11/17/09 23:25	11/17/09 23:40	SONAR
LTSAout.ltsa	Event Category	Clicks only	11/18/09 2:00		
00021627.e.wav	Clicks	Sonar only >1/2 rec	11/18/09 2:15		
00021628.e.wav	Clicks	Sonar only >1/2 rec	11/18/09 2:20		
00021629.e.wav	Clicks	Sonar only <1/2 rec	11/18/09 2:25		
LTSAout.ltsa	Event Category	Clicks only	11/18/09 19:00		
00021835.e.wav	Clicks	Sonar only <1/2 rec	11/18/09 19:35		

Table A8 Kaena Point, February 18, 2010

Kaena Pt02-18-10

Input file	Source	Call type	Start time
LTSAout.ltsa	Event Category	Clicks only	12:00 AM
00006627.e.wav	Clicks	Sonar only >1/2 rec	12:15 AM
00006628.e.wav	Clicks	Sonar only >1/2 rec	12:20 AM
00006629.e.wav	Clicks	Sonar only >1/2 rec	12:25 AM
LTSAout.ltsa	Event Category	Clicks only	2:00 AM
00006657.e.wav	Clicks	Sonar only <1/2 rec	2:45 AM
00006656.e.wav	Clicks	Sonar only <1/2 rec	2:40 AM
LTSAout.ltsa	Event Category	Clicks only	3:00 AM
00006666.e.wav	Clicks	Sonar only >1/2 rec	3:30 AM
LTSAout.ltsa	Event Category	Clicks only	5:00 AM
00006684.e.wav	Clicks	Sonar only >1/2 rec	5:00 AM
00006686.e.wav	Clicks	Sonar only <1/2 rec	5:10 AM
LTSAout.ltsa	Event Category	Clicks only	6:00 AM
00006700.e.wav	Clicks	Sonar only <1/2 rec	6:20 AM
00006701.e.wav	Clicks	Sonar only >1/2 rec	6:25 AM
00006705.e.wav	Clicks	Sonar only <1/2 rec	6:45 AM
LTSAout.ltsa	Event Category	HF Whistles & Clicks	1:00 PM
00006782.e.wav	Whistles & Clicks	1-5 & sonar or BP	1:10 PM

this day was pretty quiet (dolphin-wise) but showed a large presence of whales! Very loud whales

Table A9 Kauai Location 4 (SW), February 16-19, 2009

Input file	Source	Call type	Start time	End time	Frequency 1	Comments
LTSAout.ltsa	Event Category	Clicks only	2/16/09 2:00 AM			
00001618.e.wav	Clicks	Sonar only <1/2 rec	2/16/09 2:50 AM			
LTSAout.ltsa	other		2/16/09 5:05 AM	2/16/09 5:45 AM		BOAT
LTSAout.ltsa	other		2/16/09 9:25 AM	2/16/09 9:45 AM	2832.63	LF SONAR
LTSAout.ltsa	other		2/16/09 10:50 AM	2/16/09 11:50 AM	3251.84	LF SONAR
LTSAout.ltsa	other		2/16/09 1:00 PM	2/16/09 1:25 PM	2692.89	LF SONAR
LTSAout.ltsa	other		2/16/09 5:35 PM	2/16/09 5:40 PM	26727.8	SONAR
LTSAout.ltsa	Event Category	HF Whistles only	2/16/09 6:00 PM			
00001804.e.wav	Whistles	>10	2/16/09 6:20 PM			
00001805.e.wav	Whistles	>10	2/16/09 6:25 PM			
00001807.e.wav	Whistles	>10	2/16/09 6:35 PM			
LTSAout1.ltsa	Event Category	HF Whistles & Clicks	2/16/09 10:00 PM			
00001851.e.wav	Whistles	1-5	2/16/09 10:15 PM			
00001858.e.wav	Clicks	Sonar only >1/2 rec	2/16/09 10:50 PM			
00001859.e.wav	Whistles & Clicks	1-5 & sonar or BP	2/16/09 10:55 PM			
00001859.e.wav	other		2/16/09 10:55 PM		2972.37	LF SONAR
00001858.e.wav	other		2/16/09 10:50 PM		2972.37	LF SONAR
LTSAout1.ltsa	other		2/17/09 1:20 AM	2/17/09 1:30 AM		BOAT
00001917.e.wav	other		2/17/09 3:45 AM		3391.58	LF SONAR
00001918.e.wav	other		2/17/09 3:50 AM		3112.1	LF SONAR
00001921.e.wav	other		2/17/09 4:05 AM		2832.6288	LF SONAR
LTSAout1.ltsa	other		2/17/09 4:25 AM	2/17/09 5:10 AM	3112.1	LF SONAR
LTSAout1.ltsa	other		2/17/09 10:55 AM	2/17/09 11:50 AM	2832.63	LF SONAR
LTSAout1.ltsa	other		2/17/09 2:20 PM	2/17/09 2:25 PM	3251.84	LF SONAR
LTSAout1.ltsa	other		2/17/09 3:25 PM	2/17/09 3:35 PM		BOAT
LTSAout1.ltsa	other		2/17/09 3:50 PM	2/17/09 4:50 PM	2832.63	LF SONAR
LTSAout1.ltsa	other		2/17/09 5:45 PM	2/17/09 5:55 PM		BOAT
LTSAout1.ltsa	other		2/17/09 6:15 PM	2/17/09 7:00 PM	2553.15	LF SONAR

File	Category	Subcategory	Start	End	Value	Source
LTSAout1.ltsa	other		2/17/09 7:25 PM	2/17/09 7:50 PM	3391.58	LF SONAR
LTSAout1.ltsa	other		2/17/09 11:25 PM	2/17/09 11:50 PM	2972.37	LF SONAR
LTSAout1.ltsa	other		2/18/09 12:00 AM	2/18/09 12:50 AM	2692.89	LF SONAR
LTSAout1.ltsa	Event Category	HF Whistles & Clicks	2/18/09 12:00 AM			
00002166.e.wav	Whistles & Clicks	1-5 & sonar or BP	2/18/09 12:30 AM			
00002167.e.wav	Clicks	Sonar only <1/2 rec	2/18/09 12:35 AM			
00002169.e.wav	Clicks	Sonar only >1/2 rec	2/18/09 12:45 AM			
LTSAout1.ltsa	other		2/18/09 1:15 AM	2/18/09 1:30 AM		BOAT
LTSAout1.ltsa	other		2/18/09 2:05 AM	2/18/09 3:35 AM	3531.32	LF SONAR
LTSAout1.ltsa	other		2/18/09 5:35 AM	2/18/09 5:55 AM	4230.01	LF SONAR
00002235.e.wav	other		2/18/09 6:15 AM		4090.2707	LF SONAR
LTSAout1.ltsa	Event Category	HF Whistles & Clicks	2/18/09 6:00 AM			
00002238.e.wav	Whistles & Clicks	1-5 & sonar or BP	2/18/09 6:30 AM			
00002240.e.wav	Whistles & Clicks	>10 & sonar or BP	2/18/09 6:40 AM			
00002241.e.wav	Whistles & Clicks	>10 & sonar or BP	2/18/09 6:45 AM			
LTSAout1.ltsa	Event Category	HF Whistles only	2/18/09 7:00 AM			
00002245.e.wav	Whistles	>10	2/18/09 7:05 AM			
00002254.e.wav	Whistles	1-5	2/18/09 7:50 AM			
LTSAout1.ltsa	other		2/18/09 8:25 AM	2/18/09 8:25 AM		BOAT
LTSAout1.ltsa	other		2/18/09 8:30 AM	2/18/09 8:40 AM		BOAT
LTSAout1.ltsa	other		2/18/09 8:15 AM	2/18/09 9:00 AM	2692.89	LF SONAR
LTSAout1.ltsa	Event Category	LF Whistles only	2/18/09 9:00 AM			
00002278.e.wav	Whistles	6-10	2/18/09 9:50 AM			
LTSAout1.ltsa	other		2/18/09 10:00 AM	2/18/09 10:05 AM		BOAT
LTSAout1.ltsa	other		2/18/09 10:20 AM	2/18/09 10:30 AM		BOAT
LTSAout1.ltsa	other		2/18/09 11:10 AM	2/18/09 11:20 AM		BOAT
LTSAout1.ltsa	Event Category	HF Whistles only	2/18/09 11:00 AM			
00002300.e.wav	Whistles	1-5	2/18/09 11:40 AM			
LTSAout1.ltsa	other		2/18/09 12:45 PM	2/18/09 1:00 PM		BOAT
LTSAout1.ltsa	other		2/18/09 1:10 PM	2/18/09 1:25 PM	2553.15	LF SONAR

LTSAout1.ltsa	other		2/18/09 3:15 PM	2/18/09 3:25 PM		BOAT
LTSAout1.ltsa	Event Category	Clicks only	2/18/09 6:00 PM			
00002381.e.wav	Clicks	Sonar only >1/2 rec	2/18/09 6:25 PM			
00002382.e.wav	Clicks	Sonar only <1/2 rec	2/18/09 6:30 PM			
LTSAout1.ltsa	other		2/18/09 6:35 PM	2/18/09 7:05 PM	2692.89	LF SONAR
LTSAout1.ltsa	Event Category	Clicks only	2/18/09 7:00 PM			
00002389.e.wav	Clicks	Sonar only <1/2 rec	2/18/09 7:05 PM			
00002393.e.wav	Clicks	Sonar only <1/2 rec	2/18/09 7:25 PM			
00002395.e.wav	Clicks	Sonar only >1/2 rec	2/18/09 7:35 PM			
LTSAout1.ltsa	Event Category	Clicks only	2/18/09 9:00 PM			
00002417.e.wav	Clicks Whistles &	Sonar only >1/2 rec	2/18/09 9:25 PM			
00002418.e.wav	Clicks Clicks	1-5 Sonar & BP	2/18/09 9:30 PM			
00002419.e.wav		Sonar only >1/2 rec	2/18/09 9:35 PM			
LTSAout1.ltsa	Event Category	HF Whistles & Clicks	2/18/09 10:00 PM			
00002426.e.wav	Whistles & Clicks	6-10 & sonar or BP	2/18/09 10:10 PM			
00002429.e.wav	Clicks	Sonar only >1/2 rec	2/18/09 10:25 PM			
00002432.e.wav	Clicks	Sonar only >1/2 rec	2/18/09 10:40 PM			
LTSAout1.ltsa	Event Category	HF Whistles & Clicks	2/19/09 1:00 AM			
00002466.e.wav	Whistles & Clicks	1-5 & sonar or BP	2/19/09 1:30 AM			
00002467.e.wav	Clicks	Sonar only >1/2 rec	2/19/09 1:35 AM			
LTSAout1.ltsa	other		2/19/09 1:35 AM	2/19/09 2:25 AM	2832.63	LF SONAR
LTSAout1.ltsa	other		2/19/09 4:00 AM	2/19/09 5:05 AM	2692.89	LF SONAR
LTSAout1.ltsa	Event Category	Clicks only	2/19/09 6:00 AM			
00002523.e.wav	Clicks	Sonar only >1/2 rec	2/19/09 6:15 AM			
00002525.e.wav	Clicks	Sonar only >1/2 rec	2/19/09 6:25 AM			
00002528.e.wav	Clicks	Sonar only >1/2 rec	2/19/09 6:40 AM			
LTSAout1.ltsa	other		2/19/09 7:15 AM	2/19/09 7:25 AM		BOAT
LTSAout1.ltsa	other		2/19/09 8:25 AM	2/19/09 8:55 AM		BOAT
LTSAout1.ltsa	other		2/19/09 10:30 AM	2/19/09 10:30 AM		BOAT
LTSAout1.ltsa	other		2/19/09 11:00 AM	2/19/09 11:10 AM		BOAT

File	Category	Detail	Start	End	Value	Type
LTSAout1.ltsa	other		2/19/09 11:40 AM	2/19/09 12:00 PM	12195.1	12 kHz SONAR
LTSAout1.ltsa	other		2/19/09 12:05 PM	2/19/09 12:15 PM	3391.58	LF SONAR
LTSAout1.ltsa	other		2/19/09 1:05 PM	2/19/09 1:10 PM	2692.89	LF SONAR
LTSAout1.ltsa	other		2/19/09 3:15 PM	2/19/09 3:20 PM		BOAT
LTSAout1.ltsa	Event Category	Clicks only	2/19/09 10:00 PM			
00002722.e.wav	Clicks	Sonar only >1/2 rec	2/19/09 10:50 PM			
00002723.e.wav	Clicks	Sonar only >1/2 rec	2/19/09 10:55 PM			
LTSAout1.ltsa	Event Category	Clicks only	2/19/09 11:00 PM			
00002724.e.wav	Clicks	Sonar only >1/2 rec	2/19/09 11:00 PM			
00002725.e.wav	Clicks	Sonar only >1/2 rec	2/19/09 11:05 PM			
00002726.e.wav	Clicks	Sonar only >1/2 rec	2/19/09 11:10 PM			

Table A10 Kauai, Location 4 (SW), May 5, 2009

Input file	Source	Call type	Start time	End time	Comments
LTSAout.ltsa	Event Category	Clicks only	5/5/09 0:00		
00024048.e.wav	Clicks	Sonar only >1/2 rec	5/5/09 0:00		
00024049.e.wav	Clicks	Sonar only >1/2 rec	5/5/09 0:05		
LTSAout.ltsa	Event Category	HF Whistles only	5/5/09 1:00		
00024066.e.wav	Whistles	1-5	5/5/09 1:30		
LTSAout.ltsa	Event Category	HF Whistles & Clicks	5/5/09 3:00		
00024085.e.wav	Clicks	Sonar only >1/2 rec	5/5/09 3:05		
00024094.e.wav	Whistles & Clicks	1-5 & sonar or BP	5/5/09 3:50		
00024095.e.wav	Whistles & Clicks	1-5 & sonar or BP	5/5/09 3:55		
LTSAout.ltsa	Event Category	Clicks only	5/5/09 4:00		
00024096.e.wav	Clicks	Sonar only >1/2 rec	5/5/09 4:00		
00024099.e.wav	Clicks	Sonar only <1/2 rec	5/5/09 4:15		
LTSAout.ltsa	other		5/5/09 6:10	5/5/09 6:40	BOAT
LTSAout.ltsa	other		5/5/09 7:20	5/5/09 7:41	BOAT
LTSAout.ltsa	Event Category	HF Whistles only	5/5/09 8:00		
00024145.e.wav	Whistles	1-5	5/5/09 8:05		
00024147.e.wav	Whistles	1-5	5/5/09 8:15		
00024150.e.wav	Whistles	1-5	5/5/09 8:30		
LTSAout.ltsa	other		5/5/09 10:00	5/5/09 10:10	BOAT
LTSAout.ltsa	other		5/5/09 11:00	5/5/09 11:05	BOAT
LTSAout.ltsa	other		5/5/09 11:15	5/5/09 11:25	BOAT
LTSAout.ltsa	other		5/5/09 13:10	5/5/09 13:35	BOAT
LTSAout.ltsa	other		5/5/09 15:10	5/5/09 15:30	BOAT

Table A11 Kauai, Location 5 (NW), September 13-21, 2009

Kauai-Loc 5 Sept 13-21

Input file	Source	Call type	Start time
LTSAout.ltsa	Event Category	LF Whistles only	9/13/09 18:00
00027645.e.wav	Whistles	6-10	9/13/09 18:45
LTSAout.ltsa	Event Category	Clicks only	9/13/09 21:00
00027681.e.wav	Clicks	Sonar only <1/2 rec	9/13/09 21:45
00027682.e.wav	Clicks	Sonar & BP <5	9/13/09 21:50
00027683.e.wav	Clicks	Sonar only >1/2 rec	9/13/09 21:55
LTSAout.ltsa	Event Category	LF Whistles & Clicks	9/13/09 22:00
00027684.e.wav	Whistles & Clicks	1-5 & sonar or BP	9/13/09 22:00
00027685.e.wav	Clicks	Sonar only <1/2 rec	9/13/09 22:05
00027686.e.wav	Clicks	Sonar only <1/2 rec	9/13/09 22:10
LTSAout.ltsa	Event Category	HF Whistles only	9/18/09 10:01
00028989.e.wav	Whistles	1-5	9/18/09 10:45
00028990.e.wav	Whistles	6-10	9/18/09 10:50
00028991.e.wav	Whistles	6-10	9/18/09 10:55
LTSAout.ltsa	Event Category	HF Whistles only	9/18/09 11:00
00028992.e.wav	Whistles	1-5	9/18/09 11:00
00028995.e.wav	Whistles	6-10	9/18/09 11:15
LTSAout.ltsa	Event Category	HF Whistles only	9/18/09 17:10
00029065.e.wav	Whistles	6-10	9/18/09 17:15
00029066.e.wav	Whistles	6-10	9/18/09 17:20
LTSAout.ltsa	Event Category	HF Whistles & Clicks	9/21/09 0:00
00029696.e.wav	Whistles & Clicks	1-5 & sonar or BP	9/21/09 0:25
00029698.e.wav	Whistles & Clicks	1-5 & sonar or BP	9/21/09 0:35
00029701.e.wav	Whistles	1-5	9/21/09 0:55
LTSAout.ltsa	Event Category	Clicks only	9/21/09 2:00
00029722.e.wav	Clicks	Sonar only <1/2 rec	9/21/09 2:45

00029723.e.wav	Clicks	Sonar only <1/2 rec	9/21/09 2:50
00029724.e.wav	Clicks	Sonar only <1/2 rec	9/21/09 2:55
LTSAout.ltsa	other		9/21/09 11:10
00029821.e.wav	8282.41	LF Sonar	9/21/09 11:25

Table A12 Humpback whale detections on Oahu and Kaui

OAHU	Barber's Point	20102009	Very few whales (not too loud) present mostly between 14-16h and 18-21h
		20100218	Quiet whale calls occurred all throughout the day except with loud boats and sonars (15-23h)
		20100330_20100331	Very few whales were recorded and they were only recorded when no boats were around
	Kaena Pt.	20091117_1118	No whales were recorded during these two days
		20100218	Very loud whale songs were recorded throughout most of the day (00-14h)
KAUAI	Loc 4 (SW)	20090216_20090219	Whale songs were recorded very regularly during this four-day period