# Passive Acoustic Monitoring in the SOCAL Range Complex and Morro Bay from August 2023 to December 2024 and CalCOFI Surveys 2023 to 2024

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*HARP deployment off the R/V Bob and Betty Beyster*

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Passive acoustic monitoring was conducted in the Navy's Southern California (SOCAL) Range Complex from August 2023 to December 2024 in four locations to detect marine mammal and anthropogenic sounds. A new monitoring site was established offshore Morro Bay. Four CalCOFI cruises were conducted from fall 2023 to summer 2024 and included a total of 86 days at sea. Several active research projects within our lab group utilize data from sites funded by the Navy, contributing to significant advancements in marine mammal acoustics and ecosystem monitoring. In 2024 alone, these projects have resulted in multiple publications and conference presentations

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## *Passive Acoustic Monitoring*

Passive acoustic monitoring was conducted in the Navy's Southern California (SOCAL) Range Complex from August 2023 to December 2024 to detect marine mammal and anthropogenic sounds. A new monitoring site was established offshore Morro Bay.

High-frequency Acoustic Recording Packages (HARPs) recorded sounds between 10 Hz and 100 kHz at four locations in the SOCAL range: one site south of the Channel Islands (33.54, -120.26, 1,300 m depth, site W), two sites west of San Clemente Island (32.66, -119.48, 1,300 m depth, site E and 32.85, -119.15, 1,200 m depth, site H), and one site southwest of San Clemente Island (32.37, -118.56, 1,300 m depth, site N) to improve noise monitoring for the SOCAL range (Figure 1; Table 1-4).

The Morro Bay monitoring site (35.54, -121.78, 1000 m depth, site WEA_MBA) was occupied for the first time on November 5, 2024 (Figure 1) and is set to record for 12 months.

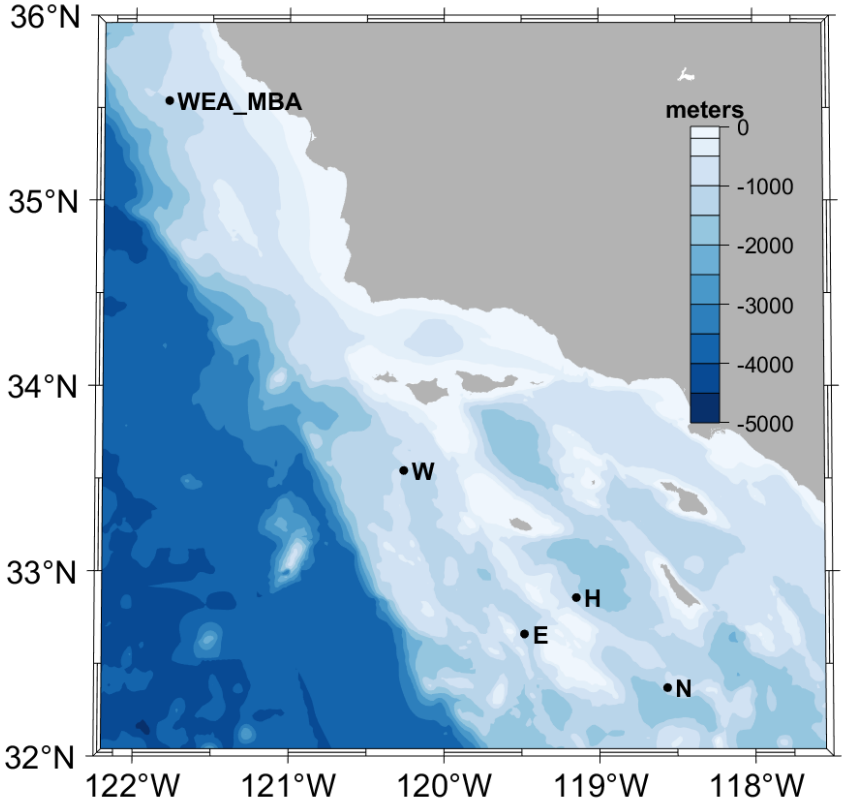


**Figure 1.** Locations of High-frequency Acoustic Recording Package (HARP) deployment sites W, E, H, and N in the SOCAL study area from August 2023 to December 2024. Color indicates bathymetric depth, shading represents 500 m depth increments.

**Table 1.** SOCAL Range Complex acoustic monitoring at site E since January 2009. Periods of instrument deployment funded over the last year are shown in bold. Deployment 66 did not record due to the implosion of instrument floats during deployment.

| Deployment # | Monitoring Period | # Hours |
|---|---|---|
| 31 | 1/13/09 – 3/9/09 | 1302 |
| 32 | 3/13/09 – 5/7/09 | 1302 |
| 33 | 5/19/09 – 7/12/09 | 1302 |
| 34 | 7/24/09 – 9/16/09 | 1302 |
| 61 | 3/5/17 – 7/10/17 | 3063 |
| 62 | 7/11/17 – 2/10/18 | 5148 |
| 63 | 3/15/18 – 7/11/18 | 2843 |
| 64 | 7/12/18 – 11/28/18 | 3356 |
| 65 | 11/29/18 – 5/7/19 | 3838 |
| 66 | - | - |
| 67 | 11/9/19 – 5/8/20 | 4362 |
| 68 | 5/9/20–10/29/20 | 4170 |
| 69 | 10/29/20–4/24/21 | 4247 |
| 70 | 4/25/21 – 10/28/21 | 4474 |
| 71 | 11/19/21 – 5/24/22 | 4435 |
| 72 | 5/24/22 – 10/13/22 | 3408 |
| 73 | 10/13/22 – 7/02/23 | 6288 |
| **74** | **7/05/23 – 10/31/23** | **2856** |
| **75** | **11/01/23 – 05/15/24** | **4704** |
| **76** | **5/16/24 – 11/10/24** | **4272** |

**Table 2.** SOCAL Range Complex acoustic monitoring at site H since January 2009. Periods of instrument deployment funded over the last year are shown in bold. Missing deployments are the result of hydrophone failures.

| Deployment # | Monitoring Period | # Hours |
|---|---|---|
| 31 | 1/13/09 – 3/8/09 | 1320 |
| 32 | 3/14/09 – 5/7/09 | 1320 |
| 33 | 5/19/09 – 6/13/09 | 600 |
| 34 | 7/23/09 – 9/15/09 | 1296 |
| 35 | 9/25/09 – 11/18/09 | 1320 |
| 36 | 12/6/09 – 1/29/10 | 1296 |
| 37 | 1/30/10 – 3/22/10 | 1248 |
| 38 | 4/10/10 – 7/22/10 | 2472 |
| 40 | 7/23/10 – 11/8/10 | 2592 |
| 41 | 12/6/10 – 4/17/11 | 3192 |
| 44 | 5/11/11 – 10/12/11 | 2952 |

| | | |
|---|---|---|
| 45 | 10/16/11 – 3/5/12 | 3024 |
| 46 | 3/25/12 – 7/21/12 | 2856 |
| 47 | 8/10/12 – 12/20/12 | 3192 |
| 48 | 12/21/12 – 4/30/13 | 3140 |
| 49 | - | - |
| 50 | 9/10/13 – 1/6/14 | 2843 |
| 51 | 1/7/14 – 4/3/14 | 2082 |
| 52 | 4/4/14 – 7/30/14 | 2814 |
| 53 | 7/30/14 – 11/5/14 | 2340 |
| 54 | 11/5/14 – 2/4/15 | 2198 |
| 55 | 2/5/15 – 6/1/15 | 2800 |
| 56 | 6/2/15 – 10/3/15 | 2952 |
| 57 | - | - |
| 58 | 11/21/15 – 4/25/16 | 3734 |
| 59 | 7/6/16 – 11/9/16 | 3011 |
| 60 | - | - |
| 61 | 2/22/17 – 6/6/17 | 2518 |
| 62 | 6/7/17 – 10/4/17 | 2879 |
| 63 | 10/5/17 – 11/3/17 | 707 |
| 65 | 7/9/18 – 11/28/18 | 3413 |
| 66 | 11/29/18 – 5/5/19 | 3784 |
| 67 | 6/1/19 – 12/8/19 | 4557 |
| 68 | 12/8/19 – 5/8/20 | 3644 |
| 69 | 5/9/20–10/29/20 | 4172 |
| 70 | 10/29/20–4/24/21 | 4245 |
| 71 | 4/25/21 – 7/30/21 | 2321 |
| 72 | 7/30/21 – 12/18/21 | 3387 |
| 73 | 12/21/21 – 5/22/22 | 3667 |
| 74 | 5/23/22 – 10/15/22 | 3480 |
| 75 | 10/16/22 – 4/17/23 | 4392 |
| **76** | **04/18/23 – 10/12/23** | **4248** |
| **77** | **11/01/23 – 05/15/24** | **4704** |
| **78** | **05/15/24-11/10/23** | **4296** |

**Table 3.** SOCAL Range Complex acoustic monitoring at site N since January 2009. Periods of instrument deployment funded over the last year are shown in bold. Deployment 50 yielded no usable data due to flooding of the instrument from a hardware failure. Data from deployment 58 in italics were only used for high frequency analysis with failure of the low frequency hydrophone component.

| Deployment # | Monitoring Period | # Hours |
|---|---|---|
| 31 | 1/14/09 – 3/9/09 | 1296 |
| 32 | 3/14/09 – 5/7/09 | 1320 |
| 33 | 5/19/09 – 7/12/09 | 1296 |
| 34 | 7/22/09 – 9/15/09 | 1320 |
| 35 | 9/26/09 – 11/19/09 | 1296 |
| 36 | 12/6/09 – 1/26/10 | 1224 |
| 37 | 1/31/10 – 3/26/10 | 1296 |
| 38 | 4/11/10 – 7/18/10 | 2352 |
| 40 | 7/23/10 – 11/8/10 | 2592 |
| 41 | 12/7/10 – 4/9/11 | 2952 |
| 44 | 5/12/11 – 9/23/11 | 3216 |
| 45 | 10/16/11 – 2/13/12 | 2904 |
| 46 | 3/25/12 – 8/5/12 | 3216 |
| 47 | 8/10/12 – 12/6/12 | 2856 |
| 48 | 12/20/12 – 5/1/13 | 3155 |
| 49 | 5/2/13 – 9/11/13 | 3156 |
| 50 | - | - |
| 51 | 1/7/14 – 2/16/14 | 956 |
| 52 | 4/4/14 – 7/30/14 | 2817 |
| 53 | 7/30/14 – 11/5/14 | 2342 |
| 54 | 11/4/14 -2/5/15 | 2196 |
| 55 | 2/5/15 – 2/23/15 | 433 |
| 56 | 6/2/15 – 10/3/15 | 2966 |
| 57 | 10/3/15 – 11/21/15 | 1168 |
| *58* | *11/21/15 – 4/18/16* | *3578* |
| 59 | 7/7/16 – 11/8/16 | 2999 |
| 60 | 11/9/16 – 2/21/17 | 2457 |
| 61 | 2/21/17 – 6/7/17 | 2528 |
| 62 | 6/7/17 – 12/21/17 | 4723 |
| 63 | 2/4/18 – 7/9/18 | 3722 |
| 64 | 7/9/18 – 11/28/18 | 3417 |
| 65 | 11/29/18 – 5/5/19 | 3768 |
| 66 | 5/5/19 – 11/7/19 | 4481 |
| 67 | 11/8/19 – 4/29/20 | 4148 |
| 68 | 4/29/20–10/15/20 | 4058 |
| 69 | 11/6/20–4/15/21 | 3861 |

| | | |
|---|---|---|
| 70 | 4/16/21 – 10/13/21 | 4337 |
| 71 | 11/19/21 – 5/13/22 | 4215 |
| 72 | 5/13/22 – 10/10/22 | 3600 |
| 73 | 11/12/22 – 4/18/23 | 3528 |
| **74** | **04/19/23 – 10/16/23** | **4320** |
| **75** | **11/04/23 – 5/24/24** | **4848** |
| **76** | **5/24/24 – 12/16/24** | **4944** |

**Table 4.** SOCAL Range Complex acoustic monitoring at site W since July 2021. Periods of instrument deployment funded over the last year are shown in bold.

| Deployment # | Monitoring Period | # Hours |
|---|---|---|
| 01 | 7/29/21 – 1/22/22 | 4248 |
| 02 | 3/10/22 – 5/27/22 | 1892 |
| 03 | 5/27/22 – 10/14/22 | 3359 |
| 04 | 10/17/22 – 4/15/23 | 4321 |
| **05** | **4/16/23 – 9/25/23** | **3889** |
| **06** | **9/26/23 – 5/13/24** | **5520** |
| **07** | **5/16/24 – 11/19/24** | **4273** |

## *CalCOFI Shipboard Visual and Acoustic Surveys*

Four CalCOFI cruises were conducted from fall 2023 to summer 2024 and included a total of 86 days at sea (Table 5). During the surveys, visual monitoring incorporated standard line-transect protocol during all daylight transits, while daytime acoustic monitoring employed sonobuoys deployed at oceanography sampling stations.

**Table 5.** Summary data from CalCOFI cruises between fall 2023 and fall 2024.

| Cruise | Cruise Dates |
|---|---|
| 2311SR | 11/04/23 – 11/19/23 |
| 2401RL | 01/10/24 – 01/31/24 |
| 2404SH | 03/26/24 – 04/20/24 |
| 2408SR | 07/27/24 – 08/11/24 |
| 2411SR | 11/15/24 – 11/24/24 |

# Science Products

Several active research projects within our lab group utilize data from sites funded by the Navy, contributing to significant advancements in marine mammal acoustics and ecosystem monitoring. In 2024 alone, these projects have resulted in multiple publications and conference presentations. More details on the scientific products that have leveraged passive acoustic data funded by the Navy can be found below.

## *Publications*

Published

Alksne, M. N., A. C. M. Kok, A. Agarwal, K. E. Frasier, and S. Baumann-Pickering. 2024. Biogeographic patterns of Pacific white-sided dolphins based on long-term passive acoustic records. Diversity and Distributions, e13903.

Posdaljian, N., A. Solsona-Berga, J. A. Hildebrand, C. Soderstjerna, S. M. Wiggins, K. Lenssen, and S. Baumann-Pickering. 2024. Sperm whale demographics in the Gulf of Alaska and Bering Sea/Aleutian Islands: An overlooked female habitat. PLoS ONE 19:e0285068.

Schoenbeck, C. M., A. Solsona-Berga, P. J. S. Franks, K. E. Frasier, J. S. Trickey, C. Aguilar, I. D. Schroeder, A. Širović, S. J. Bograd, G. Gopalakrishnan, and S. Baumann-Pickering. 2024. Ziphius cavirostris presence relative to the vertical and temporal variability of oceanographic conditions in the Southern California Bight. Ecology and Evolution 14:e11708.

Snyder, E. R., A. Solsona-Berga, S. Baumann-Pickering, K. E. Frasier, S. M. Wiggins, and J. A. Hildebrand. 2024. Where's Whaledo: A software toolkit for array localization of animal vocalizations. PLoS Computational Biology 20:e1011456.

Thompson, A. R., R. Swalethorp, M. Alksne, J. A. Santora, E. L. Hazen, A. Leising, E. Satterthwaite, W. J. Sydeman, C. R. Anderson, T. D. Auth, S. Baumann-Pickering, T. Baumgardner, E. P. Bjorkstedt, S. J. Bograd, N. M. Bowlin, B. J. Burke, E. A. Daly, H. Dewar, J. C. Field, J. L. Fisher, N. Garfield, A. Gidding, R. Goericke, R. Golightly, E. Gómez-Ocampo, J. Gomez-Valdes, J. A. Hildebrand, K. C. Jacobson, M. G. Jacox, J. Jahncke, M. Johns, J. M. Jones, B. Lavaniegos, N. Mantua, G. J. McChesney, M. E. Medina, S. R. Melin, L. E. Miranda, C. A. Morgan, C. F. Nickels, R. A. Orben, J. M. Porquez, A. Preti, R. R. Robertson, D. L. Rudnick, K. M. Sakuma, C. R. Schacter, I. D. Schroeder, L. Scopel, O. E. Snodgrass, S. A. Thompson, P. Warzybok, K. Whitaker, W. Watson, E. D. Weber, and B. Wells. 2024. State of the California Current Ecosystem report in 2022: a tale of two La Niñas. Frontiers in Marine Science 11.

In Press

Bloom, S. G., M. Alksne, A. C. Rice, A. Širović, J. D. Warren, M. Lankhorst, and S. Baumann-Pickering. (*in press)*. Seasonal changes in oceanographic conditions and mesoscale variability modulate cetacean predator-prey dynamics in the San Diego Trough. Marine Ecology Progress Series.

## *Conferences*

Arrieta, G. M., S. M. Wiggins, K. K. Cohen, B. J. Thayre, A. Širović, and S. Baumann-Pickering. 2024. Calling behavior and localization of blue whales in Southern California. Detection, Classification, Localization, and Density Estimation of Marine Mammals using Passive Acoustics Rotterdam, Netherlands.

Baggett, L. M., E. R. Snyder, A. Solsona-Berga, K. E. Frasier, J. A. Hildebrand, A. Širović, and S. Baumann-Pickering. 2024. Diving deep: 3D tracking of goose-beaked whale diving behavior in Southern California using fixed hydrophone arrays. Detection, Classification, Localization, and Density Estimation of Marine Mammals using Passive Acoustics, Rotterdam, Netherlands.

Schoenbeck C, Solsona-Berga A, Franks PJS, Frasier KE, Trickey JS, Aguilar C, Schroeder ID, Širović A, Bograd SJ, Gopalakrishnan G, Baumann-Pickering S. 2024. *Ziphius cavirostris* presence relative to vertical and temporal variability of oceanographic conditions in the Southern California Bight. Ocean Observing in California. Joint conference by SCCOOS, CeNCOOS, and CalCOFI. San Diego, CA.

## *Theses (MS and PhD)*

Arrietta, G. M. 2023. Calling behavior and localization of blue whales in Southern California. MS Thesis. University of California San Diego, La Jolla, CA.

Baggett, L. M. 2023. Long-term monitoring of Cuvier's beaked whale diving behavior in southern California using 3D tracking from fixed hydrophone arrays. MS Thesis. University of California San Diego, La Jolla, CA.

Posdaljian, N. 2023. A deep dive into sperm whale ecology using passive acoustic monitoring. PhD Thesis. University of California San Diego, La Jolla, CA, USA.

Schoenbeck, C. M. 2023. Cuvier's beaked whale (*Ziphius cavirostris*) presence relative to vertical and temporal variability of oceanographic conditions in the Southern California Bight. MS Thesis. University of California San Diego, La Jolla, CA.

Snyder, E. 2024. Studies using underwater acoustic tracking arrays. PhD Thesis. University of California San Diego, La Jolla, CA.