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## EXPERTISE

Underwater acoustics measurements and modeling, signal processing, marine mammal acoustics, acoustical oceanography, ocean engineering

## EDUCATION

<b>Ph.D.</b>	<b>Electrical Engineering (Applied Ocean Sciences)</b> Scripps Institution of Oceanography & Dept. of Electrical Engineering University of California, San Diego	2002
<b>M.S.</b>	<b>Electrical Engineering (Electronic Circuits and Systems)</b> Dept. of Electrical Engineering University of California, San Diego	1993
<b>B.S.</b>	<b>Physics</b> Dept. of Physics University of Illinois, Urbana-Champaign	1991

## EMPLOYMENT

<b>President/CEO</b> Greeneridge Sciences, Inc., San Diego, CA	2013–Present
<b>Senior Research Scientist</b> Greeneridge Sciences, Inc., San Diego, CA	2008–Present
<b>Senior Scientist</b> Heat, Light, & Sound Research, Inc., La Jolla, CA	2005–2008
<b>Graduate Researcher, Staff Scientist, Postgraduate Research Oceanographer</b> Scripps Institution of Oceanography, University of California, San Diego, CA	1993–2005

## SELECTED PROJECTS

- **Pinniped Monitoring during the Navy's Missile Launch Operations, San Nicolas Island, California (2008–Present):** Project Manager and Scientist for Naval Air Warfare Center Weapons Division's acoustic monitoring of missile launches over or near pinniped haul-out sites. Launch sounds and ambient sounds were analyzed for their levels and other acoustic characteristics, and missile overflights with potential to induce temporary and permanent threshold shifts (TTS, PTS) in pinnipeds exposed to launch sounds were determined.
- **Monitoring of Industrial Sounds, Seals, and Bowhead Whales Near BP/Hilcorp's Northstar Oil Development, Beaufort Sea, Alaska (2008–Present):** Project Manager and Scientist for marine mammal and acoustic monitoring program to assess effects of oil production activities on calling bowhead whales during autumn migration, using an array of Greeneridge's Directional Autonomous Seafloor Acoustic Recorders (DASARs). Bowhead whale, bearded seal, and walrus calls, and sounds from Northstar, vessels, helicopters, and seismic airguns were recorded and analyzed.
- **Long-Term Fixed Acoustic Monitoring of Marine Mammals throughout the Life Cycle of an Offshore E&P Field Development (2016–2020):** Project Manager and Scientist for the International Association of Oil & Gas Producers' program to assess the effectiveness of passive acoustics for whale density estimation. Led the team of scientists from industry and two academic institutions in this \$578K study.
- **Kwispaa LNG Project, British Columbia, Canada (2018–2019):** Project Manager and Scientist for Sarita LNG's \$1.3M baseline underwater noise and marine mammal measurement and acoustic modeling projects, developed by Greeneridge to assess potential impacts to marine biota resulting from proposed LNG terminal construction and operation.
- **Joint Monitoring Program in the Chukchi and Beaufort Seas (2008–2017):** Scientist for a marine mammal monitoring and mitigation program to assess impacts of oil and gas exploration activities on bowhead whale migration paths using 40 DASARs up to 55 km offshore and 280 km along Alaska's North Slope. Over 3 million bowhead calls were detected and localized using manual and automated methods.
- **Acoustic Monitoring of Beluga Whale Interactions with Cook Inlet Tidal Energy Project, Cook Inlet, Alaska (2010–2014):** Scientist for a DOE-sponsored program to use passive acoustic monitoring (PAM) to determine beluga whale presence and the baseline soundscape using seafloor-mounted recorders. Detected beluga calls throughout

5.5 months of continuous recording and pioneered successful measurement of ambient noise levels in a high-current environment.

- **Acoustic Monitoring of Odontocetes at the Navy's Southern California Offshore Range (SCORE) (2007):** Scientist for Scripps Institution of Oceanography's Marine Mammal Acoustics Group's CNO N45-sponsored PAM studies, which involved field testing of the Navy's M3R PAM system in combination with boat-based visual observations. Participated in fieldwork and developed automated detection, localization, and tracking algorithms to analyze terabytes of odontocete vocalizations, allowing tracking of free-ranging dolphin pods.
- **Acoustic Modeling of Seismic Airgun Effects on Sperm Whales, Gulf of Mexico (2007):** Scientist on the MMS-sponsored Sperm Whale Seismic Study. Analyzed location data from satellite-tagged whales, developed a site-specific waveguide model, predicted received levels using ocean acoustic propagation models, and utilized an ambient noise model to establish upper bounds on whale call detection range.

## PUBLICATIONS

- F. T. Petersma, L. Thomas, A. M. Thode, D. Harris, T. A. Marques, G. V. Cheoo, and K. H. Kim, "Accommodating False Positives Within Acoustic Spatial Capture-Recapture, with Variable Source Levels, Noisy Bearings and an Inhomogeneous Spatial Density," *JABES* (2023). <https://doi.org/10.1007/s13253-023-00563-0>
- L. Tenorio-Hallé, A. M. Thode, M. O. Lammers, A. S. Conrad, and K. H. Kim, "Multi-target 2D tracking method for singing humpback whales using vector sensors," *J. Acoust. Soc. Am.* **151**, 126–137 (2022). <https://doi.org/10.1121/10.0009165>
- C. S. Oedekoven, T. A. Marques, D. Harris, L. Thomas, A. M. Thode, S. B. Blackwell, A. S. Conrad, and K. H. Kim, "A comparison of three methods for estimating call densities of migrating bowhead whales using passive acoustic monitoring," *Environ. Ecol. Stat.* **29**, 101–125 (2022). <https://doi.org/10.1007/s10651-021-00506-3>
- A. M. Thode, R. G. Norman, A. S. Conrad, L. Tenorio-Hallé, S. B. Blackwell, and K. H. Kim, "Measurements of open-water arctic ocean noise directionality and transport velocity," *J. Acoust. Soc. Am.* **150**, 1954–1966 (2021).
- S. B. Blackwell, A. M. Thode, A. S. Conrad, M. C. Ferguson, C. L. Berchok, K. M. Stafford, T. A. Marques, and K. H. Kim, "Estimating acoustic cue rates in bowhead whales, *Balaena mysticetus*, during their fall migration through the Alaskan Beaufort Sea," *J. Acoust. Soc. Am.* **149**, 3611–3625 (2021).
- A. M. Thode, S. B. Blackwell, A. S. Conrad, K. H. Kim, T. Marques, L. Thomas, C. S. Oedekoven, D. Harris, and K. Broker, "Roaring and repetition: How bowhead whales adjust their call density and source level (Lombard effect) in the presence of natural and seismic airgun survey noise," *J. Acoust. Soc. Am.* **143**, 2061–2080 (2020).
- A. M. Thode, T. Sakai, J. Michalec, S. Rankin, M. S. Soldevilla, B. Martin, and K. H. Kim, "Displaying bioacoustic directional information from sonobuoys using "azigrams"," *J. Acoust. Soc. Am.* **146**, 95–102 (2019).
- S. B. Blackwell, C. S. Nations, A. M. Thode, M. E. Kauffman, A. S. Conrad, R. G. Norman, and K. H. Kim, "Effects of tones associated with drilling activities on bowhead whale calling rates," *PLoS ONE* **12**(11): e0188459(2017). <https://doi.org/10.1371/journal.pone.01188459>
- A. M. Thode, S. B. Blackwell, A. S. Conrad, K. H. Kim, and A. Michael Macrander, "Decadal-scale frequency shift of migrating bowhead whale calls in the shallow Beaufort Sea," *J. Acoust. Soc. Am.* **142**, 1482–1502 (2017).
- A. M. Thode, S. B. Blackwell, K. D. Seger, A. S. Conrad, K. H. Kim, and A. M. Macrander, "Source level and calling depth distributions of migrating bowhead whale calls in the shallow Beaufort Sea," *J. Acoust. Soc. Am.* **140**, 4288–4297 (2016).
- B. Streever, S. W. Raborn, K. H. Kim, A. D. Hawkins, and A. N. Popper, "Changes in fish catch rates in the presence of airgun sounds in Prudhoe Bay, Alaska," *Arctic* **69**(4), 346–358 (2016).
- A. M. Thode, K. H. Kim, R. G. Norman, S. B. Blackwell, and C. R. Greene, Jr., "Acoustic vector sensor beamforming reduces masking from underwater industrial noise during passive monitoring," *J. Acoust. Soc. Am.* **139**, EL105–EL111 (2016).
- S. B. Blackwell, C. S. Nations, T. L. McDonald, A. M. Thode, D. Mathias, K. H. Kim, C. R. Greene, Jr., and A. M. Macrander, "The effects of airgun sounds on bowhead whale calling rates: evidence for two behavioral thresholds," *PLoS ONE* **10**(6): e0125720 (2015). <https://doi.org/10.1371/journal.pone.0125720>
- J. Bonnel, A. M. Thode, S. B. Blackwell, K. H. Kim, and A. M. Macrander, "Range estimation of bowhead whale (*Balaena mysticetus*) calls in the Arctic using a single hydrophone," *J. Acoust. Soc. Am.* **136**, 145–155 (2014).
- S. B. Blackwell, T. L. McDonald, K. H. Kim, L. A. M. Aerts, W. J. Richardson, C. R. Greene, Jr., and B. S. Streever, "Directionality in the calls of bowhead whales," *Mar. Mam. Sci.* **28**, 200–212 (2012).

- A. M. Thode, K. H. Kim, S.B. Blackwell, C. R. Greene, Jr., C. S. Nations, T. L. McDonald, and A. M. Macrander, "Automated detection and localization of bowhead whale sounds in the presence of seismic airgun surveys," *J. Acoust. Soc. Am.* **131**:3726–3727 (2012).
- A. Thode, K. H. Kim, C. R. Greene, Jr., and E. Roth, "Long range transmission loss of broadband seismic pulses in the Arctic under ice-free conditions," *J. Acoust. Soc. Am.* **128**, EL181–EL187 (2010).
- K. H. Kim, S. B. Blackwell, C. R. Greene, Jr., A. Thode, T. McDonald, C. S. Nations, and A. M. Macrander, "Manual and automated detection, classification, and localization of bowhead whale calls in the Alaskan Beaufort Sea," *Proc. of the 4<sup>th</sup> International Workshop on Detection, Classification, Localization of Marine Mammals Using Passive Acoustics*, Pavia, Italy, 60 (2009).
- A. Thode, D. Mathias, S. B. Blackwell, K. H. Kim, and C. R. Greene, Jr., "Distinguishing FM-modulated bowhead whale calls from airgun and other biologic signals using image processing, feature extraction, and neural networks," *J. Acoust. Soc. Am.* **125**, 2737 (2009).
- A. Thode, D. Mathias, S. B. Blackwell, K. H. Kim, and C. R. Greene, Jr., "Automated detection and localization of nonstereotyped bowhead whale calls in the presence of seismic airgun signals, incorporating multiple directional autonomous recording packages (DASARs)," *J. Acoust. Soc. Am.* **124**, 2506 (2008).
- D. Mathias, A. Thode, S. B. Blackwell, C. R. Greene, Jr., and K. H. Kim, "Automated classification of frequency-modulated bowhead whale calls using contour tracing and image segmentation methods," *J. Acoust. Soc. Am.* **124**, 2506 (2008).
- K. H. Kim, P. Hursky, M. B. Porter, J. A. Hildebrand, E. Henderson, J. Calambokidis, and E. Falcone., "Acoustic studies of dolphins in their natural habitat: Challenges and successes," *J. Acoust. Soc. Am.* **123**, 3363 (2008).
- A. Thode, M. Winsor, B. Mate, M. Howard, K. H. Kim, J. Diebold, and M. Tolstoy, "Estimates of chronic SNR exposure levels of sperm whales (*Physeter macrocephalus*) to airguns in the Gulf of Mexico," *J. Acoust. Soc. Am.* **123**, 2987 (2008).
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- K. H. Kim, P. Hursky, M. B. Porter, J. A. Hildebrand, E. E. Henderson, and S. M. Wiggins, "Automated passive acoustic tracking of dolphins in free-ranging pods," *Proc. of the Eighth European Conference on Underwater Acoustics*, Eds. S. Jesus and O. Rodriguez, Carvoeiro, Portugal, 329–334 (2006).
- K. H. Kim, P. Hursky, M. B. Porter, J. A. Hildebrand, E. E. Henderson, and S. M. Wiggins, "Dolphin pods of the Southern California Offshore Range: Localization and behavior," *J. Acoust. Soc. Am.* **119**, 3403 (2006).
- A. Thode and K. H. Kim, "Multiple-order derivatives of a waveguide acoustic field with respect to sound speed, density, and frequency," *J. Acoust. Soc. Am.* **116**, 3370–3383 (2004).
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- K. H. Kim and W. S. Hodgkiss, "Comparison of robust matched-field processing algorithms in a real, shallow water environment," *J. Acoust. Soc. Am.* **106**, 2127 (1999).
- W. S. Hodgkiss, J. J. Murray, G. L. D'Spain, K. H. Kim, N. O. Booth, P. W. Schey, and J. Rice, "HLA/VLA broadband adaptive beamforming detection performance comparison in shallow water," *J. Acoust. Soc. Am.* **98**, 2932 (1995).
- W. S. Hodgkiss, J. J. Murray, K. H. Kim, and G. L. D'Spain, "Broadband matched-field source localization with a horizontal line array in shallow water," *J. Acoust. Soc. Am.* **97**, 3291 (1995).