

DR. CHARLES R. GREENE  
President and Principal Scientist, Greeneridge Sciences, Inc.

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## EDUCATION

- 1978            Ph.D., Electrical Engineering, University of California, Santa Barbara
- 1957            B.S. and M.S., Electrical Engineering, Massachusetts Institute of Technology

## PROFESSIONAL INTERESTS

Underwater sound research, including studies of man-made and natural noises, transmission loss, and signal and noise coherency. Research with biologists studying the effects of underwater sound on the marine environment, especially on marine mammals.

## SOCIETIES AND MEMBERSHIPS

Acoustical Society of America  
(Member, Technical Committee on Animal Bioacoustics)  
Institute of Electrical and Electronics Engineers  
Sigma Xi, National Society for Scientific Research  
Society for Marine Mammalogy

## PROFESSIONAL EXPERIENCE

- 1983–present    Principal Scientist, Greeneridge Sciences, Inc., Santa Barbara, CA. Dr. Greene plans and conducts field projects involving underwater acoustics studies, primarily in the Arctic, including both summer (ice free) and winter (ice covered) conditions. He plans and directs signal and data analyses, interprets results and prepares reports and journal manuscripts.

Since forming Greeneridge Sciences, Dr. Greene has been performing research with biologists studying the behavior of arctic whales exposed to industrial sounds from drillships, dredges, icebreakers, aircraft, seismic surveys, and drillrigs on artificial gravel islands. Three projects involved passive localization of whales using their vocalization sounds received at wide baseline arrays of hydrophones. Others have involved directional sonobuoys, using real-time processing and displays of the directions to vocalizing animals. Most projects include studies of the ambient underwater sounds and transmission loss, including modeling to describe acoustical environments. Projects have been sponsored by oil companies and by the U.S. Department of the Interior.

Dr. Greene is currently responsible for Greeneridge Sciences' subcontracts with LGL for its study of the effects of seismic survey activities on arctic whales. He reviewed and summarized the available data and literature on underwater noise sources associated with offshore petroleum operations. Two reviews were conducted, one for the American Petroleum Institute and one included as a chapter in a book on effects of acoustic disturbances on marine mammals for the U.S. Minerals Management Service, Atlantic Region. He also wrote chapters on acoustic terminology and ambient noise for the book.

In September and October of 1985 and 1986, Dr. Greene conducted the acoustics portions of three studies in conjunction with LGL Ltd. for Shell Western E & P Inc. (2) and UNOCAL (1). The studies were designed to document the underwater noise environment associated with an offshore drillship operation. Long-term measurements documented the extreme and median noise levels of the drilling operation as well as noise from two icebreakers and several icebreaking supply vessels. In addition, moored arrays were used to monitor bowhead movements and sonobuoys were used to document whale calls, ambient noise, and distant industrial noises.

During fall 1985, Dr. Greene directed acoustics research involving bowhead call monitoring and industrial noise measurement at the drillship site Hammerhead for UNOCAL, and at an artificial gravel island (Sandpiper) for Shell Western. The Hammerhead project also involved sound source localization using a five-hydrophone moored array. He measured icebreaking sounds from **Robert Lemeur** at Corona in October 1985.

In spring 1985, Dr. Greene completed a project for the U.S. Minerals Management Service involving studies of bowhead whales and offshore industrial noise in the Canadian Beaufort Sea, 1980-85. This project included studies of underwater sounds from bowheads, boats, aircraft, geophysical surveys using airgun arrays, dredges, and island construction activities.

In September-October 1984, Dr. Greene conducted the acoustics phase of the LGL/Greeneridge study of Seal Island and bowhead whales for Shell Western E & P. The study included measurements of ambient noise, industrial noise and bowhead locations using a wide baseline array of bottom-mounted hydrophones.

During June and July 1983, Dr. Greene measured sounds of the Canadian Coast Guard icebreaker **John A. MacDonald** breaking ice in Baffin Bay and Lancaster Sound. The research was for the Canadian Government and various Canadian industrial concerns. Measurements were made from ice pans by helicopter-deployed acoustic teams.

1988-93 Acoustic Systems Engineer, SAIC/MariPro, Goleta, CA. Dr. Greene has been responsible for testing and demonstrating the installed performance of hydrophone arrays to detect and localize underwater sound sources on a foreign military sale contract with the U.S. Navy. On a subsequent foreign commercial contract, Dr. Greene was responsible for testing and demonstrating an underwater torpedo tracking system.

1974-83 Senior Scientist, Polar Research Laboratory, Inc., Santa Barbara, CA. Dr. Greene's work involved scientific data analysis, equipment and instrument analysis and design, and technical management. He was concerned with the incorporation of seismic, meteorological, oceanographic, and acoustic sensors in data acquisition systems. Many of these systems included satellite data telemetry using ARGOS on the Nimbus satellites. Much of Dr. Greene's work at PRL involved studies of arctic underwater acoustics, including work based in arctic Alaska, Canada and Greenland. The work was primarily for the U.S. Navy.

From 1980 to 1982, Dr. Greene was responsible for PRL's work (through LGL for the Bureau of Land Management) concerning reactions of bowhead whales to industrial sounds associated with offshore oil and gas activities. This work included field recording and computer-assisted analysis of waterborne sounds from bowhead whales, boats, aircraft, seismic exploration, dredging, drillships, support vessels, and caisson-contained drilling structures.

In 1982, Dr. Greene also conducted three other studies on arctic underwater acoustics as related to marine mammals. On behalf of Shell Oil Co., he measured underwater sounds from construction of an artificial island (Seal Island) in the Alaskan Beaufort Sea. On behalf of the Canadian Government and a number of industrial concerns, he measured sounds from an icebreaking ore carrier that was breaking ice in the high arctic (Admiralty Inlet). On behalf of the Environmental Affairs Department of the American Petroleum Institute, he analyzed and reported on the sounds of the semi-submersible drilling rig **SEDCO 708** recorded near the Aleutian Islands.

1971-74 Senior Scientist, Anacapa Sciences, Inc., Santa Barbara, CA. Worked on sonar data display research, designed training devices and evaluated the human factors elements of submarine sonar consoles under U.S. Navy sponsorship.

1963-71 Senior Research Engineer, General Motors Corp., Santa Barbara, CA. Designed and evaluated a digital multibeam passive sonar for arctic installation. Conceived and demonstrated an effective analysis and display technique for bearing, frequency and time information from passive sonars. Developed specialized signal processors for passive sonars. Conducted arctic field experiments on low and high frequency under-ice acoustics, including ambient noise, absorption loss, propagation loss, and coherency. Evaluated the performance of three axis seismometers (geophones) on sea ice compared to hydrophones under-ice for detecting underwater acoustic signals.

1959-63 Instrumentation Engineer, Acoustics Division, U.S. Naval Ordnance Laboratory (now the Naval Surface Warfare Center, White Oak), Silver Spring, MD. Tested a system for acoustical communications to submarines. Developed techniques for tracking passive sonar targets. Conducted an arctic research project on underice ambient noise. Developed a one-bit hybrid crosscorrelator; patent award for this invention was shared with C.N. Pryor.

1957-59 Electronics Engineer, National Bureau of Standards, Boulder, CO. Maintained and operated the ionospheric physics, geomagnetic and seismology instruments for one year at the Amundsen-Scott IGY South Pole Station.

#### SOME RECENT REPORTS AND PUBLICATIONS

1998 Greene, C.R. Underwater acoustic noise and transmission loss during summer at BPXA's Liberty prospect in Foggy Island Bay, Alaskan Beaufort Sea. Greeneridge Rep. 189-1. Prepared for BP Exploration (Alaska) Inc., Anchorage, AK, by Greeneridge Sciences, Inc., Santa Barbara, CA, and LGL Ltd., environmental research associates, King City, Ontario, Canada. 47 p.

1998 Greene, C.R., J.S. Hanna and W.J. Richardson. MS. Ambient noise in leads and under pack ice in the Alaskan Beaufort Sea during spring.

- 1998 Hanna, J.S. and C.R. Greene. MS. Sound propagation in nearshore leads and below pack ice in the Alaskan Beaufort Sea during spring.
- 1998 Greene, C.R. in prep. Physical acoustics measurements. Chapter 3 *In: W.J. Richardson (ed.), Marine mammal and acoustical monitoring of BPXA's seismic program in the Alaskan Beaufort Sea, 1997. Rep. from LGL Ltd., King City, Ont., and Greeneridge Sciences, Santa Barbara, CA, for BP Explor. (Alaska) Inc., Anchorage, AK, and Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD.*
- 1997 Greene, C.R. Physical acoustics measurements. (Chap. 3, 63 p.) *In: W.J. Richardson (ed.), Northstar marine mammal monitoring program, 1996: Marine mammal and acoustical monitoring of a seismic program in the Alaskan Beaufort Sea. LGL Rep. 2121-2. Rep. from LGL Ltd., King City, Ont., and Greeneridge Sciences, Inc., Santa Barbara, CA, for BP Explor. (Alaska) Inc., Anchorage, AK, and Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD. 245 p.*
- 1995 Richardson, W.J., C.R. Greene Jr., C.I. Malme and D.H. Thomson. Marine mammals and noise. Academic Press, Inc., San Diego, CA. 576 p.
- 1991 Richardson, W.J., C.R. Greene Jr., W.R. Koski and M.A. Smultea. Acoustic effects of oil production activities on bowhead and white whales visible during spring migration near Pt. Barrow, Alaska--1990 phase: Sound propagation and whale responses to playbacks of continuous drilling noise from an ice platform, as studied in pack ice conditions. Rep. by LGL Ltd., envir. res. assoc., King City, Ontario, Canada, for U.S. Minerals Manage. Serv., Alaska OCS Region, Anchorage, AK.
- 1991 Richardson, W.J., C.R. Greene Jr., C.I. Malme and D.H. Thomson. Effects of noise on marine mammals. OCS Study MMS 90-0093. Rep. from LGL Ecol. Res. Assoc. Inc., Bryan, TX, for U.S. Minerals Manage. Serv., Atlantic OCS Region, Herndon, VA. 462 p. NTIS PB91-168914.
- 1990 Richardson, W.J., B. Würsig and C.R. Greene, Jr. Reactions of bowhead whales, *Balaena mysticetus*, to drilling and dredging noise in the Canadian Beaufort Sea. *Marine Environmental Research* **29**:139-160.
- 1989 Richardson, W.J., C.R. Greene, J.P. Hickie, R.A. Davis and D.H. Thomson. Effects of offshore petroleum operations on cold water marine mammals: A literature review. Second Edition. Am. Petroleum Inst. Publication No. 4485, Am. Petroleum Inst., Wash D.C. 420 p.
- 1989 Koski, W.R., C.R. Greene and R.A. Davis. Potential effects of exploratory drilling in nearshore waters of Camden Bay, Alaska on bowhead whales. Rep. by LGL Ltd., King City, and Greeneridge Sciences Inc., Santa Barbara, CA, for ARCO Alaska Inc., Anchorage. 57 p.
- 1988 Greene, C.R., Jr., and W.J. Richardson. Characteristics of marine seismic survey sounds in the Beaufort Sea. *J. Acoust. Soc. Am.* **83**(6):2246-2254.

- 1987 Greene, C.R. Responses of bowhead whales to an offshore drilling operation in the Alaskan Beaufort Sea, Autumn 1986: Acoustic studies of underwater noise and localization of whale calls. Report by LGL Ltd., King City, and Greeneridge Sciences Inc., Santa Barbara, for Shell Western E & P Inc., Anchorage, AK. 128 p.
- 1987 Greene, C.R., Jr. Characteristics of oil industry dredge and drilling sounds in the Beaufort Sea. *J. Acoust. Soc. Am.* **82**:1315-1324.
- 1987 Richardson, W.J. and C.R. Greene. Noise and marine mammals. *In: Environmental synthesis, Beaufort Sea Sale 87.* Nat. Oceanic & Atmos. Admin., Juneau, AK.
- 1986 Richardson, W.J., B. Würsig and C.R. Greene, Jr. Reactions of bowhead whales, *Balaena mysticetus*, to seismic exploration in the Canadian Beaufort Sea. *J. Acoust. Soc. Am.* **79**(4):1117-1128.
- 1986 McLaren, P.L., C.R. Greene, W.J. Richardson and R.A. Davis. Bowhead whales and underwater noise near a drillship operation in the Alaskan Beaufort Sea, 1985. Rep. by LGL Ltd. and Greeneridge Sciences, Inc., for UNOCAL Corporation, Anchorage, AK. 136 p.
- 1986 Johnson, S.R., C.R. Greene, R.A. Davis and W.J. Richardson. Bowhead whales and underwater noise near the Sandpiper Island drillsite, Alaskan Beaufort Sea, Autumn 1985. Rep. by LGL Ltd. and Greeneridge Sciences Inc., for Shell Western Explor. & Prod., Anchorage, AK. 129 p.
- 1986 Greene, C.R. Underwater sounds from a semisubmersible drillrig SEDCO 708 drilling in the Aleutian Islands. Rep. by Polar Res. Lab., Santa Barbara, CA, for Am. Petrol. Inst., Washington, DC. API Publ. No. 4438. 69 p.
- 1985 Davis, R.A., C.R. Greene and P.L. McLaren. Studies of the potential for drilling activities on Seal Island to influence fall migration of bowhead whales through Alaskan nearshore waters. Rep. by LGL Ltd., King City, for Shell Western E & P Inc., Anchorage, AK. 69 p.
- 1985 Richardson, W.J., C.R. Greene and B. Würsig. Project rationale and design. p. 1-11 *In: W.J. Richardson (ed.), Behavior, disturbance responses and distribution of bowhead whales *Balaena mysticetus* in the eastern Beaufort Sea, 1980-84.* OCS Study MMS 85-0034. Rep. from LGL Ecol. Res. Assoc., Inc., Bryan, TX, for U.S. Minerals Management Service, Reston, VA 306 p.
- 1985 Greene, C.R. Characteristics of waterborne industrial noise, 1980-84. p. 197-253 *In: W.J. Richardson (ed.), Behavior, disturbance responses and distribution of bowhead whales *Balaena mysticetus* in the eastern Beaufort Sea, 1980-84.* OCS Study MMS 85-0034. Rep. from LGL Ecol. Res. Assoc., Inc., Bryan, TX, for U.S. Minerals Management Service, Reston, VA. 306 p.
- 1985 Richardson, W.J., C.R. Greene and B. Würsig. Behavior, disturbance responses and distribution of bowhead whales *Balaena mysticetus* in the eastern Beaufort Sea, 1980-84: a summary. NTIS PB87-124368; OCS Study MMS 85-0034. Rep. for U.S. Minerals Management service, Reston, VA. 30 p.

- 1984 Finley, K.J., G.W. Miller, R.A. Davis and C.R. Greene. Responses of narwhals (*Monodon monoceros*) and belugas (*Delphinapterus leucas*) to icebreaking ships in Lancaster Sound - 1983. Canada Dept. Indian Affairs and Northern Development, Envir. Studies No. 37(1986). 117 p.
- 1984 Ljungblad, D.K., B. Würsig, R.R. Reeves, J.T. Clarke and C.R. Greene. Fall 1983 Beaufort Sea Seismic Monitoring and Bowhead Whale Behavior Studies. Rep. for Minerals Management Service, Alaska OCS Region. 188 p.
- 1984 Greene, C.R. Characteristics of waterborne industrial noise, 1983. p. 217-308 *In*: W.J. Richardson (ed.), Behavior, disturbance responses and distribution of bowhead whales *Balaena mysticetus* in the eastern Beaufort Sea, 1983. Chapter by Greeneridge Sciences, Inc., in Rep. from LGL Ecol. Res. Assoc., Inc., Bryan, TX, for U.S. Minerals Management Service, Reston, VA 361 p.
- 1983 Finley, K.J., C.R. Greene, and R.A. Davis. A study of ambient noise, ship noise, and the reactions of narwhals and belugas to the **MV Arctic** breaking ice in Admiralty Inlet, N.W.T.-1982. Rep. by LGL Ltd., for Canadian Dept. of Indian Affairs and Northern Development, Envir. Studies No. 37(1986). 108 p.
- 1983 Richardson, W.J., C.R. Greene, J.P. Hickie and R.A. Davis. Review of the effects of offshore petroleum operations on cold water marine mammals. Am. Petrol. Inst. Rep. No. 4370, Washington, D.C. 248 p.
- 1982 Greene, C.R. Characteristics of waterborne industrial noise. P. 249-346 *In*: W.J. Richardson (ed.), Behavior, disturbance responses and feeding of bowhead whales *Balaena mysticetus* in the eastern Beaufort Sea, 1980-81. Chapter by Polar Research Laboratory, Inc., in Rep. from LGL Ecol. Res. Assoc., Inc., Bryan, TX, for U.S. Bureau of Land Management, Washington, D.C. 456 p.
- 1981 Greene, C.R. Underwater acoustic transmission loss and ambient noise in arctic regions. p. 234-258 *In*: N.M. Peterson (ed.), The question of sound from icebreaker operations: the proceedings of a workshop. Arctic Pilot Project, Petro-Canada, Calgary, Alberta. 350 p.
- 1980 Buck, B.M. and C.R. Greene. A two-hydrophone method of eliminating the effects of nonacoustic noise interference in measurements of infrasonic ambient noise levels. J. Acoust. Soc. Am. **68**(5):1306-1308.
- 1978 Greene, C.R. and R.C. Wood. Sparse array performance. J. Acoust. Soc. Am. **63**(6):1166-1872.
- 1964 Greene, C.R. and B.M. Buck. Directional, spectral, and statistical properties of the under-ice noise in the Arctic. TR64-22. GM Defense Research Labs, Santa Barbara, CA 24 p.
- 1964 Greene, C.R. and B.M. Buck. Arctic Ocean ambient noise. J. Acoust. Soc. Am. **36**:1218-1220.

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NOTE: There were several unpublished reports prepared by Dr. Greene during the 1960s and delivered to the U.S. Navy on the results of field experiments involving sound wave detection using hydrophones and both horizontal and vertical axis geophones (small seismometers). Other reports addressed Dr. Greene's research on high frequency sound absorption under polar ice.