Ask an Acoustician: Sam H. Ridgway

Sam H. Ridgway

Address:
National Marine Mammal Foundation
2240 Shelter Island Drive
Suite 200
San Diego, California 92106
USA

Department of Pathology
School of Medicine
University of California, San Diego
9500 Gilman Drive
La Jolla, California 92093
USA

Email:
sam.ridgway@nmmpfoundation.org

Micheal L. Dent

Address:
Department of Psychology
University at Buffalo
State University of New York (SUNY)
B76 Park Hall
Buffalo, New York 14260
USA

Email:
mdent@buffalo.edu

Meet Sam H. Ridgway

In this issue, "Ask an Acoustician" features Sam H. Ridgway. Sam is president of the National Marine Mammal Foundation, San Diego, CA, and is known as the father of marine mammal medicine. He is a Fellow of the Acoustical Society of America (ASA) for his pioneering work on marine mammal hearing. Sam is also the recipient of numerous prestigious awards, including the Lifetime and Clinical Medicine Award from the International Association for Aquatic Animal Medicine and the Kenneth S. Norris Lifetime Achievement Award from the Society for Marine Mammalogy.

A Conversation with Sam Ridgway, in His Words

Tell us about your work.

I currently provide corporate memory, mentor professionals, and serve as a knowledge resource for the Navy Marine Mammal Program. My current work can be described in three words: dolphin, brain, and ear. We have just started a project, "Sounds as Indicators of Health and Welfare," where we will surreptitiously record dolphin sounds to identify their call repertoire. The dolphins will go about their regular tasks and behaviors without interference. We think that dolphin sound production may give us an early warning of their illnesses and injuries. To see if this is true, we must identify their individual sounds and the context and frequency of their use. Over the three years of the project, these data will be correlated with veterinary observations in our current care program. At the end of the project, we hope to be able to use sound to appreciate dolphin welfare, detect illness early, and keep them healthy.

I also look at brain structure to compare different cetacean species. I want to know how the auditory system scales in different-size brains (Ridgway et al., 2018). I also want to know how sound production is implemented by the two hemispheres of the brain. Dolphins pulse on the right side and "whistle" on the left side of the nasal system, and so it is possible that both sides of the brain are involved in interesting ways (Ridgway et al., 2015; Wright et al., 2017).

Describe your career path.

Growing up on a Texas farm, surrounded by livestock, I admired the work of veterinarians and chose that field at the age of 12. I did not deviate from my goal, and Texas A&M University, College Station, awarded me a Doctor of Veterinary Medicine 11 years later, in May 1960. Commissioned as a military veterinarian, I was ordered to a base in Ventura County, CA. Some of my responsibilities were

https://doi.org/10.1121/AT.2019.15.2.45

at nearby Point Mugu. There, the Navy was starting a study on marine mammal hydrodynamics, diving, and sonar, and I became Animal Health Officer. Excited by this challenge, I have been with the Navy Marine Mammal Program since, except for a fellowship to earn a PhD in neurobiology at the University of Cambridge, UK.

What is a typical day for you?
Before breakfast, I sit and grab my laptop and check two email accounts. After breakfast, I try and answer emails that are mostly from my coworkers. Later, I go in to the office for meetings with our different teams. I look out on our dolphin and sea lion areas and enjoy seeing boats coming to and fro taking animals out to sea for their daily ocean work. In between, I try and get some work on reports and papers. These days, I am at the office only 4 or 5 hours and then go back home.

Twenty to 50 years ago, my day was quite different. I would make rounds, checking all the animals, and perhaps go to sea for a test or experiment. I describe this in *The Dolphin Doctor* (Ridgway, 1987).

How do you feel when experiments projects do not work out the way you expected them to?
Some of my earliest experiments did not work out the way I expected. It was very exciting to me! I had to learn more and find out why.

Do you feel like you have solved the work-life balance problem? Was it always this way?
I was once given an award by some college classmates at a reunion: "Made It with Limited Capabilities." I quote from one of my mentors: "Sam possessed an inexhaustible energy along with a wide-ranging curiosity, an inventive mind, and a dogged persistence. He worked all day at the facility, usually came in on weekends to check the animals and administer needed medication, and spent his evenings writing technical papers. Within three years he had acquired an international reputation in the field of marine mammal medicine, and a couple of years later he was also becoming known as a physiologist" (Wood, 1973).

Fortunately, my wife Jeanette was an English teacher (later a college professor at the University of California, Los Angeles) who also had after hours work to do. Not long after our marriage in 1960, we learned we could not have children. Thus, life and work were intertwined in such a way as to allow for play in many gaps.

What makes you a good acoustician?
I stay in my own lane. When I have a problem, I ask my many friends in acoustics for help. A good acoustician must be involved in the field and must communicate with colleagues.

How do you handle rejection?
I immediately look for a work-around. I do not give up. If I get lemons, I try and make lemonade.

What are you proudest of in your career?
Some colleagues call me the father of marine mammal medicine. When, as a military veterinary officer and recent graduate, I was handed the task of keeping Navy marine mammals healthy, I had no knowledge of the subject and few resources to guide me. There were no other veterinarians working full time in the field. My efforts were supported by many mentors who knew the science but not the medicine. From such beginnings, we erected marine mammal medicine. Well over 100 individuals around the world practice it today.

We learned how to safely handle and treat dolphins in a safe and humane manner. For example, development of safe anesthesia allowed studies of the ear and brain that could not be done otherwise. Thus, medical knowledge served science. In 1965, I published a safe and humane method of dolphin anesthesia (Ridgway, 1965; McCormick and Ridgway, 2018). On the recommendation of W. E. (Bill) Schevill of Woods Hole, MA, E. G. Wever of Princeton, NJ (see acousticstoday.org/7408-2), and his graduate student James McCormick sought me out to work with them on dolphin hearing mechanisms. McCormick spent two summers with me at Point Mugu perfecting methods. Then I got to work several productive periods at the Princeton Auditory Research Laboratories. In the late 1960s, Jim Simmons, Jim Saunders, and Richard Fay were also there. It was an exciting time. On occasion, McCormick and I would work around the clock to complete an experiment. The experiments revealed not only the physiology of dolphin hearing but also the structure of the dolphin cochlea (McCormick et al., 1970; Wever et al., 1971).

The Princeton experiments baptized me in acoustics. In the 1970s, Don Carder, Bob Seeley, and I developed some methods for electrophysiological tests of dolphin hearing. We made many proposals to test this method on beached whales and dolphins. Along with C. Scott Johnson, we frequently needled our Navy sponsors about supporting more work on whale and dolphin hearing. In more recent years, our primitive methods have been made effective and modern

by Dorian Houser and James Finneran (e.g., Finneran et al., 2018). Finally, in the early 1990s (encouraged by Dennis McFadden and others), we got the first funding to look at temporary threshold shift (TTS) in dolphins and belugas.

This is the story. In 1995, I was in Washington, DC, and Kim DePaul of the Navy Environmental Office took me over to one of the Program Executive Officers who had a pending Environmental Impact Statement. Fortunately, I had my new 14-pound laptop (COMPAQ SLT/286). I set it up on a conference table and completed the proposal right there (to paraphrase President Theodore Roosevelt: "If you have them by the nuts, their hearts and minds will follow"). Tim McBride was a Navy environmental manager who helped move the project along. This funded proposal led to a long series of TTS tests to set safety criteria for marine mammal sound exposure for many species by many investigators. For me, the field leaped forward when the ASA gave James Finneran a Hunt Postdoctoral Fellowship, and he joined our group 19 years ago.

What is the biggest mistake you've ever made?

In acoustics, my biggest mistake was to miss the high-frequency narrowband pulses emitted by Dall porpoises. I had some of these interesting animals from 1964 to 1966 but published a low-frequency sonogram that apparently recorded only the envelope. Now we know that all porpoises (family Phocoenidae), including Dall porpoises, produce very short (50-ms) narrowband pulses centered at frequencies over 100 kHz. But I learned from the Dall porpoise mistake. When Don Carder and I went to Baltimore, MD, to test the hearing of a pygmy sperm whale, we were prepared. We were surprised to find that this little whale could echolocate almost continuously with high-frequency narrowband clicks similar to the porpoises. It had hearing sensitivity to match its clicks (Ridgway and Carder, 2001; Madsen et al., 2005).

What advice do you have for budding acousticians?

Learn math and how to calibrate instrumentation needed in the field.

Have you ever experienced imposter syndrome? How did you deal with that if so?

Yes! I experience imposter syndrome every time I am at an ASA meeting and the presenter starts showing complex equations. (Bill Schevill called this "sheet music.") I do not understand these. A good acoustician should understand. I calm myself by thinking "maybe I can help with anatomy."

What do you want to accomplish within the next 10 years or before retirement?

I agreed to do a book called the *Brains of Dolphins*. I also agreed on two book chapters. I hope to revise my old book *Mammals of the Sea: Biology and Medicine* (Ridgway, 1972). Also, I would like to do a sequel to *Dolphin Doctor*. And like all biologist and bioacoustics folks, there are observations still to publish. So that should take up 10 years!

References

Finneran, J. J., Mulsow, J., Jones, R., Houser, D. S., Accomando, A. W., and Ridgway, S. H. (2018). Non-auditory, electrophysiological potentials preceding dolphin biosonar click production. *Journal of Comparative Physiology* 204, 271-283.

Madsen, P. T., Carder, D. A., Bedholm, K., and Ridgway, S. H. (2005). Porpoise clicks from a sperm whale nose — Convergent evolution of 130 kHz pulses in toothed whale sonars? *Bioacoustics* 15, 195-206.

McCormick, J. G., and Ridgway, S. H. (2018). History of the development of anesthesia for the dolphin: A quest to study a brain as large as man's. *Anesthesiology* 129, 11-21.

McCormick, J. G., Wever, E. G., Palin, J., and Ridgway, S. H. (1970). Sound conduction in the dolphin ear. *The Journal of the Acoustical Society of America* 48, 1418-1428.

Ridgway, S., Dibble, D. S., Van Alstyne, K., and Price, D. (2015). On doing two things at once: Dolphin brain and nose coordinate sonar clicks, buzzes and emotional squeals with social sounds during fish capture. *Journal of Experimental Biology* 218, 3987-3995.

Ridgway, S. H. (1965). Medical care of marine mammals. *Journal of the American Veterinary Medical Association* 147, 1077-1085.

Ridgway, S. H. (1972). *Mammals of the Sea: Biology and Medicine*. Thomas, Springfield, IL.

Ridgway, S. H. (1987). *The Dolphin Doctor: A Pioneering Veterinarian Remembers the Extraordinary Dolphin That Inspired His Career*. Yankee Books, Dublin, NH.

Ridgway, S. H., and Carder, D. A. (2001). Assessing hearing and sound production in cetaceans not available for behavioral audiograms: Experiences with sperm, pygmy sperm, and gray whales. *Aquatic Mammals* 27, 267-276.

Ridgway, S. H., Carlin, K. P., and Van Alstyne, K. R. (2018). Delphinid brain development from neonate to adulthood with comparisons to other cetaceans and artiodactyls. *Marine Mammal Science* 34, 420-439.

Wever, E. G., McCormick, J. G., Palin, J., and Ridgway, S. H. (1971). The cochlea of the dolphin, *Tursiops truncatus:* General morphology. *Proceedings of the National Academy of Sciences of the United States of America* 68, 2381-2385.

Wood, F. G. (1973). *Marine Mammals and Man: The Navy's Porpoises and Sea Lions.* Robert B. Luce, Inc., Washington DC, p. 172.

Wright, A. K., Theilmann, R. J., Ridgway, S. H., and Scadeng, M. (2017). Diffusion tractography reveals pervasive asymmetry of cerebral white matter tracts in the bottlenose dolphin (*Tursiops truncatus*). *Brain Structure and Function* 223, 1697-1711.