Aquatic Mammals 2010, *36*(2), 205-212, DOI 10.1578/AM.36.2.2010.205

Historical Perspectives

Whitlow W. L. Au

Whitlow W. L. Au, Ph.D., is an expert in marine bioacoustics specializing in the biosonar of odontocetes. He is known for his work with the U.S. Navy dolphin program, from over 100 articles in *The Journal of the Acoustical Society of America*, as the author of *The Sonar of Dolphins* (1993) and senior-author of *Principles of Marine Bioacoustics* (2008) with Mardi Hastings, and as the senior editor of the book *Hearing by Whales and Dolphins* (2000) with Arthur Popper and Richard Fay. Dr. Au is the Chief Scientist of the Marine Mammal Research Program of the Hawaii Institute of Marine Biology at the University of Hawaii and is also past-president (2009) of the Acoustical Society of America.

A Short Biography

Whitlow W. L. Au

Marine Mammal Research Program, Hawaii Institute of Marine Biology, University of Hawaii

Never in my wildest dream did I imagine that I would spend a career studying marine mammals. However, the course of my career and my life cannot be discussed without interjecting a spiritual element—that is, guidance from our creator through His son Jesus Christ. At all major junctions in my life, prayer, inspiration, and divine guidance have been an important part of finding the "right" directions.

After graduating with a B.S. in Electrical Engineering from the University of Hawaii, my first assignment as a young Air Force officer was to obtain a master's degree in Electrical Engineering at Washington State University (WSU) followed by an assignment to the Air Force Weapons Laboratory (AFWL) in New Mexico. While at the AFWL, I applied and was accepted into an Air Force Ph.D. program. Immediately after accepting this appointment, I found myself disturbed at heart realizing that it was not the best decision for me and my family. When I reversed my decision (which the Air Force somehow allowed), I felt a great relief—as if a burden was lifted. Within a couple of days, I received a phone call from WSU offering me a graduate research assistantship. Thus, my scientific career started off with me studying radio wave propagation in the ionosphere of the earth, specializing in radar reflections off field-aligned irregularities in the F-layer of the ionosphere. I showed that diffraction of the radar signals from different stations around the world led to different times of maximum reflections, suggesting that a different part of the ionosphere was being examined. In reality, the same regions of the ionosphere were producing the radar echoes. I also showed that instability of the ionosphere plasma could be the cause of the charged particles aligning with the magnetic field lines. Most readers from the marine mammal science field have no idea about what I am writing. That's how strange my story is.

After graduating from WSU, I went to work at the Naval Underwater Warfare Laboratory (NUWL) in San Diego (throughout my 27-year career at this laboratory, its name changed about four times, and it is now known as the Space Warfare Systems Center – SPAWAR). During my first year with NUWL, I was in the New Professional (NP) program in which new hires work in different divisions for two to three months before finally choosing a more specific and permanent position. My first assignment in ocean acoustic propagation lasted six months, after which I wrangled an NP assignment in Hawaii to work on an underwater vehicle project. I told my wife Dorothy, "Let's go have a two-month vacation in Hawaii." Her parents were living in Hawaii at the time, and I was born and raised in Hawaii. It was during this second NP tour that I had a strong, overwhelming, unexplainable urge and desire to remain in Hawaii, in spite of my plan to work on underwater acoustic propagation in San Diego. That's when I ran into Dr. Evan Evans, who had a biosonar project with dolphins at the very same Hawaii Lab. Dr. Evans was also trying to start up an underwater environmental program, so his biosonar project was in need of someone to take it over. I was able to extend my NP tour for an additional three months in Hawaii and finally decided to stay in Hawaii after a six-month NP tour.

Evan Evans, to put it mildly, was a character not easily forgotten. His office was in the French Battery, which was a concrete structure built into the side of a hill as an artillery command post at the Kaneohe Marine Corps Station. It had been built after the surprise attack on Pearl Harbor, and it was intended to direct artillery guns (which had been removed years before) in case of any invasions. It was literally a cave, with large steel doors reaching a height of about 12 feet as the entry. If you shut the entry doors and turned off the lights, the place would be in pitch black darkness, and you would literally have to be a bat in order to navigate in this cave. Evans was the "troll" of that cave both in appearance (with his white beard) and with his habit of walking around and mumbling to himself. He had started to write a book on the biosonar system of dolphins using the sonar equation, which immediately caught my attention. It was during this NP assignment that I decided to switch career fields and work on biosonar. I have not looked back since. At that time, I did not even know what a hydrophone looked like or how they operated. However, this was a perfect time for someone with my background to enter this field. Dr. Scott Johnson at the San Diego Lab and Jerry Dericks at the Applied Research Laboratory at the University of Austin (under contract to Dr. William Evans of the San Diego Lab) were the only technical people in my adopted field of biosonar. Scott was a nuclear physicist, and Jerry was an electrical engineer-acoustician. Several years

Carrying a harbor porpoise for its medical exam in the Netherlands

earlier, Scott had published his landmark work on dolphin hearing (Johnson, 1967). Therefore, the field of dolphin biosonar was wide open with a seemingly unending list of questions and issues to address.

My first scientific publication at this Navy lab came from my first NP tour working on underwater sound propagation in San Diego. It was published in *The Journal of the Acoustical Society of America* (*JASA*) without any hitches (Au, 1971). However, the same was not true for my first publication on dolphin acoustics. It was rejected outright because the reviewers could not believe the echolocation signals I measured had peak frequencies close to 120 kHz with an average peak-to-peak source level of about 220 dB re 1 µPa. These were some of the first measurements of echolocating dolphins made in open waters (in outdoor pens), and the results were grossly different than previous measurements made of dolphins in tanks. The reviewers criticized our results as being due to artifacts in the tape recorder and the hydrophone. Therefore, I had to borrow a "good" hydrophone from Jerry Dericks and also show that my tape recorder was measuring transient-like signals in an undistorted fashion. After a year's delay, my first publication on dolphin acoustics was finally accepted and published in *JASA* (Au et al., 1974). This first publication was followed by many other publications, which were firsts of their kind (see a list of selected publications at the end of this essay). These publications were only possible because the field was "wide open," and my experience in electromagnetic wave propagation and antenna theory provided me with a unique (at that time) perspective on what is important to understand in biosonar research.

My biosonar research with the Navy culminated with the publication of my first book in 1993 entitled *The Sonar of Dolphins*. I have Dr. Arthur (Art) Popper to thank for this book. I had previously sent a chapter to Academic Press and received a reply that a reviewer recommended this book not be published. At an Acoustical Society of America (ASA) meeting in Baltimore, I had dinner with Art and was explaining the problem with my book. He immediately put me in contact with a science editor at Springer-Verlag, New York. Art's wife, Helen, was a contract worker for Springer-Verlag, so Art knew exactly whom I should contact. The editor had no doubt been prepped by Art so that by the time I contacted him, the wheels were already greased and everything flowed smoothly. Subsequently, I was the senior editor, along with Art and Dr. Richard Fay, of the book entitled *Hearing by Whales and Dolphins*. Art and Dick had co-edited a series of more than 32 books on auditory research known as the SHAR (Springer Handbook of Auditory Research) series. My second authored book (with Dr. Mardi Hastings), *Principles of Marine Bioacoustics* (2008), went through Springer-Verlag without any problems.

Another major turn in my career happened in 1993 as a result of the Base Realignment Committee's (BRAC) decision that the Navy's Hawaii Lab should be closed and personnel reassigned to the San Diego Lab. This was a very difficult time because the Hawaii Lab was scheduled to close at the end of August 1993. Many of our friends, colleagues, and co-workers had to decide whether to move to San Diego, take another federal job, retire, or move on to whatever jobs were available for them. Toward the summer, "good bye" luncheons were a regular occurrence almost every Friday. Fortunately, Dr. Paul Nachtigall and I were able to arrange an IPA (intergovernmental personnel assignment) to the Hawaii Institute of Marine Biology (HIMB) at the University of Hawaii, which was about one mile away by water, in the same bay from the Hawaii Lab. The IPA program allowed federal employees to temporarily work for a municipal or state entity, and vice versa, for up to two years. Well, we stayed for four years after getting a two-year extension. We have Mr. Homer (Hop) Porter, who earlier had moved to the San Diego Lab, and Dr. Phillip Helfrich of HIMB to thank for making the IPA possible.

Paul and I had to create our own office space on Coconut Island. We secured eight shipping containers that were flown in by a U.S. Marine Chinook helicopter from the Marine base to Coconut Island. It was quite a scene, with each container tied by lanyard to the bottom of a helicopter. Earlier, an Air Force reserve unit led by Peter Kaomea spent several weekends on Coconut Island laying a slab on which to place these

shipping containers that would eventually be our offices. One side of each container was cut open, and they were joined together. A contractor modified the inside of the building with appropriate joints and attached dry wall to the inside walls.

We had floating pens to house the dolphins, which were built at the Navy facility and then towed over by boat to HIMB. The only difference with these pens is that we built a chain-linked fence around the perimeter of our pen structure and covered the fence with shade cloth to prevent the public from looking in.

This was a new environment, away from the safety of the Marine Base and the base security personnel. We had no idea what kind of problems might arise. Over the years, we have had no major incidents, and soon our pen complex became just part of the backdrop to Coconut Island.

At the end of four years, Paul and I were hired by the University of Hawaii, but not without some last minute dramatics. It was literally during the last week of our IPA when we were to report to our new assignment in San Diego or retire from federal service that Dr. Barry Raleigh, dean of SOEST (School of Earth Sciences and Technology), hired us. At the time, I had no intention of going to San Diego and was completely at peace with the idea that the university would eventually hire us.

Although we brought seven animals from the Hawaii Lab to our new complex at HIMB, the number of animals eventually dropped to three over several years as a result of two deaths and a decision made by the San Diego Lab that they really needed two of our dolphins for their breeding program. It became clear to me that my time working in the pens with our captive dolphins was fast drawing to a close. There was simply not enough room for Paul and his students and myself to continue in our previous mode of operation. I slowly eased into doing field work starting with my first graduate student, Dr. Marc Lammers.

One container being transported to outfit our new office building

The external view of our new offices at HIMB comprised of several containers

I also was able to collaborate with Dr. Denise Herzing and work with wild Atlantic spotted dolphins (*Stenella frontalis*) on the White Sand Ridge north of Grand Bahama Island, the Bahamas (Au & Herzing, 2003) and with Dr. Lee Miller and his student, Dr. Marianna Rasmussen, measuring the echolocation signals of white beaked dolphins (*Lagenorhynchus albus*) in Iceland (Rasmussen et al., 2002). Dr. John Ford was another colleague with whom I was able to collaborate in measuring the echolocation signals of killer whales (*Orcinus orca*) in the waters around Vancouver Island, British Columbia, Canada (Au et al., 2004). I also collaborated with Dr. Bernd Würsig of Texas A&M University in the measurement of the echolocation signals of dusky dolphins (*Lagenorhynchus obscurus*) in Kaikura Bay, New Zealand (Au & Würsig, 2004).

Marc Lammers was an important influence on my transition from being a scientist working with captive dolphins to one working with dolphins and whales in the field. Another student that had a major impact on my evolving career as a field marine mammal scientist was Dr. Kelly Benoit-Bird. Her interest was on the foraging behavior of spinner dolphins (*Stenella longirostris*), and she was instrumental in making me think as a marine ecologist. Together, we embarked on several projects, including the use of echosounders for mapping of the mesopelagic boundary community prey field that spinner dolphins foraged on and measuring broadband echoes from fishes using a simulated dolphin echo ranger. A few examples of papers we have collaborated on include the following:

Benoit-Bird, K. J., & Au, W. W. L. (2001). Target strength measurements of Hawaiian mesoplegic boundary community animals. *The Journal of the Acoustical Society of America*, *110*, 812-819.

Benoit-Bird, K. J., Au, W. W. L., Brainard, R. E., & Lammers, M. O. (2001). Diel horizontal migration of the Hawaiian mesopelagic boundary community

observed acoustically. *Marine Ecology Progress Series*, *217*, 1-14.

Benoit-Bird, K. J., & Au, W. W. L. (2002). Energy: Converting from acoustic to organic resource units. *The Journal of the Acoustical Society of America, 111*, 2070-2075.

Au, W. W. L., Benoit-Bird, K. J., & Kastelein, R. A. (2007). Modeling the detection range of fish by echolocating bottlenose dolphins and harbor porpoises. *The Journal of the Acoustical Society of America*, *121*(6), 3954-3962. Retrieved 12 May 2010 from http://ir.library.oregonstate.edu/jspui/bitstream/1957/12764/1/JAcoustSociety2006_Echolocating.pdf.

Au, W. W. L., & Benoit-Bird, K. J. (2008). Broadband backscatter from individual Hawaiian mesopelagic boundary community animals with implications for spinner dolphin foraging. *The Journal of the Acoustical Society of America*, *123*, 2884-2894.

By this time, Marc and his dad were able to purchase a 30+ foot Grand Bank wooden hull boat that was used by Marc to conduct his research on spinner dolphin acoustics along the Waianae coast of Oahu. Marc was also instrumental in providing a platform for Kelly to start echo sounding surveys on the mesopelagic boundary community of organisms. Also at about this time, I walked into the office of Dr. Russell (Rusty) Brainard at NOAA in Hawaii expressing my desire to do some acoustic work using the *R/V Townsend Cromwell*, a NOAA ship that Rusty formerly skippered; Rusty was responsible for creating the ship's schedule. Despite not knowing me from Adam, Rusty was extremely receptive and was eager to help Kelly and me. This started a long-term collaboration between Rusty and me, and eventually Marc—a collaboration that has been both successful and rewarding.

Our very first venture with the *R/V Townsend Cromwell* was not something to forget. During the first planning meeting for a cruise off the Kona coast of the big island, we learned that our idea of mounting our echo sounder transducer on a pole would not work. We had to come up with another technique within a week. I designed a towed body consisting of a 2-foot section of 4-inch PVC pipe with the transducer and some lead weights mounted on the bottom of the pipe and a rope attached to the top for towing. When Kelly loaded our towed body aboard, the crew of the *R/V Townsend Cromwell* nearly died of laughter at our contraption. Poor Kelly had to live through that, but our contraption worked so well that in the end, the technician of the ship asked for the plan of our device (Benoit-Bird et al., 2001). Rusty was also on the cruise, and Kelly obtained data that showed that the mesopelagic boundary community migrated at least 2 km toward shore before midnight and then migrated back to deep waters after midnight.

The Air Force Reserve construction crew who created our new office space

The *R/V Miriam*

Our capability of performing field work was enhanced significantly when we were awarded a Defense University Research Instrumentation Program (DURIP) grant to build a coastal instrumented research vessel. The *R/V Miriam* (named after my oldest granddaughter) was built in Hilo by Force Marine on this DURIP funding. We took delivery of the *R/V Miriam* in November 2008 and have since used her to perform a number of projects in the coastal waters of Oahu and Kauai. It is a 43-foot work boat with an A-frame, a J-frame, a pinch puller, and a high flying bridge for marine mammal visual surveys. She can sleep six people, has a small galley, and internal work space for support of sensitive electronics and instrumentation. We look forward to putting the *R/V Miriam* to good use in studying the various facets of marine mammal science and on the life history of dolphins and whales within the Hawaiian Archipelago.

In 2008, I was elected President of the Acoustical Society of America, which was a surprise from several perspectives. I was the first person to be elected president of the ASA from Hawaii and also the first Asian-American to be elected. Furthermore, I also came from one of the smallest

technical committees (Animal Bioacoustics) in the ASA. Animal bioacoustics has gained more visibility in this process considering that Mardi Hastings (2nd chair of the Animal Bioacoustics Committee) was also recently elected the ASA incoming president beginning her term after the spring 2011 meeting in Seattle.

In reflecting on my career, I can truly say that I have been blessed, first by being led into this field, by having tremendous opportunities and funding to do research, and by having the freedom to pursue what I felt was important. I have also been blessed with having a devoted and loving wife who raised our four children and provided a peaceful and stable home environment for me to pursue my scientific career. Finally, I have been blessed by having so many good coworkers who understand how to handle dolphins. There are so many questions and problems in our field. I look forward to the challenge of addressing some of them and to continuing my part in contributing to this fascinating field.

Literature Cited

Au, W. W. L. (1971). An investigation of a double family of normal modes in an isovelocity underwater acoustic duct. *The Journal of the Acoustical Society of America*, *50*, 286-299.

Au, W. W. L. (1993). *The sonar of dolphins*. New York: Springer-Verlag.

Au, W. W. L., & Benoit-Bird, K. J. (2008). Broadband backscatter from individual Hawaiian mesopelagic boundary community animals with implications for spinner dolphin foraging. *The Journal of the Acoustical Society of America*, *123*, 2884-2894.

Au, W. W. L., & Hastings, M. (2008). *Principles of marine bioacoustics*. New York: Springer-Verlag.

Au, W. W. L., & Herzing, D. (2003). Echolocation signals of wild Atlantic spotted dolphin (*Stenella frontalis*). *The Journal of the Acoustical Society of America*, *113*, 598-604.

Au, W. W. L., & Würsig, B. (2004). Echolocation signals of dusky dolphins (*Lagenorhynchus obscurus*) in Kaikoura, New Zealand. *The Journal of the Acoustical Society of America*, *115*, 2307-2313.

Au, W. W. L., Benoit-Bird, K. J., & Kastelein, R. A. (2007). Modeling the detection range of fish by echolocating bottlenose dolphins and harbor porpoises. *The Journal of the Acoustical Society of America*, *121*(6), 3954-3962. Retrieved 12 May 2010 from http://ir.library.oregonstate.edu/jspui/bitstream/1957/12764/1/JAcoustSociety2006_Echolocating.pdf.

Au, W. W. L., Popper, A., & Fay, R. (Eds.). (2000). *Hearing by whales and dolphins*. New York: Springer-Verlag.

Au, W. W. L., Floyd, R. W., Penner, R. H., & Murchison, A. E. (1974). Measurement of echolocation signals of the Atlantic bottlenose dolphin, *Tursiops truncatus* Montagu, in open waters. *The Journal of the Acoustical Society of America*, *56*, 1280-1290.

Au, W. W. L., Ford, J. K. B., Horne, J. K., & Newman-Allman, K. A. (2004). Echolocation signals of free-ranging killer whales (*Orcinus orca*) and modeling of foraging for chinook salmon (*Oncorhynchus tshawytscha*). *The Journal of the Acoustical Society of America*, *56*, 1280-1290.

Benoit-Bird, K. J., & Au, W. W. L. (2001). Target strength measurements of Hawaiian mesoplegic boundary community animals. *The Journal of the Acoustical Society of America*, *110*, 812-819.

Benoit-Bird, K. J., & Au, W. W. L. (2002). Energy: Converting from acoustic to organic resource units. *The Journal of the Acoustical Society of America*, *111*, 2070-2075.

Benoit-Bird, K. J., Au, W. W. L., Brainard, R. E., & Lammers, M. O. (2001). Diel horizontal migration of the Hawaiian mesopelagic boundary community observed acoustically. *Marine Ecology Progress Series*, *217*, 1-14.

Johnson, S. C. (1967). Sound detection thresholds in marine mammals. In W. Tavolga (Ed.), *Marine bioacoustics* (pp. 247-260). New York: Pergamon Press.

Rasmussen, M. H., Miller, L. A., & Au, W. W. L. (2002). Source levels of clicks from free-ranging white-beaked dolphins (*Lagenorhynchus albirostris* Gray 1846) recorded in Icelandic waters. *The Journal of the Acoustical Society of America*, *111*, 1122-1126.

Selected Publications from W. W. L. Au's Career

Publication Summary: 180 papers in peer-reviewed literature, 164 published abstracts, 6 technical reports

Professional Presentations: 164 presentations and abstracts in peer-reviewed literature; invited speaker (13), session chairman (14), session organizer (9)

Authored Books

Au, W. W. L. (1993). *The sonar of dolphins*. New York: Springer-Verlag.

Au, W. W. L., & Hastings, M. (2008). *Principles of marine bioacoustics*. New York: Springer-Verlag.

Ocean Studies Board. (2005). *Marine mammal populations and ocean noise: Determining when noise causes biologically significant effects.* Washington, DC: The National Academies Press.

Edited Books

Au, W. W. L., Popper, A., & Fay, R. (Eds.). (2000). *Hearing by whales and dolphins*. New York: Springer-Verlag.

Nachtigall, P. E., Lien, J., Au, W. W. L., & Read, A. J. (Eds.). (1995). *Harbour porpoises: A study of bycatch*. Woerden, The Netherlands: De Spiel Publishers.

Peer-Reviewed Publications (Selected)

Au, W. W. L., Houser, D., Finneran, J. J., Lee, W. J., Talmadge, L. A., & Moore, P. W. (2009, in press). The acoustic field on the forehead of echolocating Atlantic

bottlenose dolphins (*Tursiops truncatus*). Submitted to *The Journal of the Acoustical Society of America*.

Au, W. W. L., Branstetter, B. K., Benoit-Bird, K. J., & Kastelein, R. A. (2009). Acoustic basis for fish prey discrimination by echolocating dolphins and porpoises. *The Journal of the Acoustical Society of America*, *126*, 460-467.

Benoit-Bird, K. J., & Au, W. W. L. (2009). Cooperative prey herding by the pelagic dolphin, *Stenella longirostris*. *The Journal of the Acoustical Society of America*, *125*, 125-137.

Benoit-Bird, K. J., & Au, W. W. L. (2009). Phonation behavior of cooperatively foraging dolphins. *The Journal of the Acoustical Society of America*, *125*, 539-546.

Kastelein, R. A., Wensveen, W. J., Hoek, L., Au, W. W. L., Terhune, J., & de Jong, C. A. F. (2009). Critical ratio in the harbor porpoise (*Phocoena phocoena*) for tonal signals between 0.315 and 150 kHz in random white noise. *The Journal of the Acoustical Society of America*, *126*, 1588-1597.

Mooney, T. A., Nachtigall, P. E., Breese, M., Vlachos, S., & Au, W. W. L. (2009). Predicting temporary threshold shifts in a bottlenose dolphin (*Tursiops truncatus*): The effects of noise level and duration. *The Journal of the Acoustical Society of America*, *125*, 1816-1826.

Au, W. W. L. (2008). The effects of noise on echolocating odontocetes. *Bioacoustics*, *117*, 155-158.

Benoit-Bird, K. J., Gilly, W. F., Au, W. W. L., & Mate, B. (2008). Controlled and in situ target strengths of the jumbo squid *Dosidicus gigas* and identification of potential acoustic scattering sources. *The Journal of the Acoustical Society of America*, *123*, 1318-1323.

Ibsen, S. D., Au, W. W. L., Nachtigall, P. E., & Breese, M. (2008). Functional bandwidth of an echolocating Atlantic bottlenose dolphin (*Tursiops truncatus*). *The Journal of the Acoustical Society of America*, *125*, 1214-1221.

Lammers, M. O., Brainard, R. E., Au, W. W. L., Mooney, T. A., & Wong, K. B. (2008). Anecological acoustic recorder (EAR) for long-term monitoring of biological and anthropogenic sounds on coral reefs and other marine habitats. *The Journal of the Acoustical Society of America*, *123*, 1720-1728.

Muller, M. W., Allen III, J. S., Au, W. W. L., & Nachtigall, P. E. (2008). Time-frequency analysis and modeling of the backscatter of categorized dolphin echolocation clicks for target discrimination. *The Journal of the Acoustical Society of America*, *124*, 657-666.

Au, W. W. L., & Simmons, J. A. (2007, September). Echolocation in dolphins and bats. *Physics Today*, pp. 40-45.

Au, W. W. L., Benoit-Bird, K. J., & Kastelein, R. A. (2007). Modeling the detection range of fish by echolocating bottlenose dolphins and harbor porpoises. *The Journal of the Acoustical Society of America*, *121*, 3954-3962. Retrieved 12 May 2010 from http://ir.library.oregonstate.edu/jspui/bitstream/1957/12764/1/JAcoustSociety2006_Echolocating.pdf.

Au, W. W. L., Thomas, J. A., & Ramirez, K. T. (2007). Evoked potential measurement of the masked hearing threshold of the Pacific white-sided dolphin (*Lagenorhynchus obliquidens*). *Aquatic Mammals*, *33*(1), 76-84.

Branstetter, B., Mercado III, E., & Au, W. W. L. (2007). Representing multiple discrimination cues in a computational model of the bottlenose dolphin auditory system. *The Journal of the Acoustical Society of America*, *120*, 2459-2459.

Delong, C., Au, W. W. L., Harley, H., Roitblat, H., & Pytka, L. (2007). Human listeners provide insights into echo features used by dolphins to discriminate among objects. *Journal of Comparative Psychology*, *121*, 306-319.

Ibsen, S., Au, W. W. L., Nachtigall, P. E., DeLong, C., & Breese, M. (2007). Changes in signal parameters over time for an echolocating Atlantic bottlenose dolphin. *The Journal of the Acoustical Society of America, 120*, 2446-2450.

Mooney, T. A., Au, W. W. L., Nachtigall, P. E., & Trippel, E. A. (2007). Acoustic and stiffness properties of gillnets as they relate to small cetacean bycatch. *ICES Journal of Marine Science, 64*(7), 1324-1332.

Muller, M., Au, W. W. L., Nachtigall, P. E., Allen, J., & Breese, M. (2007). Phantom echo highlight amplitude and temporal difference resolutions of an echolocating dolphin, *Tursiops truncatus*. *The Journal of the Acoustical Society of America*, *122*, 2255-2262.

Stimpert, A. K., Wiley, D. N., Au, W. W. L., Johnson, M. P., & Arsenault, R. (2007). Megapclicks: Acoustic click trains and buzzes produced during nighttime foraging of humpback whales (*Megaptera novaeangliae*). *Biology Letters*, *3*, 467-470.

Au, W. W. L., Kastelein, R. A., & Benoit-Bird, K. J. (2006). Sound propagation in the head of an echolocating harbor porpoise (*Phocoena phocoena*). *Journal of Exploratory Biology, 209*, 2726-2733.

Benoit-Bird, K. J., & Au, W. W. L. (2006). Extreme diel horizontal migrations by a tropical nearshore resident micronekton community. *Marine Ecology Progress Series*, *319*, 1-14

Benoit-Bird, K. J., Au, W. W. L., & Kastelein, R. A. (2006). Testing the odontocete acoustic prey debilitation hypothesis: No stunning results. *The Journal of the Acoustical Society of America*, *120*, 1118-1123.

Lammers, M. O., Schotten, M., & Au, W. W. L. (2006). The spatial context of free ranging Hawaiian spinner dolphins (*Stenella longirostris*) producing acoustic signals. *The Journal of the Acoustical Society of America*, *119*, 1244-1250.

Au, W. W. L., & Würsig, B. (2004). Echolocation signals of dusky dolphins (*Lagenorhynchus obscurus*) in Kaikoura, New Zealand. *The Journal of the Acoustical Society of America*, *115*, 2307-2313.

Au, W. W. L., Ford, J. K. B., Horne, J. K., & Newman-Allman, K. A. (2004). Echolocation signals of free-ranging killer whales (*Orcinus orca*) and modeling of foraging for chinook salmon (*Oncorhynchus tshawytscha*).

The Journal of the Acoustical Society of America, *56*, 1280-1290.

Nachtigall, P. E., Supin, A. Ya., Pawloski, J., & Au, W. W. L. (2004). Temporary threshold shifts after noise exposure in the bottlenose dolphin (*Tursiops truncatus*) measured using evoked auditory potentials. *Marine Mammal Science*, *20*, 673-687.

Au, W. W. L., & Benoit-Bird, K. J. (2003). Automatic gain control in the echolocation system of dolphin. *Nature*, *423*, 861-863.

Au, W. W. L., & Herzing, D. (2003). Echolocation signals of wild Atlantic spotted dolphin (*Stenella frontalis*). *The Journal of the Acoustical Society of America*, *113*, 598-604.

Benoit-Bird, K. J., & Au, W. W. L. (2003). Target strength and density structure of Hawaiíian mesopelagic boundary community patches. *The Journal of the Acoustical Society of America*, *114*, 1888-1897.

Benoit-Bird, K. J., Au, W. W. L., Kelley, C. D., & Taylor, C. D. (2003). Acoustic backscattering by deepwater fish measured in situ from a manned submersible. *Deep-Sea Research Part I*, *50*, 221-229.

Kastelein, R. A., Hagedoorn, M., Au, W. W. L., & de Haan, D. (2003). Audiogram of a striped dolphin (*Stenella coeruleoalba*). *The Journal of the Acoustical Society of America*, *113*, 1130-1144.

Lammers, M. O., & Au, W. W. L. (2003). Directionality in the whistles of Hawaiian spinner dolphins (*Stenella longirostris*): A signal design feature to cue direction of movement? *Marine Mammal Science*, *19*, 249-264.

Madsen, P. T., Carder, D. A., Au, W. W. L., Nachtigall, P. E., Møhl, B., & Ridgway, S. H. (2003). Sound production in neonate sperm whales. *The Journal of the Acoustical Society of America*, *113*, 2988-2991.

Philips, J., Au, W. W. L., Nachtigall, P. E., Pawloski, J. L., & Roitblat, H. L. (2003). Echolocation in the Risso's dolphin, *Grampus griseus*: A preliminary report. In J. A. Thomas, C. Moss, & M. Vater (Eds.), *Echolocation in bats and dolphins* (pp. 43-49). Chicago: University of Chicago Press.

Supin, A. Ya., Nachtigall, P. E., Pawloski, J., & Au, W. W. L. (2003). Evoked potential recording during echolocaiton in a false killer whale *Pseudorca crassidens*. *The Journal of the Acoustical Society of America*, *113*, 2408-2411.

Tolstoy, A., & Au, W. W. L. (2003). The matched field processing of binaural dolphin-like siganals for the detection and identification of buried targets. *Journal of Comparative Acoustics*, *11*, 521-534.

Mohl, B., Madsen, P. T., Wahlberg, M., Au, W. W. L., Nachtigall, P. E., & Ridgway, S. H. (2002). Sound transmission in the spermaceti complex of a recently expired sperm whale calf. *ARLO*, *4*, 19-24.

Au, W. W. L., Frankel, A., Helweg, D. A., & Cato, D. H. (2001). Against the humpback whale sonar hypothesis. *Journal of Oceanic Engineering*, *26*, 295-300.

Aubauer, R., Lammers, M. O., & Au, W. W. L. (2000). One-hydrophone method of estimating distances and depth of phonating dolphins in shallow water. *The Journal of the Acoustical Society of America*, *107*, 2744-2749.

Goo, G., & Au, W. W. L. (2000). Passive broadband detection and identification of underwater targets and buried targets in "*acoustic daylight*." *SPIE*, *4038*, 438-449.

Mohl, B., Au, W. W. L., Pawloski, J. L., & Nachtigall, P. E. (1999). Dolphin hearing: Relative sensitivity as a function of point of application of a contact sound source in the jaw and head region. *The Journal of the Acoustical Society of America*, *105*, 3421-3424.

Ridgway, S. H., & Au, W. W. L. (1999). Hearing and echolocation: Dolphin. In G. Adelman & B. Smith (Eds.), *Encyclopedia of neuroscience* (pp. 858-862). New York: Elsevier Science.

Roitblat, H. L., Nachtigall, P. E., Au, W. W. L., Shizumura, R., & Moons, G. (1999). Classifying buried targets by mimicking dolphin echolocation. In Y-C. Teng, E-C. Shang, Y-H. Pao, M. H. Schultz, & A. D. Pierce (Eds.), *Theoretical and computational acoustics '97* (pp. 553-559). Singapore: World Scientific Publishing.