



Symposium review

Listening to fish: an international workshop on the application of passive acoustics in fisheries

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Assessing the size and location of fish stocks continues to be a challenge for fisheries scientists. Acoustics has become an increasingly important tool in fisheries assessment. Active acoustics, such as sonar, uses the backscatter of a transmitted signal to locate fish aggregations. In contrast, passive acoustics, simply listening to fish sounds, has recently developed as an additional tool with which to locate and count fish and thereby identify and map their habitat. Over 800 species of fishes worldwide are known to be vocal and thus can be listened to. These species include some of the most abundant and commercial fish species, including the herring, cod and haddock. Listening to these fish can contribute a great deal to our knowledge of their abundance, distribution and behaviour.

On 8–10 April, 2002, European and North American researchers presented their work on passive acoustic applications to fisheries at a workshop organized by Rodney Rountree (UMass-Dartmouth), Cliff Goudey (MIT), and Tony Hawkins (University of Aberdeen), and sponsored by the MIT Sea Grant College Program, the Office of Naval Research, and the National Undersea Research Program. The main objectives of the workshop were to promote the use of passive acoustics for ocean exploration, biodiversity assessment and fisheries, and to develop an international initiative to extend the use of passive acoustics in marine science to both applied and non-applied fields. The workshop was divided into 4 sessions; three dedicated to oral presentations and a special session that included demonstrations of hardware and software. Over 40 international experts in passive acoustics as it applies to fisheries, marine conservation issues and the identification of essential fish habitats attended the conference and a total of 29 presentations were delivered.

The first session, “Passive listening for fishes – what has been done” presented a review of programs that have applied passive acoustics to research on fish ecology and fisheries issues. These talks included characterizations of sounds and their use as well as application of passive acoustics to detect spawning aggregations and habitats in seatrout (Roumillat, SCDNR) and other sciaenids (Collins, SC DNR; Connaughton, Washington College; Gilmore, Dynamac Corporation; Luczkovich, East Carolina University; Holt, University of Texas), Atlantic cod (Rowe, Dalhousie University; Nordeide, Bodo Regional University; Fudge, Memorial University) and haddock (Hawkins, University of Aberdeen), toadfish (Fine, Virginia Commonwealth University), cusk-eels (Rountree, University of Massachusetts), yellowfin and bluefin tuna (Demer, NMFS), and reef fish (Lobel, Boston University).

The second session, “Future developments and applications” highlighted the use of passive acoustics to monitor and protect coral reef ecosystems (Wong, NMFS), marine mammals on Navy ranges (Jarvis, NUWC), and seatrout spawning habitats (Baltz, LSU), as well as the potential of combining passive acoustics and underwater television for monitoring reef fishes (Brouwer, SCDNR), the use of autonomous ocean sampling networks (Schmidt, MIT), and the announcement of the recent establishment of a web-based National Archive of Fish Sounds at Cornell University (Bloomgarden, Cornell Laboratory of Ornithology).

The third session, “Acoustic technology” presented a review of current state of the art and future developments for underwater acoustic technology, underwater video-acoustic recording technology, analysis techniques and software. These presentations focused on the improvement of passive listening technology

for systematically detecting and recording sounds at sea, including use of sonobuoys (Demer, NMFS), ROVs as passive acoustic platforms (Blue, Leviathan Agency), remote-controlled instrument platforms (Ovredal, Norwegian Institute of Marine Research), hydrophone arrays and seafloor sensors for detection and tracking of whales (Clark, Cornell University), in situ sound and video recording of reef fish behaviour (Lobel, Boston University), as well as recent development of acoustic processing technologies such as digital signal processing dataloggers (Mann, University of South Florida), measurement of source levels, and calibration techniques for measuring the distance of sound sources (Sprague, East Carolina University), classifying sounds using wavelets (Wood, University of Aberdeen), and multihydrophone localization of low frequency broadband sources (Forsythe, NUWC).

The oral sessions were followed by the demonstration of acoustic and video hardware and software including pop-up recorders, data loggers and a variety of software for sound processing. The final day of the workshop was devoted to the deliberations and conclusions of two working groups that focused on the future potential for passive acoustics in fish biology (Luczkovich, facilitator), and the future development of technology and software (Mann, facilitator). Among the conclusions of the workshop were the pressing need for the development of technology to aid in small scale, low budget studies of marine fishes in estuarine and inshore habitats in addition to continued

improvement of passive acoustics systems for use in the open ocean, as well as an agreed benefit of future joint research projects. Details of the presentations, including titles, a list of participants, and abstracts are available on the "Listening to Fish" webpage (<http://web.mit.edu/seagrant/acoustics>). In addition, the conference proceedings (extended abstracts) are also available on the web page.

The workshop was successful in convening an international group of experts in such an emergent field. It would have been useful to have a broader representation from the underwater technology industry so as to alert them to biologists' needs and to listen to their development plans. The various presentations made it clear that passive acoustics have a great potential as a research tool in fisheries and other areas in marine science. The workshop served as a great forum for the exchange of information and technology among the participants, and the development of domestic and international collaborations for future research initiatives. A final discussion identified the most important research initiatives, which included: development of a national data base of historic underwater sound archives in conjunction with the establishment of a National/International Reference Library of fish sounds; planning for an International research and training center for passive acoustics applications to fisheries and marine census; and the active promotion of the technology through publications of the workshop proceedings and related articles.