

Using Ultrasound as a Tool for Fish Research and Management

Ultrasound provides non-invasive methods to assess fish

Bottom Line

Ultrasound is an accurate non-lethal way to identify gender, determine reproductive maturation, and assess the body condition of fish.

Better, Faster, Cheaper

Reclamation managers and researchers can use ultrasound rather than more expensive and more invasive techniques.

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More Information

Broderick, S., 2012. Using Ultrasound as a Tool for Fish Research and Management, Reclamation.

This final report has an in-depth literature search for more information.

Problem

To effectively manage our facilities and water operations, Reclamation needs methods to assess fish health for a range of project operations and restoration programs, including:

- **Dams and reservoir operations.** Managing Reclamation's facilities requires understanding potential fish issues (e.g., scope of predation, flows, and interactions with facilities) to assess these impacts and determine the most effective designs to avoid impacts.
- **Reclamation fish facilities.** Reclamation needs methods to ensure that facilities such as diversions, ladders, and counting stations can safely and effectively handle large numbers of fish, including threatened and endangered (T&E) species.
- **Habitat restoration programs.** Accurate methods to determine the benefits for fish and wildlife species from these programs are needed to ensure effective adaptive management.

Solution

Ultrasound is a well-developed technology with broad application to Reclamation resource management and research endeavors. Some advantages of the new generation of ultrasound machines are:

- Analysis and results are rapid, providing more timely information
- Methods are non-invasive and non-lethal
- Machines are portable and rugged
- Resolution is high
- Analyses are accurate (reproductive maturity and gender determination with over 90-percent accuracy)
- Analysis can reduce the number of handling events (maturity sorts) from four to two
- Ultrasound can effectively determine body fat and muscle thickness for body condition determination
- Technology can be used with a wide variety of species such as salmon, steelhead, surgeon, and non-game fish species as well as wildlife species

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Benefits for Reclamation Researchers and Managers

Reclamation facilities and operations can benefit from ultrasound investigations in areas of:

- **Gender and reproduction.** Ultrasound imaging is a non-invasive method to determine gender that is more accurate than visual methods. Egg development within the ovary can be measured non-invasively by measuring egg diameter on the screen. Knowing the sex and reproductive condition of fish would allow Reclamation to better manage fish facilities (e.g., diversions, ladders, and counting stations). It provides a good tool for broodstock selection for captive rearing programs.
- **Species determinations.** This technique could be used to determine the difference between resident rainbow trout and anadromous steelhead, which can assist in recovery and management efforts for T&E steelhead stocks.
- **Habitat restoration.** Ultrasonic imaging could be used in conjunction with habitat restoration efforts to measure the response of many T&E species in terms of reproductive condition. It is extremely difficult to monitor the response of populations of many T&E species such as sturgeons. Ultrasonic imaging allows direct assessment of reproductive stages of sturgeons and other species in the field with minimal impacts to the fish. This technology is minimally invasive, yet it is sufficiently sensitive to allow investigators to track the progress of individual fish through the reproductive cycle and to determine whether spawning has occurred. Fecundity of fish in restored areas can be measured and compared against fish in adjacent areas to determine if environmental cues needed to trigger development and release of eggs are present in newly restored habitats.
- **Fish handling.** Reclamation fish facilities routinely handle a large number of fish, including T&E fish species. Injury assessment is currently done using visual estimates, which are often inaccurate, resulting in an underestimation of delayed mortalities. Ultrasound would allow rapid non-invasive, non-lethal imaging to detect internal injuries so that the causes of any such injuries can be more readily identified and rectified. Conversely, ultrasonic imaging could be used to demonstrate to regulatory agencies (U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration [NOAA] Fisheries) that fish emerging from Reclamation fish facilities are uninjured and in good health.



“Ultrasound techniques can help us assess fish conditions and provide the information we need for effective facility operations with a minimal risk to critically imperiled species.”

Susan Broderick,
Principal Investigator

“Ultrasound is a rapid and non-invasive technique for fish. We can identify maturity and gender in less than 5 seconds per fish. Ultrasound is extremely accurate (greater than 90%) for both maturity status and gender determination, reducing our handling events from four to just two. Ultrasound models are both inexpensive and durable. I would highly recommend investigating this technology for your use.”

Carlin McAuley,
Fisheries Biologist,
NOAA Fisheries,
Manchester Research Station

*Photo at left:
Applying a 7.5-megahertz linear
ultrasound probe to examine a fish.*

See C. McAuley, M. Chaney, and G. Baesler, 2010. Peeking at gonads. The use of ultrasound technology in a threatened Snake River Spring Chinook salmon *Oncorhynchus tshawytscha* captive broodstock program. Presentation at the World Aquaculture Society, 2010. www.was.org/documents/MeetingPresentations/AQ2010/AQ2010_0172.pdf.

