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Innovation & Investment

Using AI to streamline gender-sorting processes in salmon aquaculture

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By Hank Hogan

Artificial intelligence promises to automate gender-sorting of salmon, yielding enhanced fish quality assessment and production

AI can not only streamline gender-sorting processes but also open avenues for enhanced quality assessment and production optimization for fish like Atlantic salmon (*Salmo salar*), above. Shutterstock image.

Salmon can easily tell the difference between male and female fish, but for people working in aquaculture, it's not as easy. It's especially challenging when fish are immature, with tiny smolts being the most difficult of all to classify. Today, trained personnel view ultrasound images to spot telltale sex characteristics (like gonads) and sort fish. However, some companies are turning to artificial intelligence (AI) to automate the process of gender identification in aquaculture operations.

"You want to make decisions regarding fish as early as possible," Stian Rognlid, CEO of AI-focused **Aquaticode** (https://aquaticode.com/about/)told the *Advocate*, in explaining why the company is producing a **gender-sorting platform** (https://www.youtube.com/watch?v=214wgGoSRlo) that handles up to 10,000 fish an hour. Aquaticode's sorter is currently in full production in Chile. "If an expert can see it visually either through a microscope or ultrasound or through some other sort of augmentation, it's a good target for artificial intelligence."

Econexus (https://econexus.cl/) has provided ultrasound-based aquaculture solutions since 1998. It offers a service that does gender identification of smolts using teams of people, with each team capable of sorting 50,000 to 80,000 fish a day.

Now, Econexus is about to deploy its AI-based gender-sorting solution. The first version will be semi-automated and will require less trained personnel, according to CEO Jaime Stange, with field testing starting in June. A more capable and fully automated version will be in the field by the end of the year.

(https://bspcertification.org/)

"We have our own artificial intelligence system and it's working really well," Stange said. "But it's just the first step. For us, the sex-sorting is just one of 10 or 20 more applications that are really useful in aquaculture."

Similarly, Aquaticode's Rognlid predicted that gender-sorting is only the beginning. The information provided by the imaging systems can identify at an early age those fish that have diseases and other problems that will hinder growth. Stange said these improvements in fish quality come early on and before the fish enter the grow-out phase.
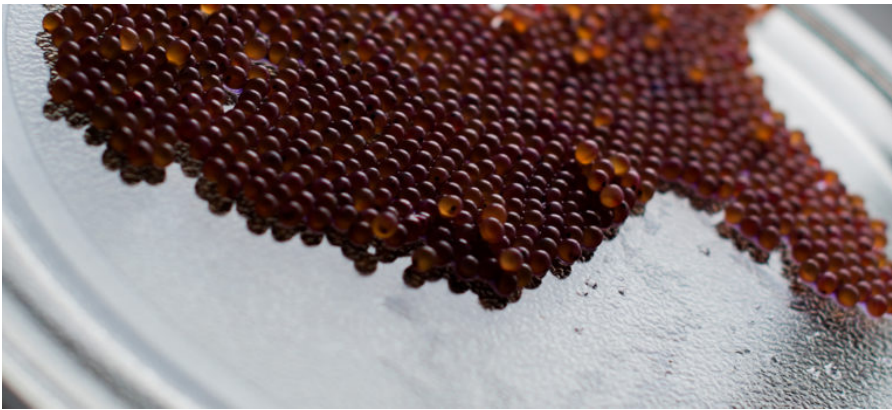
Egg sorting technology helps pick fish-growth winners

Automated egg-sorting technology developed by GenetiRate is being tested by prominent aquaculture companies and showing promising results.

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Gender sorting by itself can be useful. Rognlid noted that male salmon mature faster than females, allowing more frequent harvesting. What's more, females produce more fillets than males and their flesh color differs from males. So, producers can sell the males into the whole fish market while the females go into fillet processing.

Einar Wathne, an aquaculture industry expert and an advisor to Aquaticode, noted other benefits from separating the sexes: "Reduced stress can improve feed intake and thus growth. Reduced stress may also improve animal welfare. Since males and females differ slightly in shape and meat color, you may

use these traits in production and sales planning."

SORTpro automatically sorts 10,000 juvenile salmon per hour according to gender, maturation and other performance traits. Photo courtesy of Aquaticode.

Sorting depends on detecting sex-based differences, typically immature gonads in males, in smolts that may weigh 65 grams or less. This involves ultrasound, with high-frequency sound generated by a speaker penetrating the fish. The sound reflects off internal organs and structures before traveling back out, where a microphone detects it. The result is an image of the insides of a fish.

Traditionally, spotting gonads in the image has taken a trained eye. Thus, teams of skilled technicians take turns studying the images and assigning a gender to smolts.

AI substitutes a model developed using machine learning for those experts. Working from a comprehensive training set of images of fish with and without gonads, the technology creates a model that categorizes fish as either male or female. According to Rognlid, imaging happens while the fish are sedated, typically immediately after vaccination. The accuracy, he said, is better than 99 percent versus the 90–95 percent achieved by a human-based approach.

Stange, on the other hand, doesn't yet think AI systems are better than human ones. He does add that automated systems will eventually – and perhaps soon – perform as well or even better than people.

Wathne noted an operational drawback to gender-sorting. Extra tanks will be required to hold the male and female fish after separation. Those tanks will take up space and add cost at the sorting stage. Extra tanks may or may not be needed as fish progress through production.

Rognlid pointed out, though, that the ultrasound images provide information about the internal organs and structure of each fish. Combining that data with external images captured in the visible provides extra information. Adding an infrared camera would further increase the data generated. An AI system

can use these images for culling fish that have disease markers, indications of mineral accumulations or other signs that are not likely to grow the fastest or be the healthiest, and thus, fall short in terms of production.

Gender-sorting systems can provide a wealth of information, Rognlid said: "We actually get a very, very good snapshot of each fish in that facility both externally and internally."

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