SEA TECHNOLOGY

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MAY 2024

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AI-Powered Fish Monitoring

Comprehensive, Real-Time Insights for Hydropower Operations

By Stephanie Smedbol • Aaron Legge

Of all the many forms of renewable energy, hydropower currently provides the most reliable and predictable electricity to the grid. However, an ongoing challenge lies in monitoring fish activity to ensure safe passage through dam infrastructure.

Innovasea's fish tracking business, formerly known as Vemco, has been a global leader in acoustic telemetry for aquatic animal research for nearly 40 years. The company's products have proven to be essential instruments, cited in hundreds of published scientific research papers. The company is committed to developing innovative technologies that advance our understanding of ocean and freshwater ecosystems.

Today, Innovasea is positioned to play a key role in improving hydropower operations in North America with its newest fish monitoring solution, HydroAI.

Fish migrating upstream at White Rock Dam, a Nova Scotia Power site where HydroAI operates.

Reprinted from ***Sea Technology*** magazine.
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Fish ladder at White Rock Dam.

Canada's Growing Hydropower

Canada is well known as a global leader in hydropower, trailing only China and Brazil in the amount of hydroelectricity it generates each year. Hydropower accounts for 62 percent of all the electricity generated in Canada today. And there is room for growth, as electricity only fulfills about 20 percent of Canada's overall energy needs.

The country needs to double down on hydropower if it has any hope of meeting its ambitious goal of net-zero emissions by 2050. According to Waterpower Canada, achieving that net-zero goal will only be possible if the country produces two to three times as much clean power as it does today. And while solar and wind power get a lot of the headlines, hydropower is the clean energy workhorse that can get the country across the finish line.

Hydropower's future growth will rely on having efficient and compliant operations today. Environmental regulators need comprehensive data on fish activity to assess a dam's impact on migrating fish and other wildlife. Meeting these requirements has been a key challenge for regulators to date, as existing methods of manual counting are labor intensive, susceptible to human error and based on limited data. Because of this uncertainty, operators can face costly shutdowns to meet regulatory environmental impact mitigation and licensing demands. A better understanding of how operations impact fish could potentially decrease shutdowns and enhance transparency with regulators and NGOs. That's where Innovasea comes in.

Introducing HydroAI

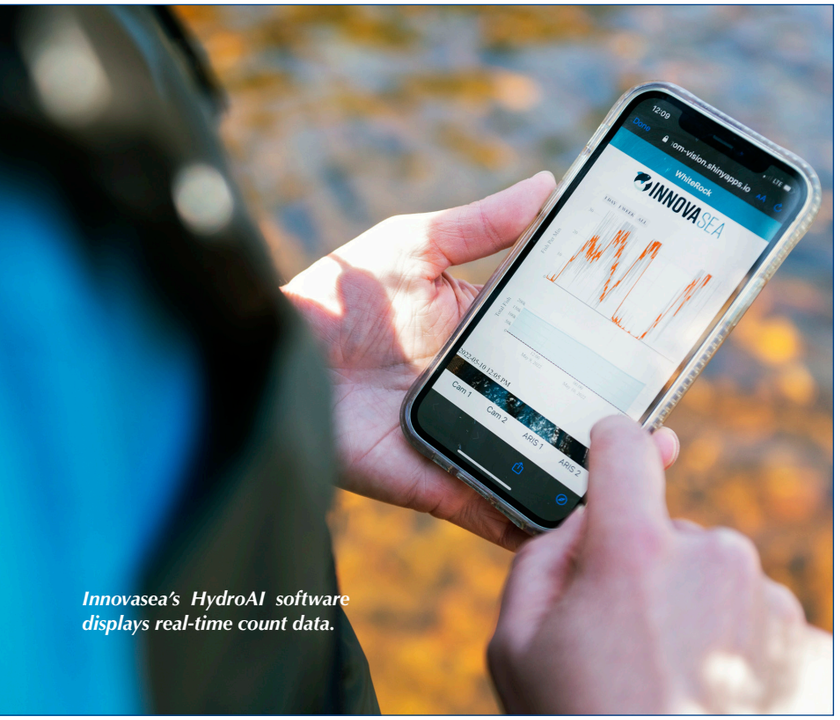
Innovasea recently launched HydroAI, an automated fish monitoring solution that provides unprecedented insights into fish activity around hydro facilities. HydroAI is focused on expanding the use of artificial intelligence in fish monitoring to help hydro dam operators improve environmental compliance and efficiency. The AI-powered camera solution autonomously counts and identifies fish around the clock with 95 percent accuracy, so dam operators can better and more easily understand fish activity around their operations with faster access to more accurate data than they've ever had before. Furthermore, when paired with Innovasea's long-standing acoustic telemetry equipment, regulators can gain an even stronger understanding of fish migrations at their operations.

By enhancing mitigation efforts, the technology can also better protect ecosystems while providing hydropower dam operators with the data they need to satisfy regulators, extend operating hours and generate more power.

The Power of Quantifiable Outcomes

Innovasea's HydroAI solution offers several benefits. It provides better data via high-resolution cameras and AI that monitor the presence of fish 24/7 with greater accuracy than existing methods of manual counting, and post-processing allows real-time access to data.

HydroAI also ensures regulatory compliance and im-



Innovasea's HydroAI software displays real-time count data.

proves transparency. It pairs a proprietary algorithm with hands-on support and maintenance. By reducing uncertainty about fish timing and presence, this technology can help avoid unnecessary shutdowns and enable hydropower operators to generate more power.

In addition, HydroAI enhances environmental impact mitigation efforts. Existing methods have prevented operators from knowing precisely where and when fish move through their sites, which has made it difficult to take timely action for impact mitigation. HydroAI helps solve this problem with hardware that seamlessly integrates with existing upstream and downstream fish passage infrastructure.

"HydroAI technology speeds up the time to getting insights by providing real-time information about the number of fish passing by a camera, as well as other events of interest, with much greater resolution than ever before possible," said Jean Quirion, Innovasea's vice president of research and development.

A Successful Partnership

The technology behind HydroAI was initially developed through an earlier Innovasea-led Ocean Supercluster project called OceanAware to develop and commercialize world-class solutions for monitoring fish health, fish movement, and the environment, and supporting both profitable and sustainable practices in the ocean.

Building on the early success of the technology, Innovasea then launched the HydroAware project, a $10.5 million R&D initiative under the auspices of Canada's Ocean Supercluster that aims to improve aquatic animal research in dynamic water environments—the types of locations ideal for hydropower and tidal power. Joining the HydroAware project are Nova Scotia Power, New Brunswick Power, FORCE and Big Moon. HydroAware, which runs through March 2026, is underway and Innovasea is in the process of working with its partners to collect data in various aquatic environments. The data will be used to continue to enhance and train the AI models in HydroAI.

"This is an important project that aims to provide hydro and tidal power operators with new tools to monitor fish in harsh environments and help them in their regulatory process so they can generate clean energy for our planet," said Quirion.

HydroAI's Momentum

HydroAI has proven highly effective based on its ability to deliver around-the-clock data on fish activity around fish ladders and other dam infrastructure—exponentially more data than humans can produce manually by counting fish on video for a few hours each week. Having access to instant data has helped dam operators better manage their day-to-day operations, and the analytics make it much easier for them to make assumptions for the future as part of decision making.

To date, the technology is in operation at four hydro sites belonging to partner Nova Scotia Power, and there are plans to expand deployments across three additional sites by the end of 2025. Thanks to the ongoing success and momentum driving this partnership, Innovasea is now offering HydroAI throughout Canada and the United States, another top producer of hydropower worldwide.

AI-generated insights are enormously valuable to regulators or anyone else concerned about protecting wildlife around hydro facilities. When the HydroAI technology launched in Canada earlier this year, Innovasea's partners saw the benefit of having access to an abundance of insight-producing data.

"First of all, it's a step up on the detection and counting and tracking of fish," noted Terry Toner, former director of environmental projects at Nova Scotia Power, during site trials. "This type of technology could be tailored for several of our other sites to give us really good information."

Opportunities Beyond Hydropower

In addition to the growth of hydropower dams in Canada, tidal power offers another exciting opportunity to generate renewable energy.

Tidal power generation involves capturing kinetic energy from the rise and fall of oceanic tides and then converting it into electricity. It requires strong currents or a large tidal range but is more predictable than wind and solar power and can generate electricity around the clock.

Researchers collaborating at White Rock Dam.

Canada's Bay of Fundy has a tidal range of 52 ft., the largest in the world, making it ideal for tidal power generation. Proponents believe its Minas Passage could one day produce 7,000 MW of energy, enough to power all 2 million homes in Atlantic Canada.

However, monitoring fish activity in this harsh and remote environment poses challenges, potentially hindering proper environmental assessments and permit acquisition for tidal power projects. Innovasea's HydroAI could serve as a solution for tidal power operations as well, simplifying fish detection and analysis in challenging tidal zones, thereby enabling more seamless project implementation.

Conclusion

Though it's already a global leader in hydropower, Canada has enough water resources to double its hydropower generating capacity. But as dam projects can significantly impact migrating fish and other wildlife, energy companies and regulators need comprehensive, real-time data to ensure their safety. Uncertainty in where and when fish are located has resulted in slow and often contentious permitting processes, in addition to costly shutdowns.

A fully autonomous solution for monitoring fish activity, the HydroAI system equips dam operators with faster and more accurate data than ever before, allowing them to meet regulatory requirements with ease and streamline their operations.

Innovasea will continue to play a key role in unleashing the power of artificial intelligence to improve and accelerate aquatic animal research in Canada and the rest of North America. With innovative technology solutions such as HydroAI, operators will have the tools they need to draw the most comprehensive and accurate conclusions to maintain operations that are sustainable and efficient.

Contact Innovasea to learn more about the latest in its fish tracking solutions at: www.innovasea.com/contact-us. **ST**

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Aaron Legge is the group product manager of Innovasea's fish tracking team. With a track record of driving impactful solutions in product management, he is dedicated to advancing technology to explore and protect our marine ecosystems.