

I N T E R N A T I O N A L

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Underwater forestry

Removing submerged trees from reservoirs

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What lies beneath?

Underwater trees in reservoirs can pose a multitude of problems worldwide. Removal prior to flooding has never been as simple as it sounds, while harvesting afterwards has long seemed like science-fiction. However, Canadian company Triton Logging has gained over ten years of experience in developing underwater forestry on a commercial scale.

AROUND the world, an estimated 300M trees stand submerged beneath the waters of dam reservoirs. Though out of sight and out of mind for most people, these trees represent both a challenge – and an opportunity – for reservoir managers, local communities and governments. Increasing attention on environmental, social and public safety issues has prompted dam owners to seek innovative solutions and partners to the problem of underwater trees.

DECADES IN THE MAKING

Largely preserved in an oxygen-deprived environment, submerged trees continue to affect the reservoirs in which they stand. Increasingly, these trees are being highlighted by governments, non-governmental organisations (NGOs) and communities as something that cannot be ignored. The incentives to address this challenge – and the risks of not doing so – have never been greater than they are today.

Removing standing timber prior to flooding has never been as simple as it sounds while harvesting post-flooding has long seemed like science-fiction. Nonetheless, Triton Logging of British Columbia, Canada has been developing the technology and expertise to survey, assess and remove submerged trees on a commercial scale for over a decade. Reservoir managers around the world – from North America to West Africa – have engaged Triton as a critical component of their reservoir management plans to make hydro facilities safer, more efficient and to create a new standard of environmental performance, economic development and corporate social responsibility.

THE CHALLENGE

Generally, reservoir managers identify the challenge of submerged trees in three categories: safety, environment, and dam performance.

Safety – Reservoirs located in populated areas act as important transportation corridors, recreational venues and economic drivers. Boat traffic – including ferries, pleasure craft or fishing vessels – use these waterways on a daily basis and run the risk of hitting submerged or partially submerged trees. Fluctuating water levels increase these risks for even experienced operators. Large, tree-filled reservoirs with underdeveloped marine safety provisions claim hundreds of lives each year. Government, hydro managers and non-governmental organisations see a clear need for the creation of verified, navigable channels where trees have been removed.

Environment – Global demand for green power is putting energy sources under a new environmental lens and hydro is no exception. Increased scrutiny of standards and performance demand not only compliance but innovation. In a report on environmental impacts of dams for The World Bank, experts highlight lower water quality, increased floating weeds, and heightened greenhouse gas release as the primary impacts of flooded forests, along with negative secondary effects such as water-related disease and poor aquatic habitat. Increasingly, NGOs, governments and funding agencies seek clarity from reservoir owners on how the impacts of submerged trees are being addressed post-flooding. Careful inventorying and eventual removal of trees can be a critical

Below: Triton Logging's remotely operated Sawfish underwater harvester uses patented technologies to find, cut and surface submerged trees



component of environmental management plans.

Dam performance – Understanding how submerged trees impact generation performance demands a shift from reactive thinking to proactive management. Woody debris, weeds and turbine corrosion due to poor water quality can be linked to the existence of submerged trees. Creating a comprehensive plan to remove some or all trees can mitigate these and other performance-related issues before they escalate into costly, long-term problems.

On the other hand, if addressed proactively and as part of an integrated management plan involving all stakeholders, the removal of submerged trees can also present opportunities for reservoir owners:

Local economic development – The removal of submerged trees can significantly contribute to communities' economic capability. Harvesting marketable, environmentally certified underwater wood can build value-added local wood economies or supplement existing land-based fibre supplies. Removing hazardous trees can open development and recreational possibilities and create new, cost-effective transportation corridors. And, in some cases, removing or thinning specific tree zones can improve fishing and aquaculture opportunities.

Community engagement – Each hydro manager holds a mandate to work closely with all stakeholders and none can be more challenging – or potentially rewarding – than the community which surrounds the reservoir. A well-planned timber harvest programme can create the basis for positive dialogue and future-oriented relationships and can help parties move past adversarial paradigms.

UNDERWATER LOGGING DRIVES INNOVATION

Ten years ago, the founders of Triton Logging had a vision to recover the millions of trees that had been flooded by dam reservoirs around the world. By providing a new source of legal and eco-certified timber – underwater trees that no longer sequestered carbon, nor acted as critical natural habitats – Triton sought to set a new standard for forestry.

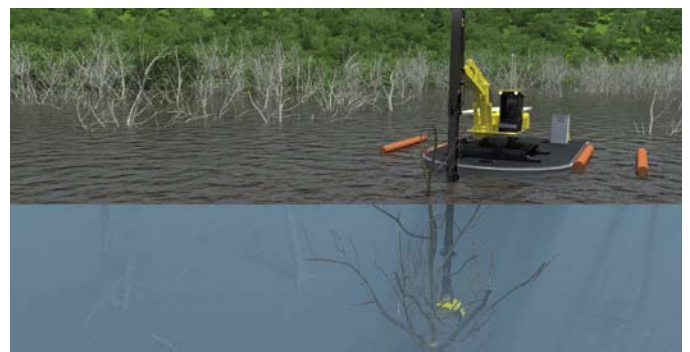
Triton's first step was to develop harvesting technologies that would overcome the key obstacles that other underwater logging systems had faced. Previous attempts using divers were limited by depth and were often dangerous. Other ideas were either too expensive, too inefficient or simply didn't work. Triton's approach matched marine technology with logging industry know-how to create two unique and complementary tools, the Sawfish and SHARC Harvesters.

THE SAWFISH UNDERWATER HARVESTER

Developed and manufactured by Triton, Sawfish is a remotely operated vehicle (ROV) with eight video cameras, sonar and GPS and is powered by a 75hp electric motor and biodegradable hydraulic fluids. Each Sawfish comes equipped with a large grapple and 55-inch chainsaw which, in the buoyant water environment, allow it to cut and handle trees larger than any land-based mechanical harvester. Trees are floated to the surface using one of the 50 inflatable airbags carried inside the machine and attached with a bolt mechanism.

Sawfish uses patented technologies to find, cut and surface submerged trees. These specifications give the Sawfish significant advan-

Below: Triton's SHARC Harvester has been developed to tackle difficult shallow water submerged forests



tages. The first is deepwater access, as it navigates precisely by a remote pilot on a barge as deep as any reservoir in the world, says the company. Secondly, the patented airbag system de-couples the cutting and surfacing processes, enabling the Sawfish to perform multiple cuts without returning to the surface. Thirdly, its remote operation means workers are safely out of harm's way. And, finally, with no need to build roads, fight forest fires and insects, or replant trees, Triton's underwater logging approach holds significant cost advantages and a reduced environmental footprint.

Triton has built Sawfish that have worked successfully across a range of reservoir and forest environments from Canada to Malaysia. Each tree cut has been marked with a GPS coordinate and can be accessed for channel marking and other navigational purposes.

THE SHARC UNDERWATER HARVESTER

Following the success of Sawfish in deep-water reservoirs, Triton developed its shallow-water tool in 2009. Soon to be deployed at Volta Lake, Ghana, Triton's patent-pending SHARC underwater harvester brings new capabilities and flexibility to the removal of submerged timber.

Utilising a customised, fully-integrated barge and excavator, the SHARC can precisely navigate using thrusters and a dynamic positioning system (DPS). Capable of reaching up to 36.5m, the SHARC's telescoping boom and highly manoeuvrable cutting head can harvest quickly and efficiently using one operator. Side bunk log cradles hold the cut trees and are towed to shore while the SHARC operator continues harvesting. Remote cameras, sonar and GPS guide the operator and, as in the Sawfish system, can provide precise coordinates of each tree cut.

Though focused initially on wood value, Triton always understood that removing submerged trees had other critical benefits for reservoirs. As the business developed the company engaged with the hydro industry to better understand how Triton's experience and tools could support specific reservoir objectives.

Triton's approach can be broken down into four key components:

- Assessment, which can involve pre-flood data collection, use of satellite imagery and field work to understand the problems and develop potential solutions
- Planning includes budget development, environmental permitting and customisation of equipment and software
- Tree removal takes advantage of its patented SHARC and Sawfish Harvesters, as well as GPS and visual verification technologies
- Maintenance involves everything from post-project mapping to data management and project integration and supervision
- Using Triton's multi-stage approach allows reservoir managers to develop customised project solutions to match individual needs. In this way, Triton's project plan can account for scheduling restrictions – such as flood seasons and wildlife, environmental and industrial activity – that offer project managers the flexibility to meet budgetary, community and business priorities.

CASE STUDIES SHOW RESULTS

Trilateral Partnership in Northern Canada

Ootsa Lake is part of the Nechako reservoir in northern British Columbia, Canada and was built by Alcan (now Rio Tinto Alcan) to generate power for its Kitimat aluminium smelter in the early 1950s. More than 10Mm³ of pine and spruce were flooded; however, all previous salvage attempts had been unsuccessful.

In 2005, the company engaged Triton Logging in a pilot project with a long-term goal in mind – salvage enough marketable fibre to sustain a modest-sized industry of 100 to 300 jobs for 50 to 75 years. Working under contract to Alcan and in collaboration with the Cheslatta Carrier Nation, Triton deployed two Sawfish. A total merchantable volume of 1093m³ was harvested and 7.1ha of emergent snags were cleared. The operation was certified by The Rainforest Alliance's SmartWood Rediscovered Wood programme and met or exceeded all standards set by Alcan and regulatory agencies.

"Through this underwater logging initiative, the company is working with regional stakeholders and the government to develop an



Above: Triton wood harvested from Lake Kenyir, Malaysia brings value to local communities

associated industry and to bring value to local stakeholders," reported Alcan. "Facilitating access to the valuable submerged timber will also help mitigate an expected downturn in the forest industry. By developing a deeper relationship with the community, Alcan has fostered open dialogue and created a more collaborative environment."

"The pilot project went well in the first year and even better the next," says Triton's Vice President of Operations, Richard Shipley. "We continue to view Ootsa Lake and other BC reservoirs as great places to show a shared approach to submerged forest management."

Salmon enhancement project

More recently, Triton was asked to survey and plan the removal of biomass in an area earmarked for a proposed salmon propagation facility on a US hydro reservoir.

Triton deployed two different sonar surveys for the assessment work. Multi-beam sonar was used to identify and target underwater obstacles, forested areas and anthropogenic structures within the survey area. Sonar transects were conducted over the entire survey area in both east/west and north/south directions with 50% transect overlap to ensure 100% coverage and to determine anomalous returns. The data was processed by Triton's team to give spatial reference of any object and its depth information within the survey area, allowing them to: locate areas requiring obstacle removal or further sampling; identify the size of the proposed removal/sample areas; approximate tree heights and water depths; and produce a bathymetric map in digital and paper format.

High resolution sonar was then used to detail tree and obstacle characteristics, including stem and canopy profiles and tree height and diameter. Both surveys identified the presence of woody obstacles in the form of standing and downed trees and stumps throughout the survey area. "The client now has the results of our work and our analysis of what it will take to remove the problem trees," says Shipley. "We expect to start the tree-removal phase this fall."

THE FUTURE OF SUBMERGED FORESTS

Triton and its partners around the world continue to explore the immense value of underwater logging. Increased social and environmental expectations point to a growing need for dam owners and managers to understand and address the challenges and opportunities posed by submerged forests.

"We've had hydro managers approach us on a regular basis because they need to meet new social and environmental criteria set by funders," concludes Shipley. "The World Bank, IFC and other international financial institutions want to know what reservoir owners and managers are going to do with flooded trees." IWP & DC

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