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FORESTRY

# Reservoir Logs

A submersible robot called the Sawfish can harvest healthy timber from long-forgotten underwater forests. Clear-cutting never looked so green.

BY MICHAEL BEHAR

I'm standing on a steel barge in the center of Ootsa Lake, a 154-square-mile reservoir in northwestern British Columbia. A chafing wind blows from the west, where the snowy, nearly treeless slopes of the Kitimat Range vanish into overcast skies. I jump as a voice booms over the outdoor PA system: "Clear to cut!" A few seconds later, a massive spruce tree erupts from the murky water. ¶ Two hundred feet below, a remotely operated vehicle dubbed the Sawfish is wielding a 54-inch-long chain saw. On the deck of the barge, an operator sits inside a cramped, dimly lit control room made from a shipping container. He's maneuvering the Sawfish with a joystick, and his eyes are locked on a video feed of footage from eight underwater cameras embed-

ded in the contraption. A generator delivers power to the sub through a 720-foot-long high-voltage cable that also encloses a set of fiber-optic lines to transmit guidance commands from the pilot.

If you're on the shoreline or live nearby, underwater timber harvesting is remarkably quiet: no screaming chain saws or

smoke-belching heavy machinery. In a steady, splashing procession, tree after tree bobs to the surface, where a small tugboat rigged with a pair of hydraulic claws grabs the trunks and tows them into something called a bunk, a partly submerged U-shaped cradle. I can see three bunks from the barge. Each stores up to 300 trees and can be raised onto a second transport barge that holds up to 1,000 logs. The Sawfish and its four-person crew will fill it in just four days.

to make good financial sense. Operated by just one person, a so-called feller buncher—the fastest and cheapest way to harvest timber on land—can cut at least 500 trees a day. But then it takes an additional three-member crew up to three weeks to trim and load the trees for transport. A single Sawfish is more efficient. It may clear only 250 trees in an eight-hour shift with four crew members, but there's no need to skid the logs down a hillside and truck them to a mill. Instead, a barge delivers

logging outpost about a two-hour drive from Ootsa. Tall and lean, with neatly combed brown hair, he's wearing tennis shoes, faded jeans, and a blue windbreaker. Later, as we drive through dense forestlands in his rented sedan, Godsall tells me how he got interested in trees. Nine years ago, while working as a marketing consultant in Toronto, he took on a client in the log salvage business. Wet Wood Underwater Fibre Recovery employed loggers to search riverbeds and shallow lakes for sunken timber with potential market value. Eventually, Godsall signed on with Wet Wood full-time as general manager. He soon realized that hunting for a log here and there wasn't exactly the way to rake in the dough. It was akin to collecting soda cans for the five cent return deposit—profit margins were slim, and the work was tedious and time-consuming. Also, it could be unpopular with the public because scouring lake beds can upset ecosystems, churning up silt and debris that then threaten fish and wildlife.

One day during a meeting, a client showed Godsall an image of an underwater forest at the bottom of a reservoir. "I had become so obsessed with retrieving lost logs that the picture of a whole forest of trees underwater seemed at once surreal, obscene, and too good to be true. I was convinced it was trick photography." But the photo was genuine, and a few weeks later Godsall approached his bosses with a question: "Why are we hunting for sunken logs when there are entire forests waiting to be reclaimed?" Godsall suggested they build technology to go after all the standing underwater timber in the world. Everyone just laughed. Godsall resigned two days later, and in May 2000 he launched Triton.

Godsall is from a clan of overachievers—his father, he says, is a "compulsive entrepreneur"; his mother, an "extremely creative" art gallery owner. One brother is a Hollywood director; another battles infectious diseases in Africa. But building a new, unproven technology from scratch made him nervous. "I am not an engineer," he admits. "It was one thing to have a good idea, quite another to execute it." He assembled a design team from a cross-section of fields, including commercial aviation, undersea exploration, and marine

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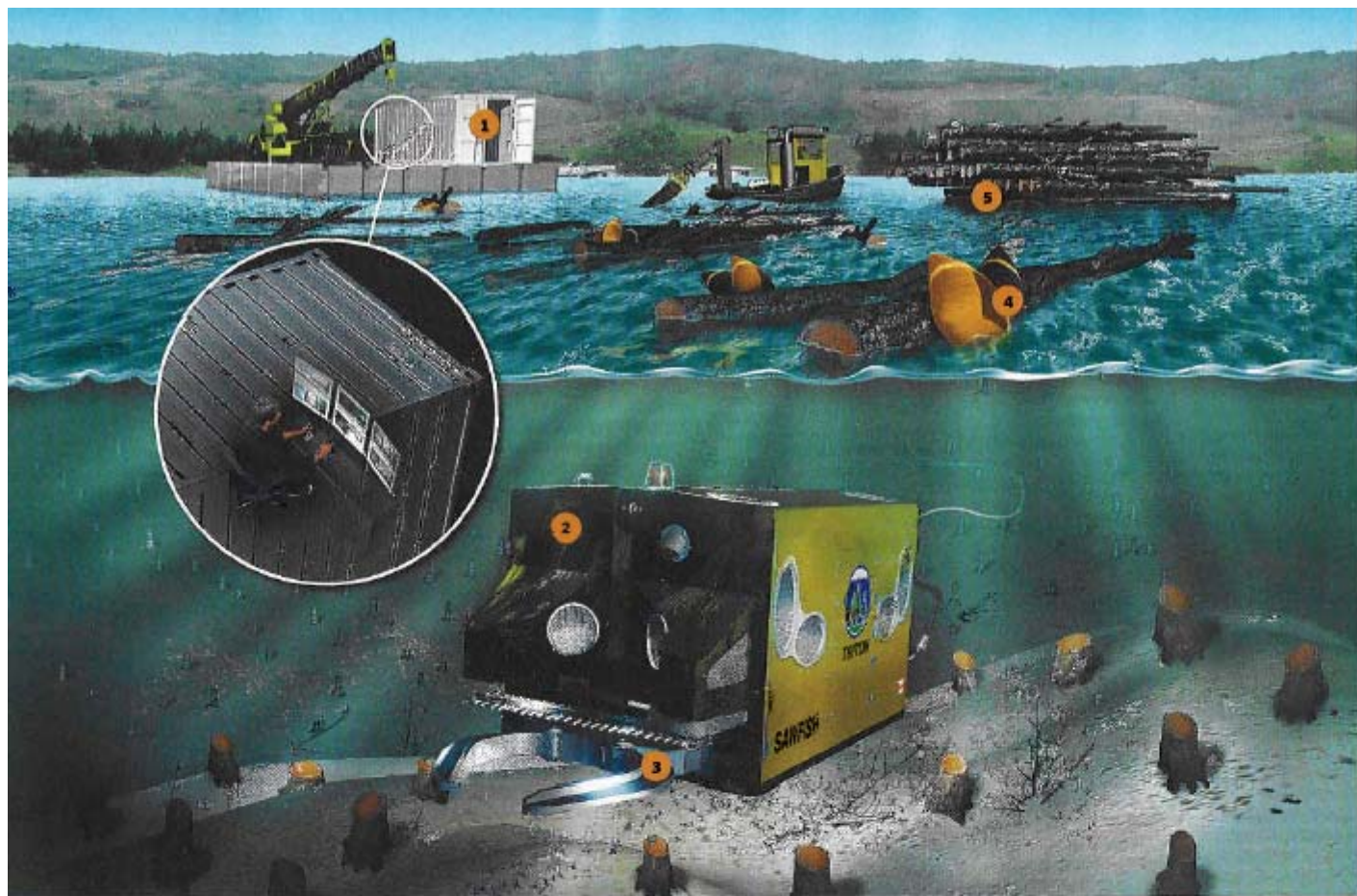
This unusual harvesting method is made possible by a submersible that can probe the deepest reservoirs for underwater trees to cut and deliver to the surface. It was developed by Chris Godsall, the 38-year-old founder and CEO of Triton Logging. The company is based near Victoria, but the principal underwater logging operation is at Ootsa Lake, almost 750 miles to the north. The lake was formed in 1954, when Alcan, the world's second-largest aluminum producer, built a hydroelectric dam here to power its smelter. The water behind the dam flooded millions of lodgepole pine, spruce, Douglas fir, and hemlock trees, leaving some \$1.2 billion worth of timber preserved in a kind of suspended animation. In the cold, dark, oxygen-poor water, tree wood won't decay for thousands of years. And Ootsa is one of 45,000 spots around the globe where dams have inundated valleys and submerged vast forests. By some estimates, there is \$50 billion worth of marketable timber at the bottom of these man-made lakes. Godsall is quick to point out that he has the only technology able to retrieve it.

To gather up a few logs, it might seem like lunacy to deploy the same kind of sophisticated and pricey ROVs used to explore the *Titanic* or investigate 9,000-foot-deep geothermal vents along the mid-Atlantic seafloor. But do the math and Godsall's method starts

the trees to the mill faster and more cheaply, and because they've been submerged they're generally already stripped of foliage and bark. A Sawfish, including the control room, tool shop, and power generator, costs \$800,000 to \$1 million, depending on the gadgetry packed into the ROV. That's significantly less than the onetime equipment cost of roughly \$1.5 million needed to run a comparable feller buncher operation. Add up all the numbers and, while conventional harvesting costs about \$50 per cubic meter of wood, Peter Keyes, an executive at a global timber wholesaler and marketer, estimates Godsall's cost at closer to \$40. "Sure, there are big R&D costs to pay down," Keyes says. "But the technology has given Godsall access to all these trees as if they were on land. It's like finding a new penny."

There are environmental advantages to the Sawfish method as well. Conventional aboveground harvesting contributes to deforestation, a cause of global warming that's responsible for the release of 25 percent of the world's CO<sub>2</sub> emissions. But because underwater trees are already dead, cutting them down doesn't worsen the situation. And with underwater logging, there are no unsightly clear-cuts and no spotted owls to worry about.

**I first meet Godsall** when he arrives at my motel in Burns Lake, a soggy, desolate



biology—there was even an engineer from the Woods Hole Oceanographic Institution in Massachusetts.

During his years as a consultant, Godsall had seen all sorts of contraptions and schemes for retrieving sunken logs—submersible cranes, scuba divers with pneumatic chain saws, and a “tree mower” that was dragged like a straight razor along shallow lake beds. Most didn’t work, some were extremely dangerous, and very few could go much deeper than 60 feet. But Godsall knew that in Ootsa, nearly three-quarters of the good timber is more than 60 feet below the surface. “We had to make that our territory,” he says.

The team needed to invent something totally new—like the Sawfish. About the size of a VW bus and painted bright yellow, the sub can dive to 1,100 feet—deeper than any reservoir on earth—and fell a tree in two seconds. Besides advanced video imaging, sonar, and GPS capabilities, the ROV has a 75-horsepower engine and seven directional thrusters, making it extremely agile. And the vehicle is robust enough to withstand an

## Up From the Deep

Piloted by a joystick jockey at the surface of the water, the Sawfish can cut 250 trees in eight hours.

### 1) COMMAND AND CONTROL

Lowered into the water by a crane, the sub connects to a diesel generator on the surface with a 720-foot cord. Inside a container on the barge, a pilot (INSET) scans video from eight underwater cameras and maneuvers the Sawfish with a joystick.

### 2) ROAM

The ROV has a 75-HP engine and seven directional thrusters, allowing it to move safely through treacherous terrain.

### 3) CUT

To fell a tree, the Sawfish clasps the trunk with its steel pincers so its 54-inch chain saw can rip through the wood.

### 4) RETRIEVE

Waterlogged wood doesn’t float, so the Sawfish screws airbags into the tree trunks using a hydraulic ratchet. The buoyant bags raise the trunks to the surface.

### 5) STORE

A tugboat rigged with a pair of hydraulic claws drags cut logs onto one of several floating storage bunks.

errant tree toppling on it underwater. The Sawfish has a set of 52-inch-long lobster-like steel pincers used to attach the ROV to the base of a tree while cutting. A powerful waterproof chain saw, mounted on a hinged mechanical arm, can slash through trunks up to 8 feet wide.

Perhaps the most ingenious innovation, though, is Godsall’s solution for bringing trees to the surface. Underwater timber is

waterlogged and doesn’t float. So the Sawfish attaches airbags to each tree before cutting it. Using a mouse, keypad, and joystick, a remote pilot can load an airbag on a chain-driven conveyor belt located inside the belly of the Sawfish, then engage a hydraulic ratchet that ejects the bag, screws it onto a tree trunk, and fills it with 5 cubic feet of air. After the log floats to the surface, a tugboat drags it into a storage bunk, and a crew mem-

ber removes the reusable bag. The Sawfish can deploy up to 50 airbags before engineers have to raise it for a refill.

In August 2002, preparing for its maiden voyage, Triton engineers loaded the Sawfish onto the back of a semi and hauled the sub 14 hours to Ootsa Lake. "We cut the first tree and everybody cheered," Godsall recalls. "We cut another tree and everybody cheered. Then we cut a third tree and the Sawfish broke and everybody went home." There were other setbacks—airbags exploded, the Sawfish got its tether lines wrapped around branches—but Godsall persisted. To work out the kinks, he raised more money (for a total of roughly \$1.2 million) and built a floating R&D lab on a reservoir near Triton's headquarters.

**Triton now operates** two Sawfish vehicles on Ootsa Lake, and Godsall plans to build 10 more. He aims to harvest 45,000 trees a year in Ootsa Lake and hundreds of thousands more in other reservoirs. The timing is perfect: Demand for decks, hardwood floors, and roofs crafted from sustainable timber is increasing. Just as organic food swept into grocery stores in the 1990s, Godsall is planning to line the lumber aisles of Home Depot and Lowe's with underwater-harvested timber. He's also talking to Ikea about an exclusive deal to provide wood for tables and chairs. And the Triton logo is becoming an "Intel Inside"-type seal that retailers can slap on products to attract green-minded buyers. A study by the Forest Stewardship Council, a nonprofit based in Germany, says the market for so-called good wood, which includes underwater logs, grew 25 percent in each of the previous two years to hit \$5 billion in 2005.

Godsall is also eager to expand operations beyond Canada. He recently met with reservoir managers in the US, Australia, South America, Africa, and Southeast Asia to broker additional deals. One project involves clearing trees from the bottom of Volta Lake in Ghana, where seasonal drops in the water level bring submerged timber dangerously close to the surface. Trees have punctured holes in boats and passenger ferries sinking them and

killing hundreds of people in the past four years alone.

Most salvage loggers believe that reservoirs conceal 200 million to 300 million trees worldwide. "That's a low estimate," Godsall says. "We're continually discovering reservoirs with trees in them. There's one in Brazil called Tucuruí with \$1 billion worth of timber." Eastern Europe is another untapped frontier: "It has the largest reser-



Just as I step out of the control room and onto the deck, a log bursts through the surface. It's a little like watching rockets take off.

voirs with the most trees." But pinpointing underwater forests is tricky. Godsall's team studies old maps that show where forests once stood. They also use specialized sonar to verify the existence of trees and underwater cameras to identify the variety—spruce, pine, fir, or rare hardwoods such as teak and ebony. Some species are more valuable than others, and Godsall wants the sticks that will bring in the most money.

To snag the best logs, Godsall hires people who know trees and can make snap decisions about wood quality based on a quick scan of underwater camera footage. Take Josh Chernov, a marine biologist and one of Triton's five pilots. He's inside the Sawfish's control room atop the barge, watching six LCD panels relay video from the submerged cameras. Sitting in a *Star Trek*-style captain's chair, he uses a joystick to zoom around a stand of valuable lodgepole pines at the bottom of Ootsa Lake, ignoring nearby timber of lesser value. There's a muffled whir in the corner from the 2.8-GHz off-the-shelf Wintel PC—that's the Sawfish brain. Chernov clicks a button on the joystick to toggle between video feeds, panning a front-mounted camera across the lake bed. The scene is eerie: A lost forest beckons from the shadowy depths, ancient giants still standing proud in the 46-degree-Fahrenheit water.

At the moment, however, Chernov is about to slice through the 3-foot-wide trunk of a

lodgepole pine. He deftly glides the Sawfish to the base of the tree, where it hovers a few feet above the lake bed before clasp onto the trunk with its pincers. While the Sawfish clutches the tree, Chernov switches to a different camera, this time with a view from behind the hydraulic airbag ratchet. From this angle, I can see a column of fluorescent airbags stacked single file in a storage compartment. Another click on the joystick and the

ratchet telescopes forward, snagging an airbag, bolting it to the tree, then inflating it.

He radios over the PA: "Clear to cut?"

"Roger, clear to cut," a deckhand calls.

Chernov starts the chain saw, which swings out from inside the nose cone of the Sawfish and slices through the trunk in seconds. Because the airbag is affixed to the base of the trunk, the tree inverts 180 degrees before beginning its ascent. I step out of the control room and onto the deck just as it bursts through the surface of the water. "It's kind of like watching the Apollo rockets go up," says Dave Menzies, a Sawfish operator who spent 20 years as a pilot for a commuter airline before joining Triton. Moments later, another log appears, then another. There is enough timber in Ootsa Lake to keep the Sawfish busy for 50 years—and plenty more lumber in Panama, Malaysia, and other countries where Godsall hopes to begin harvesting by 2008.

"Mother Nature never intended for trees to be underwater," Godsall says. But that's where forest after forest has ended up. He still marvels at the perfect preservation of the submerged trees. Just waiting, he says, to be harvested guilt free and for profit, by the Sawfish. ■

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