Ecology

Project Baseline in Finland Raises Awareness of Threats to the Baltic

by David J. Cord



A project diver using a Valtamer tablet with an antenna for underwater data reading

N a windy night in December 1944, five German warships set out to lay a minefield in the Gulf of Finland. The squadron mis-navigated in a snowstorm, and two destroyers hit their own previously laid mines. Both sank in only a few minutes. Today, one of those warships, the *Z*-36, is once again a threat in the waters around Finland: remaining fuel might

be leaking out of the vessel. To help monitor this warship and other wrecks like her, a team of amateur divers is partnering with local authorities.

The Baltic Sea is considered one of the world's most polluted bodies of water. It is connected to the North Sea by only narrow straits,

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Model C/38 twin 20mm Flak cannon "Zwilling" on the deck of German destroyer Z-36

so circulation with the Atlantic is limited. An analysis by the Helsinki Commission identified seven major threats to the Baltic Sea: eutrophication, hazardous substances, marine litter, underwater sound, non-indigenous species, overfishing, and seabed loss. The last thing the marine environment needs is fuel leaking from old wrecks.

The fuel used by ships decades ago had a much higher sulfur content than what is used today. During World War II, Germany used synthetic oil produced from coal, which was even worse. The *Z-36* had a capacity of about 835 tons of fuel oil; today, as it slowly decays, there is a risk that fuel will leak into the surrounding waters.

"It has been estimated that the fuel oil in sunken ships around the world is more than what was released during the Deepwater Horizon disaster in the Gulf of Mexico," said diver Mauro Sacchi.

CITIZEN SCIENTISTS ARE KEY

The Finnish Environment Institute, also known as SYKE, has been concerned about fuel leaking from sunken ships for some time. In Fall 2019, they sent the research vessel *Aranda* to study two wrecks in the Åland archipelago between Finland and Sweden. The plan was to cut holes in the hulls and, if feasible, remove the remaining fuel oil. But first, the team had to identify the location of the sunken ships and determine which ones were leaking oil. Gathering such detailed information with limited resources is a difficult task. To solve the challenge, a partnership was created—and continues to evolve—between authorities, diving groups, and companies.

"There are hundreds of sunken vessels at risk of leakage, but the authorities can't monitor them all alone," explained Juha Flinkman, a marine scientist and a development manager for research vessels at SYKE. The authorities then "asked the diving community for help and to report back what they discovered." To accomplish this, SYKE sought "to develop a simple survey method that non-professional divers can perform: a visual survey that includes photogrammetry of the wreck, soil samples, and the placement of sensors. Our goal is to test drive it with the *Z-36* wreck as a start."

One key partner in the project is the diving group Badewanne. They document shipwrecks in the Gulf of Finland and wanted to expand their operations to include assessments of the impact of shipwrecks on their surrounding environment.

When SYKE expressed concern about leaking oil, the idea was advanced to place hydrocar-

bon sensors on the wrecks because leaking oil is often invisible to the naked eye. A group of amateur diving enthusiasts from the technology group Wärtsilä volunteered to help in this endeavor.

For Wärtsilä, a key equipment manufacturer and technology solution provider for the energy and shipping industries founded in Finland in 1834, preserving the marine environment is central to their corporate mission. Since 2014, employees have volunteered in Project AWARE activities to clean up marine debris around the world, both above and below water. More recently, a group of Finnish Wärtsilians began setting up sensor stations to collect important underwater data and document changes to these sensitive environments under the umbrella of the global Project Baseline.





Ojamo Quarry, a world-class mine diving destination is the perfect environment for divers to hone their skills in preparation for Baltic Sea projects.

"We're concerned citizens and employees, not marine biologists. We have the passion but need direction from specialists," explained Sacchi, who in his day job is director for business development at Wärtsilä. "The Baltic is rough, cold, and dark, and some of the wrecks might be 50–100 m (164–328 ft) deep. We had to start by training in an easier environment."

FINNISH AUTHORITIES EAGER TO HELP

Under Flinkman's guidance, the Project Baseline team began working in calmer inland waters in Finland to gain the skills and experience necessary to tackle the tougher challenge of Baltic wrecks.

"We needed to train to dive as a team and develop methods for safely deploying the sensors in cold water," said Mikko Gustafsson, chief project engineer at Wärtsilä. "We needed to understand how to configure the sensors, install them, and read the data safely before we moved on to the harsher environment of the Baltic."

In 2019, the divers began training at a test site in Kaatiala, Finland. They placed three visibility boards for photos and two sensors at modest depths to record temperature and luminosity. Data was collected between May 2019 and March 2020, and sensors were reinstalled to test the life of the batteries. The experiment was a success; the sensors worked even better than expected, and the team refined the techniques needed to install them and retrieve the data.

"You deploy an array of sensors based on the questions you want to answer," Gustafsson said. "We worked with SYKE to design a station suited to the task. This approach culminated with our first fully fledged station at Ojamo."

CONNECTING HUMAN ACTIVITY AND BIOLOGICAL IMPACT

The second inland site, Ojamo Quarry, is just 60 km (37 miles) from Helsinki. It was a calcite mine until the 1960s, and since then, it has filled with groundwater. It is one of the most popular diving sites in Finland, for professionals as well as amateurs.

"The quarry is used by Luksia, a school for commercial divers, as well as Meriturva, a maritime safety training center," said Andrei Voinigescu, general manager for business intelligence at Wärtsilä. "It is not a natural lake and has a lot of human activity, which makes it particularly interesting for us."

The overall aim of the project is to understand how humans impact the underwater environment, which made the Ojamo Quarry perfect for a second deployment. If the team noticed a change in the data, they could consult with the other site users to possibly link the change with specific human activity. They began deploying sensors at progressively greater depths and returning at regular intervals to retrieve the data.

"In two and a half months, we collected 33,000 data points, and we quickly noticed interesting changes," Voinigescu explained. "On January 6, the pH and dissolved oxygen levels began to change. Why? Was it some natural process, maybe changes due to the weather, or was it because of human activity, such as people practicing underwater construction in the lake? Right now, we think there are clear connections between human activity and biological impact." At Ojamo, the divers also wanted to explore the "winter kill" phenomenon common in northern lakes. During winter, ice cover and snowfall stops atmospheric oxygen from dissolving into the water while decaying organic matter uses up the existing oxygen. Due to this lack of oxygen, fishes and other marine life suffocate and die. With climate change causing milder winters, it is possible that "winter kills" will happen less frequently or be less severe, but scientists need hard data to be sure.

The Project Baseline team is happy to share the data with anyone who can use it. Luksia is studying the data to understand how their construction activities impact the water environment where they practice. The nearby city of Lohja is also interested because groundwater drawn near Ojamo supplies the neighboring community. The sensors in the quarry could be an additional data point for their own water quality monitoring.

SUCCESS DEMANDS PRACTICE, PRACTICE, AND PRACTICE

The Ojamo site is an important training environment for Project Baseline volunteers. The quarry is deep, making it a good simulation of some of the conditions and decompression obligations faced in the Baltic when placing sensors on sunken wrecks.

Natural cave diving is not possible in Finland, but Ojamo has old, flooded mining tunnels. There, the team can practice overhead environment diving skills, which will help them prepare to work in the confined spaces, poor visibility, and great depths where Baltic wrecks reside. "For 2020, the plan is to go deeper and install more sensors in the tunnels," said Voinigescu. "Initial project activities at Ojamo were carried out with support of Luksia, but the quarry's fragmented governance has created a lot of uncertainty about how that work can continue."

"We really hope we can deploy sensors away from the open pit where human activity happens," he continued. "That's the only way we're going to be able to get comparison data to isolate the changes caused by the underwater construction work."

According to Sacchi, all Wärtsilä volunteers completed GUE Fundamentals training and are prepared to safely and effectively operate as a team underwater.

"We did the GUE Tech 1 course for managing greater depths and the GUE Cave 1 course for managing line operations and poor visibility conditions," Sacchi said. "The environment is very challenging. Communicating underwater is challenging. Having every team member on the same page in terms of operating procedures is absolutely essential, and that's what the GUE training ensures."

The next step will be training for closed-circuit rebreather diving, which will be necessary for the Baltic dives.

PARTNERSHIPS ARE CRITICAL

Several different private and public partners have joined the endeavor. Onset sensors have been used as water quality data loggers, and Valtamer has supplied the group with underwater tablets to collect data.



Project Baseline Station One, which collects data at four levels of stratification, is marked by a buoy with a flag.

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"When you have sensors at 50 or 60 m (164 or 197 ft) in an overhead environment in 4°C (39°F) water, you don't want to be doing multiple dives to remove and replace them every time you need to get the data offloaded," said Jouni Leinikki, founder of Valtamer and Finnish member of the European Scientific Diving Panel. "Having a tablet that can wirelessly download the data in-water eliminates a lot of logistical and safety challenges associated with back-to-back technical dives."

The local diving community at Ojamo has been extremely helpful as well, volunteering to support the Project Baseline team. When they move to the Baltic, the dives will be conducted from the Badewanne expedition vessel.

"All of these partners are critical to conducting these activities in safety and with the right tools," Sacchi said.

EXORCISING THE GHOSTS OF WWII

Divers will continue running the Project Baseline Ojamo site because it has created the right level of interest among many parties and provides the perfect ground for piloting study techniques. However, the goal for the overall project is to eventually move to the Baltic. Two missions are planned to visit old warships from World War II.

The *M-103* is a Soviet submarine that disappeared in mid-August 1941. It was discovered 57 years later during a NATO minesweeping training exercise and now lies covered with trawling nets on the seafloor.

These "ghost nets" are a worldwide problem. They can entangle fish, birds, marine mammals, or even human divers. SYKE collaborates with the Finnish Fishermen's Association to locate abandoned nets in the Gulf of Bothnia, the large body of water between Finland and Sweden. Badewanne divers have mapped and even removed some of the nets. With their help, the Wärtsilä Project Baseline team plans to clean the ghost nets off the *M-103* wreck. They'll also place sensors on the wreck of the German Z-36 destroyer to detect the presence of hydrocarbons and monitor marine conditions. If the old ship is leaking fuel, the authorities can act, but for that, they need reliable data. The volunteer divers are ready to help obtain that data.

"It is important to take this project step by step," said Sacchi. "We need lots of practice to do this correctly, and we will move on to the next stage only when the team is ready. We are very happy that Wärtsilä is supporting us on this multi-year commitment."

Project Data

Wärtsilä Project Baseline

Phase 1: Kaatiala (2019–2020)

Goal: Train as a team while deploying boards and sensors

Station 1 at 30 m (100 ft) Station 2 at 21 m (69 ft) Station 3 at 39 m (128 ft)

Phase 2: Ojamo (2019-2020+)

Goal: Deploy full stations to test human impact on marine environment and to expand dive training

Station 1 at 0, 3, 10, 20, and 28 m (0, 10, 33, 66, and 92 ft) Station 2 at 42 m (138 ft) (to be deployed) Station 3 at 58 m (190 ft) (to be deployed)

Phase 3: Baltic Sea (2020+)

Goal: Monitor old wrecks and help clean them where possible

Z-36 for oil leakage *M-103* for ghost nets



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