

Aiming to improve local marine conditions

SURFACE WATER MEASUREMENTS IN THE STOCKHOLM ARCHIPELAGO

Waxholmsbolaget shipping company assists the entrepreneurially lead Baltic Deepwater Life organisation to make high-resolution surface water measurements in the Stockholm archipelago.

The [Baltic Deep Water Life](#) is a recent privately funded effort to map and model the driving factors behind eutrophication, too much nutrients in the marine environment, in the Stockholm archipelago, with relevance for the Baltic Sea Proper in its entirety. After some years of initial monitoring, the intention is to suggest possible measures to improve local conditions permanently. A significant difference between this and previous efforts is the intention to do more measurements in space and time.

The first system [to assess surface water conditions](#) was recently installed in the machine room of M/S Sandhamn, one of the many ships owned by [Waxholmsbolaget](#) that transports people and goods in the beautiful [Stockholm archipelago](#), with more than 20 000 islands.

A small amount of water, about 20l/min, is deviated into a [SooGuard flow-through system](#) from the bow propeller cooling pump, which operates permanently at a fixed rate when the engines are running (Fig. 1). The system takes in water about 2 m below the surface. It reports [Oxygen](#), [Salinity](#), [Temperature](#), [Chlorophyll A](#), [Turbidity](#), [Phycocyanin](#), and [Pressure/Flow](#) in real-time as the ship roams the archipelago (Fig. 2, next page).

Figure 1:

SooGuard flow-through system on-board M/S Sandhamn.

- A.** SooGuard chamber, 10 bar rated & Veritas approved.
- B.** SmartGuard logger logs/sends sensor and position data in real-time, data back-up on internal SD card.
- C.** UPS stable power.
- D.** Pump for cooling of a bow propeller, water for the systems comes from here
- E.** Valve to take water samples, e.g., for analyzing of nutrients and algae. When the ship is not sailing, the chamber is filled with air which prevents fouling. Maintenance is done by opening and wiping the inside of the chamber and the sensors one time per month. This operation takes approximately 5 minutes.



M/S Sandhamn passing in front of the Vaxholm fortress

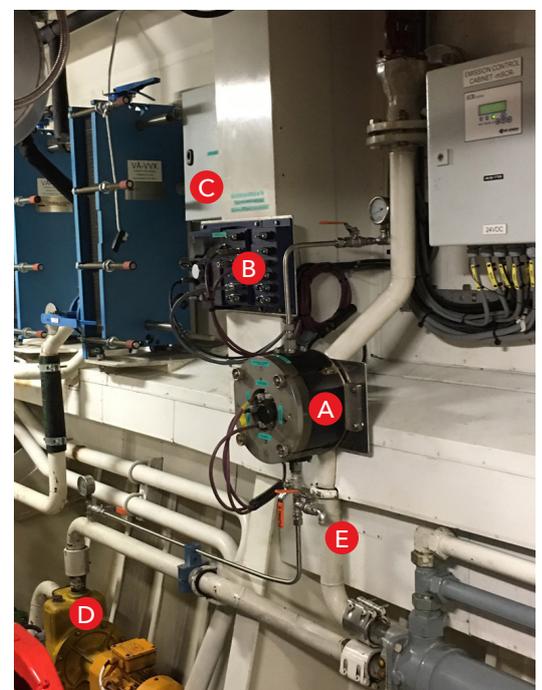


Figure 1

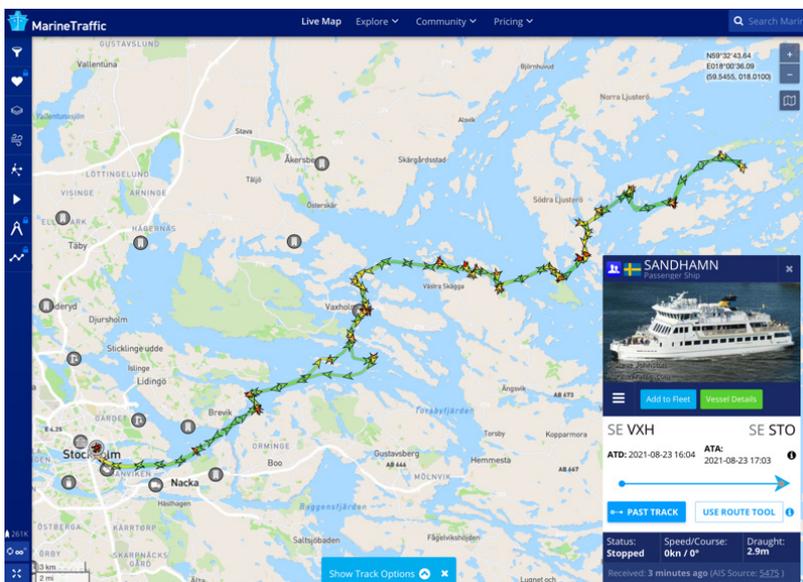


Figure 2: One of the routes of M/S Sandhamn starting from the city center of Stockholm transporting people and goods to the many islands in the archipelago. (Screenshot from Marine Traffic)

The collected data is important in understanding local variations and conditions and detecting the on-set of local algae blooms (Fig 3). The measurements are already filled with important data and this success warrants installations on more vessels lead by Baltic Deepwater Life and Aanderaa.

The surface water measurements will be complemented by multiple systems measuring in the water column placed at strategically important locations. The project has close collaborations with different research institutes and supports innovative research on phosphate extraction from seawater and on the development of new monitoring technology.

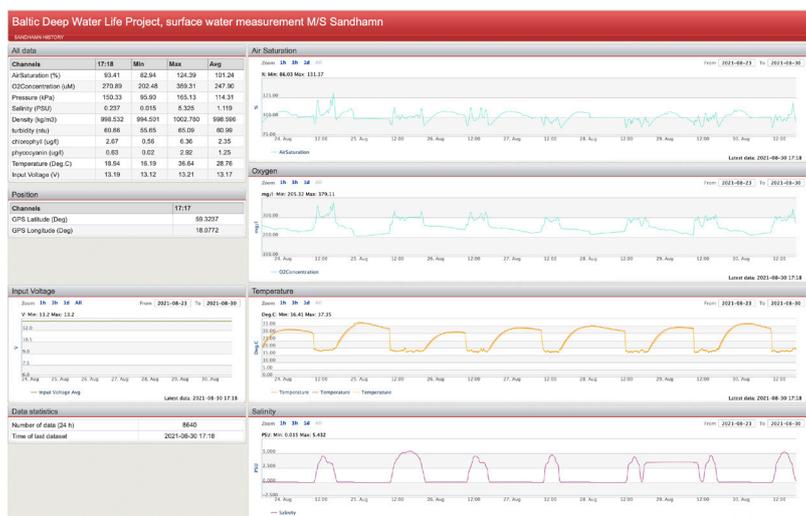


Figure 3

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Sensors from Aanderaa measure Oxygen, Salinity, Temperature and Pressure/Flow in real-time as the ship roams the archipelago.

Coastal Eutrophication

Excessive nutrient input from human land activities often leads to eutrophication, which results in ecosystem changes, including abundant and sometimes toxic plankton blooms and oxygen depletion at the seafloor, as well as excessive loss of biodiversity. Collaborations between the nine countries surrounding the Baltic Sea for the past 40 years have significantly reduced the nutrient input from land and improved local marine conditions. Still, large amounts of nutrients, especially phosphorous, are stored in the sediments and are released when oxygen is depleted in deeper water bodies.

Environmental engagement

Waxholmsbolaget is a publicly owned company that transports people in the Stockholm Archipelago. The company has a strong environmental engagement. A ship like M/S Sandhamn is running on renewable HVO diesel produced from Swedish wood industry residuals. It has catalysts of the same type as on trucks to clean the exhaust from NOx. It has a closed tank system that collects sewage water and transfers it to the public water treatment plant when the ship is at the dock. The ships' crew is engaged and trained to minimize the ship's environmental footprint, and M/S Sandhamn is fitted with the Marine blue drive system, which helps reduce the use of fuel.

Figure 3: Measurements from one week, end of August 2021. The ship operates during day time. At night it is docked in the Stockholm city center. Then the pump is turned off, and the system is filled with air. This prevents growth and allows for air pressure drift check of the oxygen optode and the pressure sensor and zero checks of the Salinity sensor. Please observe that the Baltic Sea water is brackish, and in the center of Stockholm, the salinity is particularly low (below 2 psu) because of the inflow from the lake Mälaren. The factory recalibration interval of the sensors is normally five years.