

# IMPORTANT USES OF HYDROPHONES & THEIR CONTRIBUTIONS TOWARDS OCEAN HEALTH

## HYDROPHONES 101

Sound is the most effective energy for making observations in the ocean as, unlike light, sound propagates efficiently in the ocean and can often be heard many kilometres from its source. In the ocean the main sources of sound come from marine mammals, from human activities, or from environmental events such as rain, thunder, wind, and geophysical

events (e.g., earthquakes). Digital hydrophones are precise underwater microphones that make listening to the ocean easier than ever before. They digitize ocean sound, calculate the energy at each frequency, send the data out via the Internet, and can be programmed to send alerts if a specific event (such as a whale call) is detected, and it all

comes in a package smaller than a water bottle. Hydrophones have different uses depending on the purpose of their mission. Currently, Fisheries and Oceans Canada, Ocean Networks Canada, and not-for-profit organizations operate and maintain many hydrophones along Canada's extensive coastline.



## HYDROPHONE DATA

Data from hydrophones form the largest data set housed in Ocean Networks Canada's data management system, Oceans 2.0 that captures, archives, and makes these data accessible over the Internet. Hydrophones send acoustic data from the ocean environment at different sampling rates, continuously or intermittently, and can either stream live or record autonomously until the instrument is recovered. Some hydrophones sample at high frequencies and continuously produce large amounts of data, while others, particularly autonomous hydrophones, sample intermittently and at lower sample frequencies, producing smaller amounts of data.

## HYDROPHONES WORKING TOGETHER FOR OCEAN NOISE METRICS



Recently, acoustic and biology experts defined the acoustic data and metrics needed to monitor our ocean habitat. Only by analyzing the combination of data collected from all hydrophones, regardless of their purpose, can ocean metrics be truly useful. Evidence-based decision-making is dependent on high-quality scientific data.

As Ocean Networks Canada's expertise is in designing, installing, and operating world-leading ocean sensors—specifically in this case hydrophones—Ocean Networks Canada can store, archive, and deliver the acoustic data from these underwater microphones to users, including policy and decision makers, easily and accessibly through its data management system, Oceans 2.0.

## HYDROPHONES & THEIR USES

On the west coast of Canada, hydrophones are used to study marine mammals, to detect the presence of marine mammals to provide protection, and to study the impact of ship noise on the ocean environment. Each hydrophone (or array) is configured differently and the operating costs vary significantly depending on their purpose and data requirements.



### FOR CONDUCTING MARINE MAMMAL RESEARCH

Hydrophones deployed for this type of research are placed in key locations to detect behaviour, foraging, and habitats and are set at a low sampling frequency rate. These data are retrieved periodically and have minimal data storage requirements.

These acoustic data are used to detect ambient noise and marine fauna vocalization abundances to better characterize the ocean soundscape. The benefits of installing hydrophones for these purposes include a fast initial deployment time and economic project costs. The drawbacks are the long delay before the data are processed, and the risk of instrument failure, unknown until recovery, which could include the subsequent loss of up to six months of data.



Not in real time



Low storage



Calibrate yearly



Cost



### FOR MARINE MAMMAL PROTECTION

Hydrophones used for marine mammal protection and detection, such as vessel or oil spill avoidance, require vessel operators to receive information in real-time and therefore need to continuously collect and transmit real-time data, year round. These hydrophones are set at high frequency sampling rates, create vast volumes of data, and need to be calibrated and maintained two times per year to minimize the risk of malfunction and to ensure that data quality remains high. The maintenance and the volume of data collected results in higher costs.

The value of these real-time data that locate marine mammals increases when combined with data from automatic identification systems that determine the location of vessels. The hydrophones can be programmed to send alerts to ships when whales are in the vicinity of ships. These data are also multipurpose and the archived data can be used for other areas of research.



Real time



High storage



Calibrate yearly



Cost



### FOR SHIP NOISE

Ships are a significant source of noise contributing to the overall ocean soundscape. Each vessel, much like individual human fingerprints, has its own unique noise signature. Hydrophones can record these signatures and class them according to their noise level. These data allow governments and port authorities to test mitigation solutions, such as determining if cleaning a ship hull reduces noise emission, and then set incentives for ship owners to adopt reduced noise, green vessel technology.

To detect and assign ship noise signatures requires the placement of an underwater listening station in a busy shipping lane. The listening station comprises multiple hydrophones that collect and transmit data in real-time and are calibrated daily to meet international ANSI standards (American National Standards Institute). Specialized operations are needed to deploy the power and Internet-connected underwater listening station, and the large volume of data generated requires specialized software programs that contribute to a larger capital investment and operating costs.



Real time



High storage



High Calibration



Cost