The future of marine mammal monitoring

Laurent Guerineau, manager of Sercel's Underwater Business Acoustics Unit, says that Passive Acoustic Monitoring must respond to big changes ahead in the environmental regulatory regime for seismic monitoring.

The seismic industry has strived to reduce its impact on the environment and in particular marine mammals, such as baleen whales (blue whales, humpback whales), toothed whales (sperm whales and dolphins) and Pinnipeds (seals and sea lions). All these marine mammals vocalize in varying ways and in different frequencies.

In the marine seismic sector, after more than four decades of worldwide acquisition, there is still no consensus in the scientific community on the potential impact of anthropogenic sound generated during geophysical surveys on marine mammals. This topic has lately received increased attention from government regulators of several countries, leading to the introduction of mitigation and monitoring guidelines aimed at reducing the potential impact of marine seismic sources on marine mammals.

Recently, the Bureau of Ocean Energy Management (BOEM) opened up the US Atlantic coast to offshore geological and geophysical survey activities and issued a Record of Decision establishing robust mitigation measures and safeguards to reduce impact on marine life.

A growing number of regulatory agencies are requiring or encouraging the use of Passive Acoustic Monitoring (PAM) for real-time detection and localization of marine mammals within the Exclusion Zone (EZ), to minimize the potential environmental impact from marine seismic sources. 'There are currently standards requiring PAM in Canada and New Zealand, while standards are being drafted in Trinidad & Tobago and Brazil. Robust standards are expected to be imposed in the Arctic region. Eventually a global marine monitoring standard could be established.

The exclusion zone, usually defined as the radius around the seismic sources within which mitigation measures, such as seismic source shutdown, is generally set at 500 m. The 500 m offshore exclusion zone is expected to be extended in shallow water areas of the US Gulf of Mexico. In future other regularity agencies are likely to extend such zones.

Current PAM systems typically comprise a dedicated towed array containing several hydrophones, an onboard signal conditioning and data acquisition device, all of which is connected to a dedicated computing system.

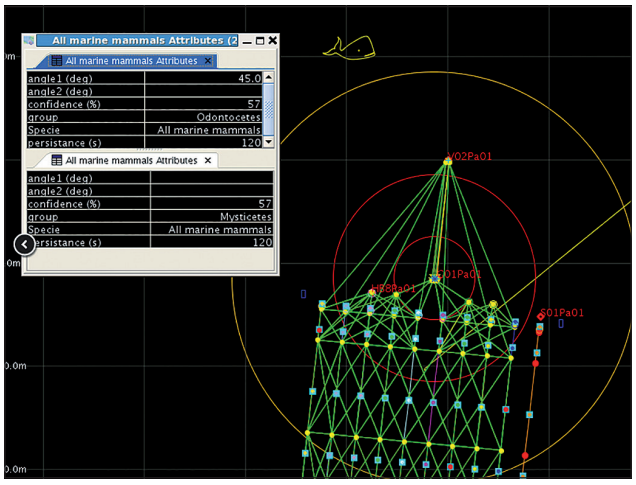
Although the potential value of Passive Acoustic Monitoring as a real-time mitigation tool has been recognized by most regulatory agencies, the currently available PAM systems, while well suited for research and scientific use, are limited as a practical tool for marine seismic surveys that involve the towing of streamers.

On the survey vessels, the management of a dedicated PAM towed array poses safety concerns for operators during the deployment and retrieval phases. The current PAM systems also greatly increase the risk of entanglement with lead-ins and streamers, which increases the likelihood of unnecessary down-time and equipment replacement costs for the seismic contractor.

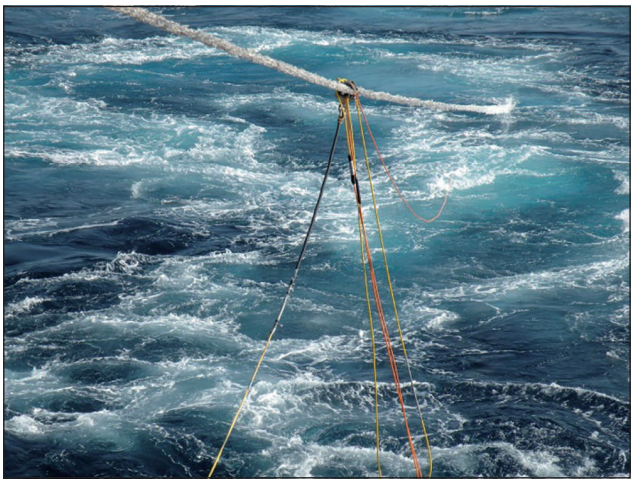
PAM towed arrays are usually deployed a few hundred metres from the back deck of the seismic vessel. The boat-induced noise masks the marine mammal vocalization and the wash created by the propellers acts as an acoustic barrier, thus hindering the system's ability to detect cetaceans.

Commercially available PAM systems typically rely on a single linear antenna containing a limited number of hydrophones, which leads to several restrictions in terms of system performance:

- Limited forward detection/localization performance, and the inability to solve the port/starboard localization ambiguity.
- The use of a single antenna results in operational downtime during night time in case of entanglement.



PAM towed array entanglement with lead-in.



SeaProNav display showing Exclusion Zones and localized cetacean.

- Towed arrays don't provide any QC status concerning their state of health, elevating the risk of operating a malfunctioning system.
- Poor low-frequency response may exclude some baleen whale species from the acoustic monitoring.

Current PAM systems also require specialized personnel to operate the software as there are no standard software settings for optimal results. System performance may be inconsistent and highly dependent on the skills, ability and experience of the operator. Expert skills are required to analyze the data, confirm acoustic detections, reject false alarms, and provide range estimates. Inadequately skilled personnel can result in inconsistent performance.

Sercel's QuietSea system is a fully integrated Passive Acoustic Monitoring system that overcomes many of the limitations of current PAM systems. The sensors are designed to fully integrate with the Seal 428 seismic acquisition system, SeaProNav navigation system, and incorporated with the hydrophones in the Sentinel streamer. The system offers numerous benefits to seismic contractors. It will take advantage of a full range of sensors in the sentinel streamers enabling a range from 10 Hz to 96 Hz and probably more in the future

By eliminating the need for deployment of separate PAM antennas at sea for streamer vessels, the system mitigates the possibility of accidents during deployment, retrieval and operation, thus significantly reducing operational downtime and possible equipment replacement costs.

In addition, the bidirectional communication with the navigation software, coupled with the network of broadband in-sea modules seamlessly integrated within the Sentinel streamers, provides improved cetacean localization accuracy and real-time reporting of detected events for faster decision making.

The low noise performances of Sercel Sentinel hydrophones enable baleen whales to be detected down to 10 Hz. Additionally, numerous broadband hydrophones are dedicated to the detection of toothed whales.

These sensors, placed in strategic positions (outside the vessel wash and close to the centre of the exclusion zone) constitute a large, redundant 2D array that provides good detection and localization regardless of the listening direction.

It relies on advanced automated detection and localization algorithms, which drastically decrease the false alarm rate, delivering truly objective, consistent and reliable information for decision making, regardless of the skills, ability or experience of the operator.

The GUI is intuitive and user-friendly, with minimal settings, relying on self-adjusted software parameters to deliver stable performance across various environments.

The rugged and reliable in-sea modules have built-in quality control capability that allows the system to assess the health of the hydrophones as well as the detection performance of the modules.

Passive Acoustic Monitoring is recognized as a promising tool to complement current mitigation measures during offshore geophysical and geological survey activities, but has yet to realize its full potential.

By balancing the expectations of the regulatory agencies and the operational constraints of the seismic contractor, QuietSea will help Passive Acoustic Monitoring to gain the wide acceptance it deserves among the marine seismic industry while actively contributing to the reduction of the environmental footprint of marine seismic surveys.