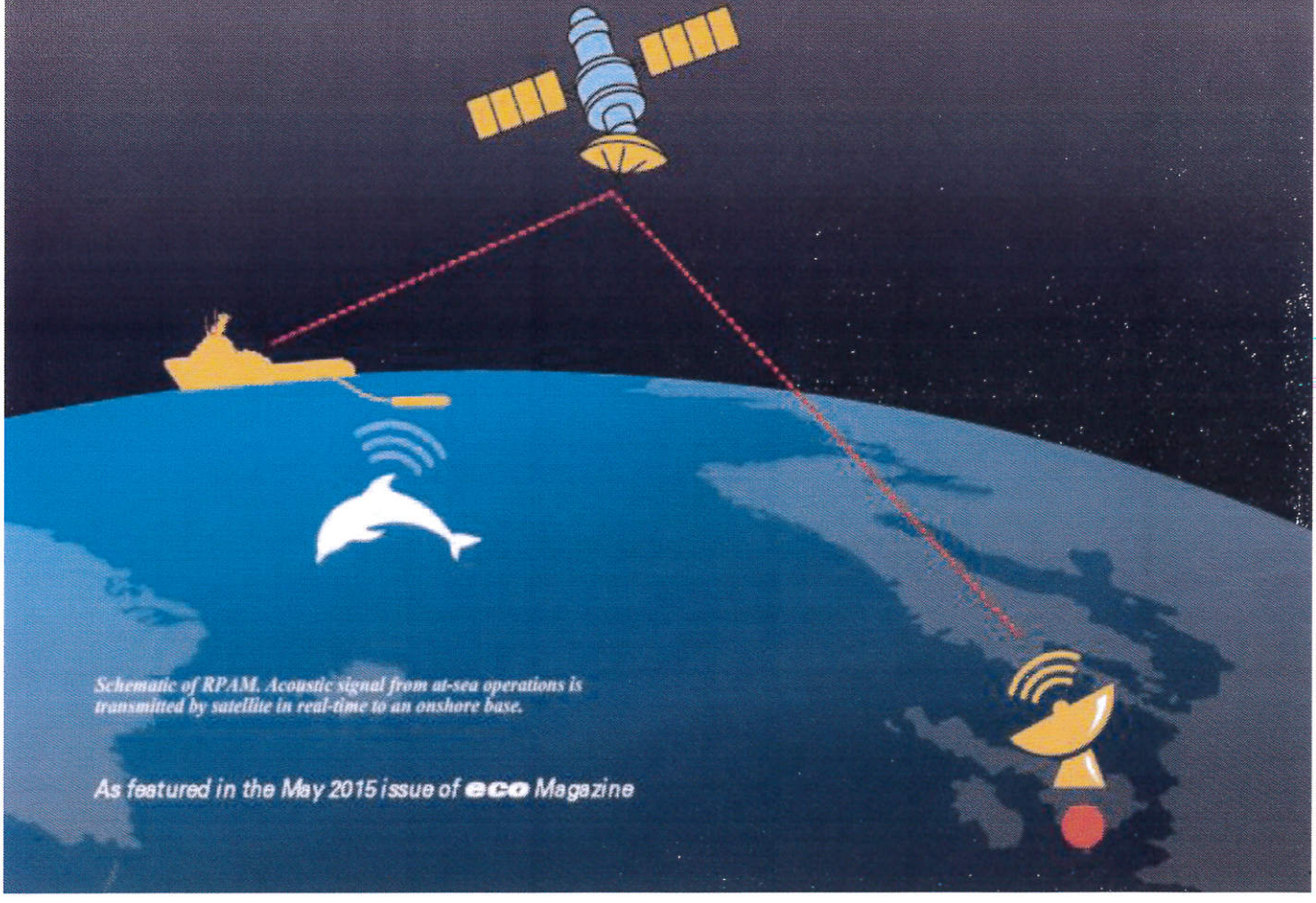
EDITORIAL FOCUS

REMOTE PASSIVE ACOUSTIC MONITORING (RPAM):

Listening for Whales and Dolphins from the Safety of Land

By: Phil Johnston, Seiche Ltd.

A pioneering technique that enables real-time, high-quality Passive Acoustic Monitoring (PAM) for mitigation during marine offshore Industry operations—from anywhere in the world.



Schematic of RPAM. Acoustic signal from at-sea operations is transmitted by satellite in real-time to an onshore base.

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Introduction
Remote Passive Acoustic Monitoring (RPAM) is a new technology that enables the acoustic monitoring of marine mammals—from an onshore location. Acoustic data are transferred, in real time, via satellite link from an at-sea PAM system. From anywhere in the world, an RPAM operator can detect, listen to, and track vocalizing whales and dolphins, potentially reducing the number of operators at sea.

Regulatory requirements for effective noise mitigation have increased, particularly for the protection of whales and dolphins. It has become standard practice for several industry sectors to have Marine Mammal Observers (MMOs) and Passive Acoustic Monitoring (PAM) operators, personnel that are dedicated to monitoring, visually and acoustically, to ensure that animals are not in the close vicinity of an active sound source. These requirements necessitate more environmental specialists going offshore, increasing safety risks and costs.

From Seiche's offices in Devon, UK and Houston, USA, seven full-scale RPAM projects have now been completed. In total, over 12,000 hours of acoustic monitoring have been conducted from projects off Australia, South Africa, Malaysia, the U.S. Gulf of Mexico, Canada, and Trinidad & Tobago. At the latest count, 943 real-time acoustic detections of marine mammals have now been recorded—from the safety of onshore offices, many miles from their actual location in the ocean.

This technology, critical for the offshore industry such as marine seismic exploration, offers a clear added value by providing a high-quality and cost-effective real-time mitigation solution.

In addition, RPAM can be readily applied to academic research, civil engineering projects, baseline studies, and environmental education programs.

Seiche
Seiche was formed in 1996 to undertake underwater acoustics research projects, and the company was involved in the early stages of PAM development. Seiche is now the leading worldwide supplier of PAM equipment to the oil and gas and renewable energy industries, with a proven track record exceeding 125,000 days of deployment. The company specializes in the design, development, and manufacture of underwater acoustic systems with advanced visual detection systems. Strong partnerships are maintained with industry, academics, and government agencies around the world. Seiche has a global reach via three main offices in the UK, USA, and South Africa.

As well as pioneering the use of remote monitoring of PAM, the company also provides a range of solutions for noise measurement, monitoring, and mitigation. In addition, camera systems have been developed to integrate the use of thermal imaging technology and Real-time Automated Distance Estimation at Sea (RADES) software. This enables accurate range and distance assessment when visually detecting marine mammals by day or night.

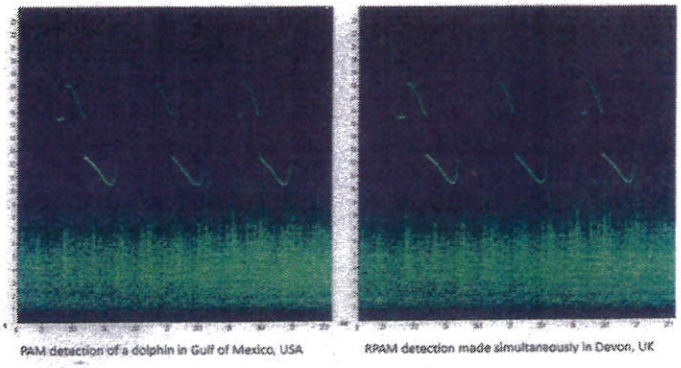
Seiche has both extensive experience in the offshore marine environment and knowledge on sound and marine mammals. Both Joint Nature Conservation Committee (JNCC) and U.S. Bureau of Ocean Energy Management (BOEM) accreditations have been awarded to their MMO training courses; the company also provides industry-leading PAM and underwater acoustics training courses.

A Potential End to PAM Operators Offshore?
Running operations from shore has the potential to reduce the number of people required at sea. At the same time, RPAM is able to reduce logistical challenges and increase cost effectiveness. The most significant benefit, though, is reducing health, safety, and environment (HSE) risk. There is the possibility, in the near future, that RPAM could completely reduce the need for offshore PAM personnel. However, for now, it's more likely to fulfil an expert supporting role.

Regulatory requirements in several areas of the world stipulate the use of more than one PAM operator; yet the pool of experienced operators is small. There is also tremendous pressure on physical bunk space on board seismic vessels. In these instances, RPAM can play a significant role in ensuring the highest levels of environmental protection and regulatory compliance.

On-board and Remote PAM Operators Working Together
Remote PAM is conducted simultaneously with a local PAM operator on board the vessel. The operators can communicate continuously with the remote operator via instant messaging or simply by using a direct telephone link. The PAM operator role is a multi-skilled one. It requires both biological knowledge and technical ability as well as the competence and attitude needed for working offshore. With expertise on technical and biological matters available at the shore base, the offshore operator benefits significantly from the support of the RPAM operator.

"It takes experience to pick out a marine mammal detection, confirm it, and then accurately localize its position,"



A dolphin whistle detected at sea in the USA (left) and simultaneously on land in the UK (right).

says Sherry Baruwa, project manager at the Seiche RPAM shore offices. "But, the offshore operator now gets an instant expert opinion, and talking through it makes it a great way to learn."

RPAM for Mitigation

RPAM is particularly useful for mitigation. The approach of having additional expertise has already proved vital in ensuring robust decisions are made for shutdowns to seismic industry operations.

Delays and shut-downs to industry operations are costly and must be evidence based. The critical need is to establish whether an animal has entered the mitigation zone around the seismic source—not an easy task. With RPAM, there is no need for a lone operator on board the vessel to take sole responsibility for high-pressure decisions.

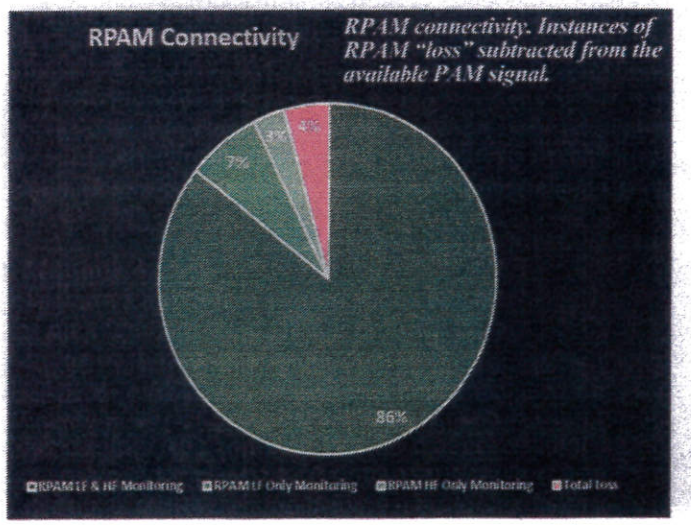
Additionally, without RPAM support, the on-board operator, in some countries, may have to continuously monitor for a full 12-hr shift—without breaks. Fatigue inevitably affects concentration levels. Remote operators on land allow flexible shift patterns to eliminate such problems completely. Furthermore, any on-board technical problems or even illness of the operator can readily be covered by RPAM.

Multiple Access

The provision of live support for technical troubleshooting is an additional asset. If the problem cannot be fixed by either on-board or remote operators, the signal can be patched to more experienced technical experts, wherever they may be. Viewing the same signal and listening to the same audio, the problem can be diagnosed and the on-board operator can be talked through how to resolve it as swiftly as possible. Furthermore, if required, the live PAM feed can be directly accessed by the client.

How RPAM Works

The technical set-up for RPAM was first pioneered in 2013. It has been evolving and improving ever since. Today, in addition to the conventional PAM system on board, a twin processing unit streams the low-frequency (LF: 20 to 19,000 Hz) audio signal via the existing vessel VLAN by secure connection. The twin processing unit also independently runs PAMGuard, which can be accessed independently and viewed by remote desktop software, for the high-frequency (HF: 19,000 to 200,000 Hz) data.



This enables the real-time monitoring of both the LF and HF PAM signal at the RPAM station, which can be situated anywhere in the world with a robust internet connection. Alternatively, when closer to shore, the system can be directly operated over radio link.

Robust Connection

To gain a simple assessment of how well RPAM performs against the PAM on board, we subtract the amount of RPAM "loss" from the total available PAM signal. This connectivity rate has improved as RPAM has developed and projects now consistently deliver rates of 95%.

In all of the projects, the technical and operational performance of RPAM is closely monitored and assessed. All instances of "loss" to RPAM connectivity are recorded, whether high frequency or low frequency. RPAM connectivity loss only amounts to a tiny percentage of the overall monitoring effort. Never the less, to keep improving the RPAM system, we investigate each instance of connectivity loss.

A key lesson learned has been the choice of satellite and bandwidth provision to suit the specific project. On-board physical obstructions may also affect the signal and may vary by the vessel heading, pitch and roll. Additionally, periods of intense solar activity occasionally has an effect on satellite communications. With these lessons learned the connection to RPAM is now robust and consistent.

Remote Future

With an ever greater need for high-quality environmental mitigation for anthropogenic sound, RPAM has great potential. Like any innovative technique, it needs to prove itself. Maintaining connectivity levels of 95%, providing timely onshore personnel rotation, and live support will help it to gain regulatory approval and further allow a direct mitigation role.

The role of RPAM as a platform for training and support is already up and running. In several parts of the world, there is a growing requirement for local personnel—yet the existing pool of available expert PAM operators is still extremely small. As this trend continues, the ability of RPAM to provide live support to those in the field may prove particularly valuable.

This pioneering technique of listening for whales and dolphins from the safety of land may soon become perfectly normal practice.