PAMGUARD: FINDING AND TRACKING MARINE MAMMALS USING THEIR SOUNDS

E&P **SOUND**
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PROGRAMME

PAMGUARD: FINDING AND TRACKING MARINE MAMMALS USING THEIR SOUNDS

The IOGP E&P Sound and Marine life Joint Industry Programme (JIP) has funded the development of a software tool called PAMGuard, designed to enhance Passive Acoustic Monitoring (PAM) of marine mammal sounds.

- **Provides a common tool for all those researching the occurrence and behaviour of marine mammals.**
- **Runs different vocalisation detectors simultaneously, allowing multiple species to be identified and potentially tracked at the same time.**
- **Enables the sharing of improvements with an expanding community of users; as an open software tool that allows users to upgrade the system.**

Background

Marine mammals spend a majority of their time underwater, making them difficult to detect. Historically, marine mammals have been identified by visual observation, but many species spend 75 – 80% of their time underwater only surfacing to breathe, and rough weather conditions can limit visibility further. Passive Acoustic Monitoring (PAM) provides an effective complement to visual methods, as many species make loud sounds, such as biosonar clicks or whistles.

History of PAM Systems

The oil and gas industry maintains rigorous standards to protect marine animals. Mitigation measures are implemented to reduce the likelihood of potential impacts during seismic surveys, if marine mammals are detected within a given exclusion zone. The sounds they make (vocalisations), can be recorded by underwater microphones (hydrophones) and then analysed by computer systems running PAM software to provide information on the animals' location, and in some cases facilitating timely implementation of mitigation measures.

Initial trials on PAM began in the late 1990s, and showed promise as a complementary monitoring method to visual observation. However, further improvement was hindered by the technical challenges of both classifying the sheer variety of sounds that different species produce and lack of standardisation between different types of monitoring equipment. In addition, before this project, there were only limited numbers of experienced personnel able to operate PAM systems. At the time, the same individual had to both operate the system and interpret the technical data produced. PAM personnel therefore required a unique multi-disciplinary set of skills (bioacoustics, hardware operation, software operation, and seismic operations) which was hard to acquire.

The JIP's contribution to advancing PAM

PAMGuard has been designed to enhance and advance the technical capabilities of PAM. The IOGP E&P Sound and Marine life JIP has supported PAMGuard's development by funding a variety of studies and projects conducted by both businesses and universities.

The development of PAMGuard had two complementary goals:

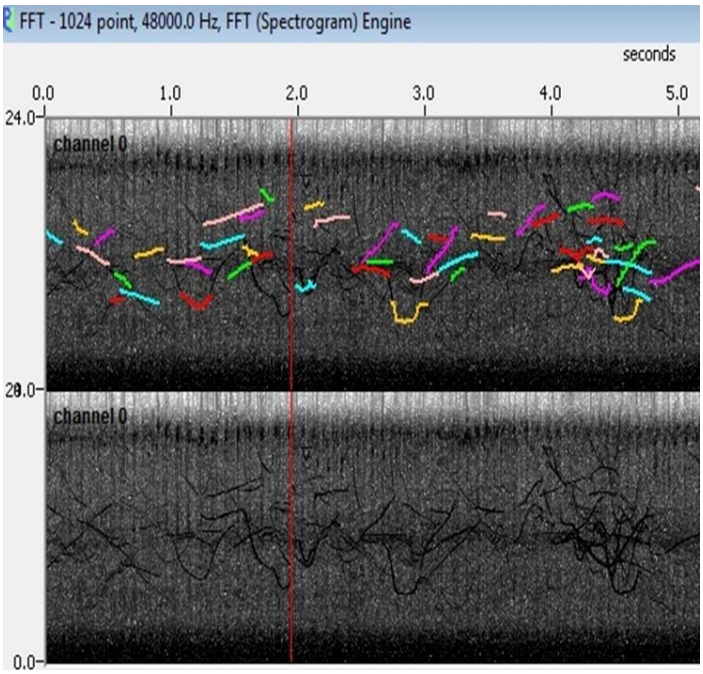
1. **To provide a common tool for monitoring marine mammals at sea, especially during poor visibility conditions.**
2. **To build a community of experienced PAM users.**

A strong knowledge base already existed around PAM, developed through years of previous research funded by the International Fund for Animal Welfare and the US Navy. However, ease of use remained a problem and hindered growth of the user community. To tackle this issue, the JIP envisioned PAMGuard as a completely transparent system allowing full access to both source codes and their underlying assumptions.

PAMGuard:

1. **Runs several different vocalisation detectors which can be configured for the different sounds produced by various species.**
2. **Provides a common software interface to work with multiple hardware systems.**

Visual displays help the user to identify and track deep diving whales while they are below the surface, or during poor visibility conditions. The PAMGuard software is also designed to work with different hardware systems; building user numbers.



The PAMGuard whistle detector output (top) highlights individual and overlapping dolphin whistles when they are not visually obvious in the raw audio recording (bottom).

Significance

PAMGuard has greatly advanced the use of passive acoustic monitoring for all those researching the behaviour of marine mammals, not just industry users. A standardised user interface combined with free, open access code, periodically updated by the PAMGuard support team, has attracted users from industry, research, regulation, and resource management. The JIP has funded this vital support function for over six years.

PAMGuard, especially in combination with traditional visual observations, has also achieved its objective of becoming an industry standard as the most commonly used software for the industry. Its widespread use has greatly increased the effectiveness of both research and environmental risk mitigation efforts.

Learn more about PAMGuard: The more that people use PAMGuard, the better it gets

More information about PAMGuard can be found at: http://www.soundandmarinelife.org/innovation/pamguard.aspx.

The PAMGuard website (www.pamguard.org) offers support, with tutorials for users and detailed developer training notes.

The PAMGuard Community

The development of PAMGuard was a team effort with contributions from over eight universities and small businesses[i]. The Lead Investigator was Dr. Douglas Gillespie, from the Sea Mammal Research Unit (SMRU) at St. Andrews University in Scotland. Dr. Gillespie wrote the core structure of PAMGuard and the original whistle and click detectors. Dr Gillespie's other research interests include the use of PAM systems for population surveys of marine mammals. He is working with colleagues to develop detection systems that can run on low power devices mounted on moored buoys and autonomous vehicles such as submarine gliders.

To date companies and institutes that have contributed to PAMGuard include: Akoostix, Ecologic, Heriot-Watt University Edinburgh, Oregon State University, Scripps Institution of Oceanography, UC San Diego, Sea Mammal Research Unit (SMRU) Southampton University, and the University of Hawaii.

ABOUT THE JIP

One of the most extensive environmental industry research programmes bringing together the world's foremost experts across industry, academia and independent research centres.

This fact sheet has been produced by the IOGP E&P Sound and Marine Life Joint Industry Programme (JIP). The JIP was founded in 2005 and supports research to help increase understanding of the potential effect of sound generated by oil and gas exploration and production activity on marine life.

To learn more about the JIP and our research, please visit http://www.soundandmarinelife.org/

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[i] Further reports available at: http://www.soundandmarinelife.org/library/project-reports.aspx These include:
Gillespie, D, 2009. PAMGuard CODA field trial final report.
Hood, J. 2009. Mitigation & monitoring: Passive Acoustic Monitoring (PAM) software development detection, classification and localisation capabilities.
Gilespie, D, 2009. Development and Implementation of Automatic Classification of Odontocetes within PAMGuard.
Gillespie, D, 2008. PAMGuardIV: Final Report from SMRU Ltd.

Summaries available at: http://www.soundandmarinelife.org/research-categories/mitigation-and-monitoring.aspx