

# MARINE MAMMAL MONITORING

## Use sound to explore, identify and track underwater wildlife.

Understanding the marine mammals that are present in a marine environment, including their habitat use and behaviours, is a fundamental step when studying or moving towards preserving it. When clients need to monitor the presence and behaviour of marine mammals, underwater acoustics can deliver reliable, high-quality results at a much lower cost than other survey methods.

Whether it be weeks, months, or years, our marine mammal monitoring service can be tailored to the needs of any project and budget.

Our scientists are experts in all aspects of marine mammal monitoring using acoustics, and will select the right combination of survey tools to provide clients a comprehensive understanding of what marine mammal species are present and insights into their habitat use.

### **Our marine mammal monitoring tools include:**

- Active surveys: from vessel-deployed cabled hydrophones on GPS-tracked buoys to towed arrays with localisation capabilities.
- Passive acoustic monitoring: Acoustic recorders that continuously eavesdrop for marine mammal vocalisations. Data is processed after the recorder has been retrieved. Deployment in any water depths with our acoustic releases.
- Real-time detection: Moored systems consisting of hydrophone arrays connected to data acquisition modules (such as those from National Instruments) and central processing units.

Our scientists aim to provide clients real insight into marine mammal activity through our proprietary acoustic analysis software, FinFinder. FinFinder uses a range of signal processing techniques, species classifications using machine learning algorithms, and accelerated performance using GPU arrays and parallel computing capabilities.

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# PASSIVE ACOUSTIC MONITORING

## Studying oceans, lakes, and rivers through sound.

Passive Acoustic Monitoring (PAM) provides accurate and detailed information on the presence and behaviour of marine mammals, fish and invertebrates. It can even provide detailed information on the overall health of marine ecosystems. If you want to study life underwater, then PAM can get you closer.

PAM is a valuable tool in marine science research. Our scientists can support clients with the right combination of Acoustic Monitoring systems to gather and interpret the data, as well as comprehensive data analyses.

Our PAM systems have been deployed across the world, from the Yangtze River to the High Canadian Arctic, from Northern Australia to Northern Ireland. We have worked in all main environments on Earth, from the tropics to the poles and deep ocean: making us adept at monitoring any underwater environment.

Clients can choose the duration of specific Passive Acoustic Monitoring projects, or we can design PAM programmes for them. Whether they require a short-term study or going for the long haul: we can design, implement, and service a system that will provide the insights they need.

Track, monitor and explore the life of marine mammals across oceans. Our PAM systems can locate and track a source on compact or large-scale arrays. Follow echolocating dolphins or baleen whales using multi-element hydrophone arrays to triangulate signals and obtain the source's location and movement.

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# PASSIVE ACOUSTIC MONITORING (CONT)

Explore the impact of anthropogenic noise on underwater life. Our PAM systems make it easy to monitor anthropogenic noise and understand its impact on hearing, masking and behavioural changes.

**Our Passive Acoustic Monitoring service includes:**

- Real-time and/or passive acoustic logging systems
- A range of underwater recording hardware that allows us to customise each project for the best results, including hydrophones from High Tech Inc, Cetacean Research, Ocean Instruments NZ and Teledyne Marine.
- State-of-the art recording equipment: including long-term autonomous loggers; cabled systems for towed surveys; and remotely operated systems.
- Real-time PAM data acquisition from National Instruments. Real-time detections of marine mammals or vessels are communicated via 4G/5G networks to SMS or email.
- The option to deploy long-term PAM systems in deep waters.

We use state of the art analyses to process the tens to hundreds of terabytes (TB) of data that PAM produces. Our intelligent analysis systems for automated signal detections and soundscape processing incorporate parallel processing and GPU arrays for accelerated results. So, our clients can focus on their science, faster.





# UNDERWATER NOISE MODELLING

## Accurately predict and model underwater noise

Understanding the potential effects of underwater noise on marine environments requires accuracy and expert noise modelling. Our Underwater Noise Modelling service combines advanced software with years of scientific experience working in underwater acoustics. For clients requiring predictions of underwater noise impacts from anthropogenic noise sources, such as shipping, pile driving, or blasting on any scale: we deliver. Our scientists have access to wide range of internationally recognised modelling code, such as, but not limited to, parabolic equation models (RAMGeo implementation), ray tracing (Bellhop implementation), normal modes, energy flux and specific models that are empirically generated from real-world data.

Our specialist software has been developed to incorporate the most accurate and advanced data, so you can rely on the output. Fully range-dependent models that incorporate a range of environmental parameters are standard. And writing the model's input and output code in-house means we produce completely tailored results for any application. For example:

- Ship noise modelling that fully integrates Automatic Identification System (AIS) data or GPS waypoint tracks (such as for predicting future routes), as well as vessel specifications, to produce a wide range of noise metrics.
- Seamlessly incorporating multiple piling driving methods and pile type in any environment.
- Differentiating between confined and open water blasting for shockwave modelling and far-field propagation.
- Self-adjusting algorithms to calibrate model outputs against empirical noise measurement data.

Underwater noise modelling can also be used to map the acoustic detection ranges of noise sources, such as marine mammals and fish. This is an essential component to effective Passive Acoustic Modelling which relies on the appropriate placement of hydrophones.

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# AUTOMATED SIGNAL DETECTION

## **Automatic detection and classification of source signals.**

Require marine mammal tracking around subsea structures, or monitoring of vessel movements through specific environments for management? Use Automated Signal Detection to understand or mitigate potential dangers to marine mammals from fishing nets, dredgers or construction sites.

Automated Signal Detection is a system of acoustic monitoring that has wide range of applications and potential. Using Automated detectors and the latest machine learning algorithms, automatic detection and classification allows us to track signals using localisation arrays.

Clients define the area - no matter how large or small - and our detectors can be set up to monitor it. Enjoy the benefits of advanced signal processing in MATLAB and seamless implementation in the field.

```
dta = 4*(R2^2 - (c^2 * t21^2)) * ((x3*y4) - (x4*y3));
dtb = 4*(R3^2 - (c^2 * t31^2)) * ((x4*y2) - (x2*y4));
dtc = 4*(R4^2 - (c^2 * t41^2)) * ((x2*y3) - (x3*y2));

DATA ANALYSIS

t1 = (dta + dtb + dtc) / d;
```

```
%Solution for Sx and Sy
%Sx
```

## More than numbers: we turn your data into insight so you can focus on your science.

Whether you carry out your own monitoring or recruit an acoustic expert, turning raw acoustic data into meaningful results can be a time-consuming process.

Advancements in the technology used to monitor underwater acoustics have resulted in an exponential increase in the volumes of data that even a small project can generate. Transforming this data into results can require a lot of computing power and hours or weeks of processing time you don't necessarily have.

Our complete data analysis service frees up your time to focus on the science that's important to you. Using accelerated performance via multi-thread computing and machine learning models, we can analyse acoustic data from any acquisition or recording device in any format. Data products generated include the ability to self-validate your results for peace of mind.

Our service also includes the ability to tailor and code software to provide you with bespoke apps and routines that put you in charge of your own data, including automated detection programmes. We also provide training for all aspects of data analysis to ensure your team has the right skills to work with the data you have gathered.

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# UNDERWATER NOISE ASSESSMENT

## **Prepare for consent; preserve the marine environment.**

Underwater noise assessment is an important part of the consenting process for any development project that could impact the underwater environment.

To carry out Underwater Noise Assessments, our scientists and consultants work alongside your team and project Marine Ecologists to understand the potential noise effects of any development project.

This process can be varied. It may begin by studying the underwater wildlife that exists in proximity to the proposed development's area using Marine Mammal Monitoring, followed by Underwater Noise Modelling and impact zone modelling to inform mitigation recommendations. Or it may only require Data Analyses and Underwater Noise Modelling.

Mitigation recommendations suggest steps that can be taken to support delivery of a project as efficiently and quickly as possible with minimal or no impact to the marine mammals or fish that may also be present.

Once consent has been granted, our consultant team use acoustic monitoring and underwater noise measurement to ensure that the conditions of consent are followed.

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