



Australian Government



AUSTRALIAN INSTITUTE
OF MARINE SCIENCE

ReefScan

The future of marine monitoring

ReefScan is the quantum leap needed for marine monitoring and management to meet the challenges of our rapidly-changing ecosystems.

The ReefScan family of smart, custom-designed technology will enable users to monitor much greater areas in exciting new ways, providing deeper insights.

ReefScan frees human effort from the routine and sometimes dangerous, allowing more time for the critical big-picture tasks. And it is designed to evolve with your needs and technological advances.

Image: CoralAUV, a high-performance ReefScan configuration.



Why do we need to change the way we monitor marine ecosystems?

Marine monitoring is expensive, labour-intensive, sometimes dangerous, and currently only achieved at a small scale.

Even the best funded monitoring systems are only able to survey a few percent of the total target areas, with surveys often undertaken years apart or in an ad-hoc manner.

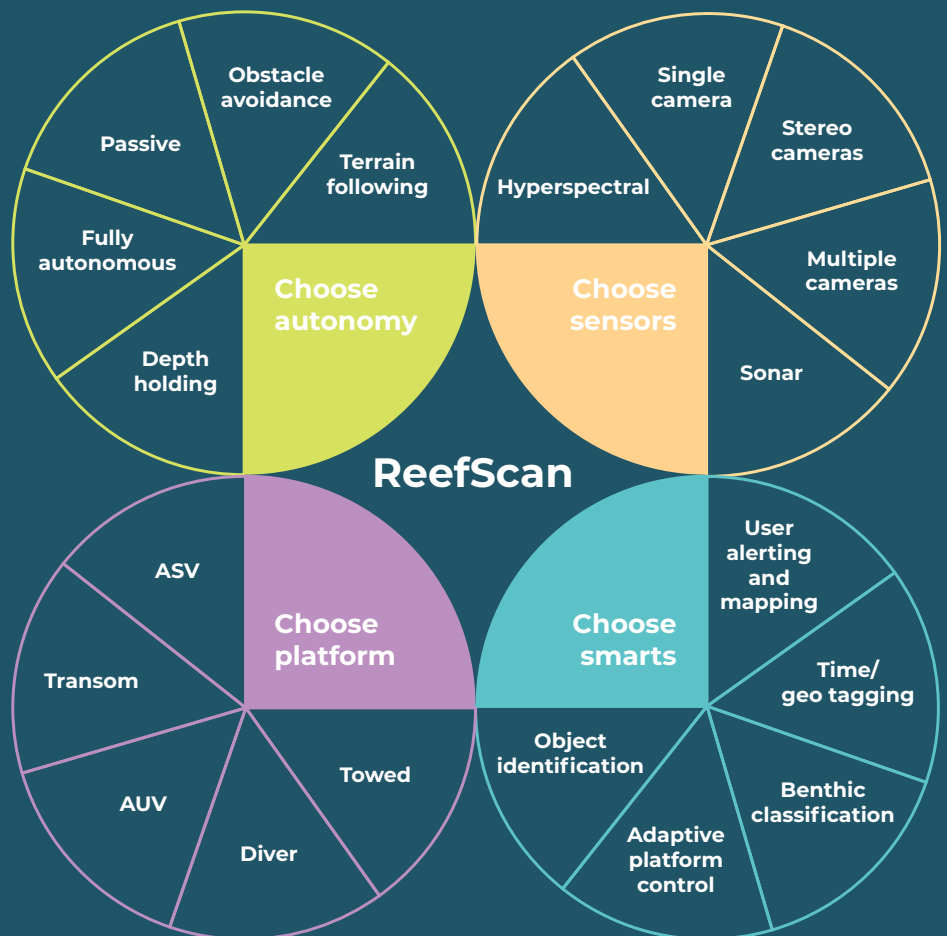
This limits our ability to understand our rapidly changing and increasingly stressed marine ecosystems to make informed decisions about the most effective response.

What is ReefScan?

With more than 30 years of world-leading marine monitoring experience, the Australian Institute of Marine Science (AIMS) understands the challenges and limitations of current methods and the growing need to increase the scale and frequency of monitoring.

Working with innovative partners, AIMS has drawn on its unique knowledge and operational experience to design ReefScan - a suite of smart, efficient, automated, vision-based marine monitoring systems that can be configured to cater for a wide range of needs and environments.

Seamlessly integrating state-of-the-art computing (such as machine-learning), advanced imaging sensors and robotics, ReefScan offers an 'end-to-end approach' from monitoring design to data collection, analysis and reporting.



A modular family of technologies



ReefScan Diver – the simplest configuration, comprising the ReefScan scientific payloads arranged for diver deployment. A basic example is the stereo machine-vision cameras with embedded AI for image analysis and a georeferencing system.

Unified by a single architecture, **ReefScan** is a modular system suitable for non-technical operators. It can be configured for many different purposes (such as monitoring coral reef health and detecting invasive species). It accommodates a range of scientific payloads including high-resolution imaging, hyperspectral cameras and sonar systems.



ReefScan Transom – the simplest non-diver configuration comprising a scientific payload directly mounted on a manned or autonomous surface vessel. Initially, this configuration is designed as an alternative to manta tows and incorporates a high-resolution optical imaging system and artificial intelligence (AI) computing capabilities called ReefScanAI. The modules are designed to be as unobtrusive as possible, and data may be acquired in the background while other activities are underway.

ReefScan includes products that can be used manually or integrated as packages of sensors and platforms – from autonomous underwater vehicles (AUVs) and autonomous surface vehicles (ASVs) to aerial platforms such as drone technology.



ReefScan CoralAUV – a high-performance autonomous underwater vehicle designed to mimic high-resolution monitoring tasks normally completed by divers. It uses sophisticated optical methods (sonar is to be added for turbid conditions) to create a 3D terrain map in real time and navigates as a diver would, relative to the terrain. It features a sophisticated georeferencing capability and a scientific payload bay for high-resolution optical (stills, stereo, video), hyperspectral and sonar-based monitoring. It has onboard AI capability to undertake analysis and detection tasks in real time.

This **ReefScan** family of products can be customised to cater for a wide range of needs and terrains and is suitable for use where marine pests and environmental conditions compromise diver safety. Initial configurations include:



ReefScan Aerial – can be configured for either above- or below-surface monitoring. Above-surface systems are commercially available from many unmanned aerial vehicle (UAV) manufacturers, with selected models included in the ReefScan family for seamless data and analysis integration. Below-surface monitoring comprises an underslung scientific payload that can be dipped under the water ReefScan DropCam. For example, a ReefScanAI image module is deployed in a pattern to collect high-resolution benthic images.



ReefScan Towed - midway between the capability of the ReefScan Transom and CoralAUV, ReefScan Towed can be configured with interchangeable scientific payloads in two ways:

1. a simple system with basic collision avoidance and either constant-depth or bottom-offset-holding for use in relatively undemanding environments, or where the platform does not need to be too close to the targets
2. with the terrain-following technology of the CoralAUV, enabling the platform to closely follow the ocean floor, or operate in more complex environments.

Monitoring
Design

Data
Acquisition

Processing
Filtering

Analysis

Products

Designed to grow with your needs and changing technology

ReefScan is agnostic to the make or model of any specific component, allowing the best solution to be assembled for each use.

The architecture allows for full integration into autonomous platforms and includes capabilities such as adaptive sampling – where the operation of the autonomous platform is informed by the data being collected.

ReefScan uses machine learning (a form of AI) to implement real-time object identification and classification. This allows the user, or autonomous platform, to know what has been seen or detected as it is captured.

Part of the data collection is automated, freeing human effort from routine tasks and allowing them to focus on the value-added work.

ReefScan uses state-of-the-art imaging systems to capture the best quality data to provide a permanent record or baseline and to ensure quality data for the AI and other analysis systems.

Smart technology masks the complexities of the system, with easy-to-use apps for systems control and data collection, providing a range of operators, including Traditional Owners, with access to new technology in a form that is field-focused and fit-for-purpose.

By using open architecture and standards it is future-proof. New capacity can be added without having to modify the underlying system.

Survey type	Delivery platform(s)
Broadscale benthic monitoring – shallow (manta tow equivalent)	ReefScan – Transom ReefScan – ASV
Broadscale benthic monitoring – deep	Reefscan – CoralAUV ReefScan – Towed (passive or active depending on terrain)
Reef flat surveys	ReefScan – Transom ReefScan – ASV
Benthic transects (diver transect equivalent)	Reefscan – CoralAUV
Crown-of-thorns surveys (reef margins, shallow to deep)	Shallow <ul style="list-style-type: none"> • ReefScan – Transom • ReefScan - ASV Deeper <ul style="list-style-type: none"> • ReefScan – towed (active) • ReefScan - CoralAUV
Reef assessment surveys (incident response)	ReefScan (shallow), DiverRig-3D for diver-based surveys
Reef health impact surveys (RHIS)	ReefScan – Transom ReefScan – DropCam
Seagrass surveys	ReefScan – Transom ReefScan – ASV ReefScan – Towed
Night surveys	Any ReefScan system fitted with strobe cameras Sonar systems replace cameras for platform control, terrain following and collision avoidance (field-tested but not yet operational)
Turbid water surveys	Not yet resolved, working on how sonar and hyperspectral imagery can assist
3D coral surveys (rugosity, growth)	Any of the ReefScan products if a structure from motion method is utilised Stereo machine vision cameras can be integrated into platforms if more sophisticated 3D is required



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