National Marine Pest Surveillance Work Plan

Version 1.0, 2022

Disclaimer

This surveillance work plan aims to outline priority requirements for enhancing surveillance of marine pests in Australia, and to improve coordination and implementation of these surveillance activities.

This surveillance work plan is made available on the understanding that the Commonwealth of Australia is not thereby engaged in rendering professional advice. The Commonwealth does not warrant the accuracy, currency or completeness of the guidelines, or their relevance for any particular purpose. It should be noted that legislation, regulations and by-laws may vary between different jurisdictions and ports in Australia. Consequently, the surveillance work plan does not purport to state what is necessary or sufficient to comply with laws applying in any place.

Before relying on the surveillance work plan in any important matter, users should obtain appropriate professional advice to evaluate its accuracy, currency, completeness and relevance for their purposes.

Contents

Purpose of the Work Plan

The purpose of the National Marine Pest Surveillance Work Plan is to guide implementation of the National Marine Pest Surveillance Strategy,(the Strategy) developed by the Marine Pest Sectoral Committee (MPSC) and published in 2019. Development of the Strategy is an activity in MarinePestPlan 2018-2023 (MarinePestPlan), Australia's national strategic plan for marine pest biosecurity. The Strategy outlines priorities for enhancing surveillance of marine pests and aims to improve coordination and implementation of surveillance activities in Australia. The Strategy identifies four nationally agreed objectives for marine pest surveillance and fifteen activities.

One of the fifteen activities is the development of this National Marine Pest Surveillance Work Plan (the Work Plan). The Work Plan provides users with a description of the need and background to the remaining fourteen activities, identifies the key stakeholders, desired outputs and suggested projects that could be undertaken to achieve the activities.

The aim of this Work Plan is to identify and prioritise projects for when resources become available, and it is not expected that all suggested projects will be addressed or completed. Key stakeholders should select the projects (including projects not in the Work Plan) that are most appropriate to achieve activity outcomes. While there is no specific funding allocated for its implementation, having a plan identifying key issues in a range of areas will enable best use of resources when they do become available. Marine pest surveillance requirements and priorities will likely evolve throughout the implementation period of the Strategy (2021-2026); therefore the Work Plan is intended only as a guidance document. In addition, the Work Plan may be required to be adapted during the life of the plan due to changes to marine pest surveillance priorities or technologies.

MPSC will oversee implementation of the Strategy as outlined in this Work Plan. Progress in Strategy implementation will be published on the Marine Pest Website and updated biannually. Strategy implementation will be reviewed mid-term and at the conclusion of the implementation period, and may include revision, deletion or addition of projects.

Some of the activities in the Strategy overlap with MarinePestPlan activities (see Table 1). Furthermore, some of the suggested projects in this Work Plan address the needs of multiple activities and so may appear more than once. These overlaps highlight the parallel biosecurity objectives of MarinePestPlan and the Strategy as well as the interconnectedness of biosecurity activities more broadly.

Where activities are directly linked to MarinePestPlan activities, it indicates that they are an essential element of Australia's marine pest surveillance system and could be treated as a single project that is an integral component of both.

Table 1 National Marine Pest Surveillance Strategy objectives and activities and corresponding MarinePestPlan 2018–2023 activities

Objective	Activity number	National Marine Pest Surveillance Strategy activity	Corresponding MarinePestPlan 2018–2023 activity
Objective 1 To define the need, objectives and scope for surveillance	1.1	Develop an understanding of factors associated with incursion pathways (including vessels) that may affect likelihood of introduction of marine pests.	MarinePestPlan activity 4.4
	1.2	Relevant authorities to identify priority surveillance locations for marine pests based on outcome of 1.1.	MarinePestPlan activities 2.6 and 2.7
	1.3	Maintain an agreed list of priority pest species for surveillance.	na
Objective 2 To describe the different components and types of surveillance required to meet those objectives	2.1	Develop new and maintain existing surveillance tools and information for priority pest species for use in marine pest management.	na
	2.2	Provide advice on use of surveillance techniques such that methods used across and between jurisdictions are quantifiable.	MarinePestPlan activity 3.5
	2.3	Incorporate guidance for components of surveillance in the Emergency Marine Pest Plan.	MarinePestPlan activity 3.5
	2.4	Ensure validated molecular detection techniques are nationally available for priority pest species.	MarinePestPlan activities 2.4 and 2.5
	2.5	Review and provide guidance on pest distribution modelling techniques that may be used in surveillance programs.	na
	2.6	Facilitate passive surveillance by identifying mechanisms and resources required.	MarinePestPlan activity 2.3
	2.7	Develop and implement a national marine pest surveillance data repository.	MarinePestPlan activity 2.7
Objective 3 To outline a nationally agreed approach to marine pest surveillance	3.1	Develop a national marine pest surveillance work plan.	na
	3.2	Review marine pest surveillance activities and data sets relevant to Australia.	MarinePestPlan activity 2.8
Objective 4 To outline stakeholder responsibilities including identification of lead agencies responsible for undertaking surveillance and communications	4.1	Identify and engage stakeholder groups (including government) and educate on the importance of marine pest surveillance.	MarinePestPlan activity 2.2
	4.2	Develop and maintain relationships with stakeholders to encourage surveillance, data sharing and early reporting.	MarinePestPlan activity 5.5
	4.3	Support and develop international partnerships, to improve surveillance tools and capability.	na

na No corresponding MarinePestPlan 2018–2023 activity.

Objective 1: To define the need, objectives and scope for surveillance

Activity 1.1 Develop an understanding of factors associated with incursion pathways (including vessels) that may affect likelihood of introduction of marine pests

Need

This activity aligns with MarinePestPlan activity 4.4 'Conduct risk analyses of marine pest vectors and pathways and make recommendations for improved management.' It is recognised that the relative risks of most pathways are well identified and, following consultation with MPSC, it was agreed to modify the activity to: 'Make recommendations and implement measures to improve management of marine pest vectors and pathways'.

This activity would examine pathway changes that may have occurred since the previous review undertaken in 2010 (Hewitt and Campbell 2010). For the purposes of effective marine pest management this activity will be limited to anthropogenic factors contributing to the introduction of marine pests to—and spread within—Australia, that could be managed through intervention.

Background

Both anthropogenic and natural dispersal vectors have an important role in the range expansion of introduced marine species (Richardson et al.,2016). Bax et al (2003) lists anthropogenic factors that contribute to the introduction of marine pests, with ballast water and hull fouling on commercial shipping being most significant.

The relative contribution of vectors to the introduction and translocation of marine species was reviewed by Hewitt and Campbell (2010). Analysis of the global dataset indicated that more species have life history characteristics associated with biofouling (55%) than any other vector. The second highest association was with ballast water (31%). A similar relative contribution was found in the Australian context through analysis of the National Port Survey Database, with biofouling contributing 60 per cent of species association, and ballast water 24%. Other factors contributing to local domestic movements include fishing and aquaculture, which were found to be responsible for most of the remaining introductions in Port Philip Bay (Hewitt and Campbell, 2010).

The importance of ballast water and biofouling is reflected in their regulation via the International Maritime Organization's (IMO) International convention for the control and management of ships' ballast water and sediments (BWM Convention) and 2011 Guidelines for the Control and Management of Ships' biofouling to minimize the transfer of invasive aquatic species (resolution MEPC.207(62)). Domestic ballast water movement is managed through the Australian ballast water management requirements applying the Biosecurity Act 2015. Implementation of the BWM Convention has likely changed the relative impact of ballast water as an introduction pathway; increased attention now needs to be given to biofouling risks and how these are best managed. Relative impact of pathways will continue to change as new regulations are implemented.

While managing natural dispersal of most marine pests is not feasible, understanding dispersal pathways through hydrodynamic and biophysical models allows for the identification of:

- natural biogeographic barriers that restrict dispersal to other areas
- detection of pests in areas where natural dispersal is not possible, which suggests human mediated translocation.

Outputs

Recognition of factors contributing to spread of marine pests that are currently not adequately addressed, taking into account changes in risk and management measures since 2010, and understanding the efficacy of ballast water treatment systems.

Suggested projects

1.1.1   Improve understanding of the efficacy of current ballast water and biofouling management procedures and develop practical recommendations of possible mechanisms to reduce risk further if required.

1.1.2   Department of Agriculture, Water and the Environment (DAWE) to complete sampling of ballast water management systems on ships arriving into Australia to provide data on the efficacy of the systems for the Experience Building Phase of the BWM Convention.

1.1.3   Improve ability to anticipate future marine pest risks through environmental scanning, overseas surveillance, improved mechanisms for intelligence and information sharing, and apply this information to protect Australia's unique environment and heritage.

1.1.4   Undertake contemporary risk analyses to review factors influencing incursion pathways, including vessel movement patterns and key donor regions, reassessment of introductions associated with particular pathways and effectiveness of measures to manage the risks.

1.1.5   Implement actions to understand movements of shipping including recreational boats, and their potential role as vectors for marine pest spread and introductions.

1.1.6   Investigate methods to assess vessel biofouling that could be used to inform management and control measures.

Key stakeholders

- Barge and construction vessel operators
- Charter operators/vessel hospitality
- DAWE
- Defence
- Diving and marine engineering contactors
- Game fishing clubs
- Marina Industries Association
- Port and marina operators
- Recreational boating industry
- Shipping industry.

Priority

Medium. Key factors have already been identified, but efficacy of management uncertain and changes in the volumes and nature of shipping have occurred. Surveillance aspects of efficacy of ballast water management systems using molecular techniques are already under investigation.

Activity 1.2 Relevant authorities to identify priority surveillance locations for marine pests based on outcome of 1.1

Need

The identification of priority surveillance locations for marine pests in Australia is needed to maximise detection probabilities of new introductions early, and allow for the targeted use of limited resources to establish the most effective marine pest surveillance network. The review on the vectors and pathways for the introduction and spread of marine pests in activity 1.1 will provide an up to date understanding of introduction and spread risk that can help guide relevant authorities and stakeholders to identify priority surveillance locations for marine pests within their jurisdiction.

Background

Identification of surveillance sites for marine pests was undertaken as part of the establishment of Australia's National System for the Prevention and Management of Marine Pest Incursions (the National System) and the development of the Australian marine pest monitoring guidelines (2010). This work focussed primarily on likely locations of new introductions and listed 18 sites around Australia (mostly ports and harbours) to form a National Monitoring Network (NMN). Since the development of the NMN, traffic patterns and vector dynamics have changed, and there is a need to identify priority surveillance locations for marine pests in light of current domestic and international translocation risks. The NMN was not implemented consistently across Australia, largely due to resourcing constraints, and this has impacted the ability to gather ongoing surveillance information on marine pest status in Australia.

The risk of new introductions and spread of established marine pests is not evenly distributed around Australia and surveillance should be targeted at locations with a high risk of introduction, or at sites with significant commercial, environmental or cultural value. This may include ports, harbours, marinas, gas and oil infrastructure, as well as fishing and diving areas, aquaculture operations, marine protected areas, and world heritage sites. Identification of priority areas needs to occur through the engagement of local stakeholders. This not only allows for the identification of appropriate priority areas, but also provides the opportunity to identify local activities and stakeholders that may be able to contribute to active and passive surveillance programs. Several national (for example Integrated Marine Observing System (IMOS) reference stations) and local organisations (for example Environmental Protection agencies, catchment management authorities, port authorities, water companies) undertake regular monitoring and surveillance that could be expanded to include testing for marine pests. There are also a variety of public or community group activities that provide the opportunity for developing a passive surveillance network.

Outputs

Development of a marine pest surveillance network through the identification of priority surveillance locations based on the risk of introduction.

Suggested projects

1.2.1   Develop guidance material on how to identify and rank priority surveillance locations based on the risk of introduction, establishment and spread of marine pests.

1.2.2   Commonwealth, state and territory government agencies responsible for marine biosecurity in their jurisdiction engage with local stakeholders to collate local information to identify priority surveillance locations and species within their jurisdiction.

1.2.3   Identify existing monitoring and surveillance programs that provide opportunities to integrate both active and passive surveillance of marine pests.

1.2.4   Identify and match surveillance options (active and passive surveillance) needed for established effective marine pest surveillance programs within each jurisdiction.

1.2.5   Identify resources needed, and stakeholders responsible, to undertake surveillance.

Key stakeholders

- Aboriginal and Torres Strait Islander Traditional Owners and Ranger Groups
- Aquaculture industry
- Aquarium trade
- Commercial and recreational divers
- Commercial and recreational fishing groups and peak bodies
- DAWE
- Defence
- Gas and oil industry
- Marina industry
- Museums
- Parks Australia
- Port, and marina and slipway operators
- Recreational boating industry
- Shipping industry
- State and territory agriculture/biosecurity agencies
- State and territory marine park authorities
- University researchers and scientific institutions.

Priority

Medium. Identification of priority areas will assist in efficient surveillance resource allocation and support other Strategy activities such as activity 4.1.

Activity 1.3 Maintain an agreed list of priority pest species for surveillance

Need

The National Biosecurity Committee (NBC) and the sectoral committees that NBC oversees have recognised a need for lists of priority species to enable focus of awareness, education and surveillance efforts on particular species. Because of this, development and maintenance of priority lists is an Intergovernmental Agreement on Biosecurity (IGAB) 2.0 priority. Although priority species can be used to identify known threats, it is not possible to identify all potential biosecurity threats. Therefore, lists must be adaptable and include emerging threats. However, priority lists remain important for guiding activities outlined in Objective 2 of this Work Plan.

Background

Current lists include the [Australian Priority Marine Pest List](#) (APMPL), [National Priority List of Exotic Environmental Pests, Weeds and Diseases](#) (EEPL), the Northern Australia Priority Pest List, and the Domestic Ballast Water Risk Assessment List recently reviewed by the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES). Each list has been developed for a specific purpose, using different selection criteria.

Two national priority pest lists for Marine Pests exist, these being the APMPL created and managed by MPSC, and the EEPL managed by the Environmental Biosecurity Office. There is overlap in priority marine pest species represented on both of these national lists. Most states also maintain marine pest lists, which usually reflect national lists and include additional species of regional concern.

Maintenance of a national priority marine pest list will require periodic review as well as ad hoc assessment of new and emerging pests (for example *Mytella strigata*). Where new information emerges, listed species may be considered for addition or removal. Currently the APMPL is reviewed biannually at MPSC meetings, where new species can be added, or consideration given to removal of species if circumstances warrant consideration.

Outputs

Up to date lists of priority species are maintained and used to guide targeted marine pest surveillance. All national lists (e.g. APMPL, EEPL) published in a single location for easy access and comparison.

Suggested projects

1.3.1   Owners of national marine pest species lists to assess species proposed for inclusion on or removal from national priority species lists.

1.3.2   Environmental Biosecurity Office and MPSC to routinely liaise on EEPL and APMPL lists (at least annually).

Key stakeholders

- DAWE
- MPSC
- State and territory agriculture/biosecurity agencies
- University researchers, taxonomists and diagnostic labs.

For the APMPL, MPSC is the activity lead. The maintenance of the other lists is the responsibility of other biosecurity areas or intended to support policy outside the scope of MPSC.

Priority

Low. The various lists of priority marine pest species were developed fairly recently and now only require periodic review and ad hoc updates.

Objective 2: To describe the different components and types of surveillance required to meet those objectives

Activity 2.1 Develop new and maintain existing surveillance tools and information for priority pest species for use in marine pest management

Need

There is a need to ensure that surveillance procedures (such as tests, sampling procedures and spatial analysis) used during marine pest surveillance activities provide meaningful information and are cost-effective. This activity should not be limited to laboratory analysis but also include improvement of sampling techniques.

Background

As new technology becomes available it requires assessment before a decision can be made as to whether it should be included in existing surveillance recommendations. Assessment should include factors such as cost-benefit, ease of use, whether results are quantifiable and comparable, and overall fitness for purpose. In addition to emerging technology, many existing surveillance tools have not been validated meaning results from these would be difficult to compare with other tests/procedures. This is of particular importance when assessing negative results and demonstrating proof of freedom. Activity 2.1 should advise and guide projects in activity 2.2, with 2.1 considered research and development and 2.2 operational.

Outputs

Continued use of up-to-date surveillance procedures that are fit-for-purpose and cost effective.

Suggested projects

2.1.1   Review existing surveillance tools for priority pest species and identify any gaps present. The review should take into consideration the requirement for both screening and confirmation tests/tools.

2.1.2   Identify priority areas of investigation for future funding (should it become available). Recommended priority areas include (but are not restricted to) projects to:

a)   enhance distribution and viability modelling techniques that identify most appropriate locations for testing, as outlined in activity 2.5

b)   develop a series of tests that may be used to confirm results provided by screening tests—areas of development could include use of chemical attractants (for example pheromones) to concentrate populations, development of techniques that may be used to accurately document grid-searches and development of molecular data interpretation methods suitable for confirmation of eDNA results

c)   develop technology that allows remote access by experts during inspection and surveillance programs

d)   investigate and assess technology that allows remote sampling

e)   investigate alternative sampling procedures for the collection of eDNA samples

f)   ongoing proof of concept, development and validation of novel test procedures.

Priority

Medium. The requirement for ongoing improvement of testing and sampling techniques to support surveillance programs is essential, but existing techniques first need to be established as part of activity 2.2. The development of techniques that reduce overall costs to surveillance programs are important and should be ongoing. Activity 2.1 will support and continue to feed into advice provided in activity 2.2.

Key stakeholders

This activity should be led by DAWE with input from MPSC. Key stakeholders include, but are not restricted to:

- ABARES
- CSIRO
- DAWE
- Government agencies involved in biosecurity and environmental management
- International research organisations
- MPSC
- Universities and other research organisations.

Activity 2.2 Provide advice on use of surveillance techniques such that methods used across and between jurisdictions are quantifiable

Need

Activity 2.2 will review currently available surveillance techniques and provide advice on their use. Although a range of surveillance procedures are available, when new techniques are developed the relative benefits of each is often not broadly understood. There is also a lack of advice around when, where and how procedures and techniques should be used. This activity aims to identify surveillance techniques that are currently available and clarify methodology by developing a series of technical guidance documents and training workshops.

Activity 2.2 should be guided by the priority species (activity 1.3), introduction pathways (activity 1.1) and key surveillance locations (activity 1.2) identified in Objective 1. The surveillance techniques should also be updated as new test procedures are developed (activity 2.1). Activity 2.2 also should be used to guide advice provided as part of activity 2.3.

Background

The term 'surveillance techniques' includes three components:

- Sampling methodology—the technique used to collect and preserve appropriate samples used for testing (for example plankton tows, traps, settlement arrays or video transects)
- Test method—the testing procedure used to identify species collected during sampling (for example molecular analysis, taxonomic identification or visual assessment)

- Spatial analysis—the number of tests that must be applied to provide a significantly meaningful result, (for example timing and placement of sampling within a specific location, use of modelling to predict most likely habitats and locations (as described by activity 2.5) or sensitivity analysis).

The Marine pest monitoring manual provides advice on surveillance techniques, however this advice needs to be reviewed and updated in light of new techniques, be simplified, and provide a more flexible/adaptable approach. Significant work has been undertaken during recent years on the use of molecular diagnostic techniques, however they have not been adopted by all key stakeholders.

Advice on the most appropriate test methods is required, together with, where possible, information relating to test accuracy and repeatability. Having readily available, clear advice on the most appropriate procedures available, and guidance on their use is particularly important during emergency response.

Outputs

Production of instructional and training material that can be used to increase the use of accepted marine pest surveillance techniques.

Suggested projects

2.2.1   Review the sampling procedures and tests currently available and provide advice on the marine pest species and circumstances they are most suited to.

2.2.2   Develop standard operating procedures (SOPs) for the field sampling methods identified in 2.2.1.

2.2.3   Document SOPs for test methods identified in 2.2.1. Should include information on preservation techniques and potential service providers.

2.2.4   Where possible, refine existing procedures for designing sampling programs, such that test results can be quantified and compared.

2.2.5   Following completion of 2.2.4, develop a series of workshops on sampling design. The workshops should include aspects of modelling developed as part of activity 2.5.

2.2.6   Complete the development of a survey design tool for molecular surveillance to supersede the Monitoring and Design Excel Template (MDeT). This will determine the minimum number of samples required to meet a desired confidence level.

Key stakeholders

- Aquaculture industries
- DAWE
- Defence
- Government agencies involved in biosecurity and environmental management
- MPSC
- NGOs
- Oil and gas industries
- Port and marina operators
- Private consultants
- Regulators of biofouling or other introduction pathways
- Shipping industries

- Universities and other research organisations.

Priority

High. The implementation of active surveillance programs and response to new incursions requires clear advice on the most appropriate surveillance tools currently available and how they are most effectively used. This information and training is not currently available.

Activity 2.3 Incorporate guidance for components of surveillance in the Emergency Marine Pest Plan

Need

Surveillance is a crucial component of biosecurity emergency response. It informs response management actions throughout all phases of a response, from target species delimitation in the investigation phase through to determining proof of freedom in the stand-down phase. Incorporation of surveillance specific guidance material in national emergency response resources contributes to enhanced marine pest biosecurity preparedness and emergency response capabilities.

Background

The [Emergency Marine Pest Plan](#) (EMPPlan) is a series of nationally agreed guidance documents for use in marine pest responses. The series provides information on Australia's biosecurity response framework; guidance on biosecurity response activities in marine environments; and response options for specific types of marine pests.

The EMPPlan series is currently undergoing review and updates as part of two MarinePestPlan activities; activity 3.4 'Review the EMPPlan framework' and activity 3.5 'Plan and implement procedures to develop and update the EMPPlan response manuals and related guidance materials.'

To date, two surveillance related updates are being incorporated into the EMPPlan series:

- Development of a marine pest management manual with a chapter on modelling the spread and likely extent of marine pest incursions.
- High level guidance on the use of molecular surveillance methods in the Rapid Response Manuals (RRM) series.

Guidance on other components of surveillance relevant to marine pest emergency response would provide response personnel with the information required to implement effective surveillance plans during incursions. Surveillance guidance can take the form of new standalone EMPPlan resources, addition of new guidance to existing EMPPlan resources or the inclusion of links within existing EMPPlan resources to non-EMPPlan materials.

Outputs

The development or compilation of surveillance guidance materials that can be incorporated into the EMPPlan series to support marine pest response personnel.

Suggested projects

Develop national policy and guidance material on components of surveillance as part of the ongoing update of the EMPPlan series including:

2.3.1   Recommended surveillance techniques with links to available SOPs (developed as part of activity 2.2).

2.3.2   Estimates of surveillance test sensitivity and specificity, together with recommendation on confirming suspect results.

2.3.3   Photography of marine pests for identification purposes (developed as part of activity 2.2).

2.3.4   Sample collection and preservation to facilitate molecular surveillance methods (developed as part of activity 2.2).

2.3.5   Interpretation of surveillance data for example molecular detections in the absence of visual and physical specimen confirmation.

2.3.6   Information on molecular assays for specific marine pest species that could be used in surveillance.

2.3.7   Identify the need for and scope of proof of freedom for marine pest biosecurity

2.3.8   Subject to the outcomes of 2.3.7, development of national policy on proof of freedom for marine pest biosecurity.

2.3.9   Guidelines on determining proof of freedom through surveillance, once nationally agreed policy on proof of freedom for marine pests is developed.

2.3.10 Field sampling techniques for the taxa that will be included in the updated RRM series (developed as part of activity 2.2, for example crab sampling techniques).

Outputs from activity 2.1, activity 2.2 and activity 2.4 of this Work Plan may achieve some of the objectives of these projects, so specific elements may need to be chosen to complete the projects. Implementation of the Strategy should be undertaken strategically, with oversight from MPSC to avoid project repetition.

Key stakeholders

- DAWE
- MPSC
- State and territory agriculture/biosecurity agencies.
- Universities/research institutions

DAWE oversees development and review of EMPPlan materials and publishes nationally endorsed documents on the Marine Pests website. MPSC is responsible for providing policy advice, technical review and facilitating national agreement on the framework and content of the EMPPlan resources. DAWE and MPSC will work collaboratively to update the EMPPlan series based on the recommendations provided within this Work Plan.

Priority

Medium. Marine pest responses can occur at any time. Ensuring that the EMPPlan series provides up to date and relevant information to guide emergency responses is a crucial part of Australia's biosecurity preparedness capability. The EMPPlan series is being updated as part of MarinePestPlan and already provides guidance on many of the fundamental components of a marine pest emergency response.

Activity 2.4 Ensure validated molecular detection techniques are nationally available for priority pest species

Need

Molecular detection techniques have emerged as promising tools for pest surveillance, allowing for the early detection of species-specific genetic material. Molecular assays have been—or are currently being—developed for a wide range of marine pest species; however, not all have undergone the same level of validation and testing. The Australian Government Guidelines for development and validation of assays for marine pests provides a framework for assay development and validation for new molecular methods for the detection or identification of marine pests. Most of the technical details of these molecular assays are published in scientific journals or reports that may not be readily accessible. There is, therefore, a need to develop an up-to-date list of molecular detection tools that are currently available, and the location of the technical details to facilitate their use. This will also facilitate the identification of new assays or genomic resources that require development.

Background

Molecular techniques provide a set of highly sensitive, and cost-effective tools for marine pest surveillance. They allow for the identification of marine pests or can indicate if a marine pest is present at a location. These approaches can be used to analyse a diverse range of samples, from tissue biopsies taken from specimens, surface scrapings, plankton tows, or filtering of cellular material directly from water or sediment samples (so called environmental DNA). Several different molecular approaches can be applied to these samples, from species-specific assays, to metabarcoding approaches that allow for the profiling of tens to thousands of species simultaneously from a single sample (Wood et al. 2013, 2019).

Several species-specific quantitative PCR (qPCR) assays have been developed for pest species of relevance to Australian marine biosecurity (Bott et al. 2010, Bax et al. 2006, Wood et al. 2017) and have been used to understand vectors of range expansion and the detection of new incursions (for example Hirst et al. 2013, Richardson et al. 2016). However, not all assays have been developed and tested to the same level (for example specificity and sensitivity), with validation needed to understand detection probabilities and the likelihood of false positives and false negatives. The Australian Government Guidelines for development and validation of assays for marine pests, outlines a framework for assay development and validation of new molecular tools for the detection or identification of marine pests. The guidelines follow a similar structure to the World Organisation for Animal Health (OIE) Principals and methods of validation of diagnostic assays for infectious diseases.

Metabarcoding, and other similar sequencing approaches, target taxonomically informative genes (for example CO1, 18s, 16s, 23s) but have not been widely applied for marine pest surveillance due to many of the markers lacking species level taxonomic resolution, or a lack of taxonomically verified reference sequences (Cristescu and Hebert 2018). This approach holds much promise for marine pest surveillance but further genomic resources are needed for a wider range of pest species, and closely related native species, to enable the targeting of gene regions with species level taxonomic resolution. The National Marine Pest Reference Sequencing Project, funded by DAWE, recently has begun developing genomic resources for a number of marine pest and native species.

The different molecular approaches have various benefits and limitations in terms of sensitivity, specificity, technical capability and processing time that need to be considered when selecting an approach for surveillance purposes. It is likely that the list of molecular tools available for use in marine pest surveillance will constantly evolve, and new molecular approaches will become available. Any list will need to be regularly updated and reviewed annually to remain relevant.

Outputs
Increased national capability to detect marine pest species through the application and further development of molecular detection technologies.

Suggested projects
2.4.1   Develop an up-to-date list of molecular detection tools for priority marine pests. This list should be made readily available online and updated as required.

2.4.2   Develop and validate molecular detection assays for priority pest species for which these do not currently exist.

2.4.3   Develop taxonomically verified genomic reference sequences for priority pest species and related native species.

2.4.4   Determine sensitivity and specificity of assays and detection probabilities for priority pest species. This includes species-specific information around eDNA shedding rates, eDNA particle characteristics (for example size and buoyancy) and decay rates—currently unknown for most marine pest species.

2.4.5   Optimise eDNA sampling and collection methodologies and technologies for target priority marine pest species.

2.4.6   Identify facilities that have the expertise and capability to provide molecular diagnostic services, develop new molecular tools for marine pests, or further validate existing ones.

Key stakeholders

- DAWE to host and maintain list of molecular tools for surveillance of marine pests—for example on the [Marine Pests website](#)
- Universities and other research organisations.

Priority
High. The implementation of the Strategy requires access to information about currently available molecular diagnostic techniques and suitably skilled people to compile it.

Activity 2.5 Review and provide guidance on pest distribution modelling techniques that may be used in surveillance programs

Need
Modelling approaches provide a broad range of tools that can be used in marine pest surveillance programs to track and predict the spread of pests from introduction sites, prioritise surveillance locations, design surveillance programs, predict population growth and identify pathways of introduction. There is a need to provide guidance on the types of modelling approaches available, what type of information they can provide to guide marine pest surveillance and management, the types of input data required for the models and the scale and resolution of those models.

Background

Several types of modelling approaches exist that can contribute to surveillance and management of marine pests. These range from quite generic models that are applicable to a number of species or locations, to more spatially explicit and/or species-specific models. The Marine Pest Management Manual (under development) will provide an overview of some of the modelling approaches that may contribute to marine pest surveillance, response activities and the different inputs required for the different modelling approaches. These include the use of biophysical dispersal/dispersion models that combine hydrodynamic models with biological characteristics to predict dispersal and movement, species distribution models based on habitat requirements/preferences, population growth models to understand establishment trajectories, and risk modelling to identify pathways of introduction.

Outputs

Increased national capability to detect marine pest species through the application and further development of modelling tools.

Suggested projects

2.5.1   Undertake a review identifying different modelling approaches for marine pest surveillance and how they can be applied to response and management.

2.5.2   Identify currently available data sources and highlight knowledge gaps that need to be filled to improve models.

2.5.3   Identify what modelling approaches are already available for priority areas in Australia (identified in activity 1.2) that can be used to assist with surveillance and management of marine pests and areas where data are needed.

2.5.4   Identify biological data needed to parameterise models for priority pest species.

2.5.5   Use hydrodynamic modelling to identify the potential for discharges (via ballast water or in-water cleaning) to reach unintended sites and inform policy regarding locations where discharges should not occur.

Key stakeholders

- Australian Marine Science Association
- Commonwealth Science and Industrial Research Organisation (CSIRO)
- Gas and oil industry
- Geoscience Australia
- Government agencies involved with biosecurity and environmental management
- International biosecurity organisations
- International port and marina operators
- International research organisations
- Port and marina operators
- Private consultants
- State and Territory governments
- Universities and other research organisations.

Priority

High. The review of modelling approaches for marine pest surveillance is needed to provide up to date information on how modelling approaches can be applied in the context of marine pest surveillance, response and management, and identify data gaps for priority areas/species.

Activity 2.6 Facilitate passive surveillance by identifying mechanisms and resources required

Need

Passive surveillance is a powerful and cost-effective tool for surveillance as it encourages reporting of unusual events that may be of biosecurity significance. However, it needs educational tools to assist in raising awareness of what warrants reporting and how to do this most efficiently. Reporting mechanisms (hotlines and in most cases apps) are in place in all states and territories, and a national hotline is also in operation.

Background

This action is fed by MarinePestPlan activity 2.3 'Promote tailored awareness and education materials to engage marine pest observer groups in passive surveillance'. This project has identified the groups for which education and awareness materials are lacking. A compendium of existing education and awareness materials has been developed and is held on a publicly accessible website by Ocean Watch. Sectors for which information was lacking included the aquaculture sector, some shipping sectors (particularly international), port operators and divers. Mechanisms for passive surveillance facilitation need to be identified alongside tailoring material to specific audiences.

Direct messaging is the most effective method of delivering a specifically tailored message for smaller stakeholder groups. As currently available material has been documented and stored, this written and visual material will be used as a base for material to be provided, with new material produced to address specific gaps in potential observer groups. Better identification of the resources required and provision of a sound rationale for allocation of those resources is required.

Mechanisms currently in place are increasingly using videos for general awareness, and more specific printed/online materials for identification and provision of information. However, as platforms for effective communication evolve, adaptations will need to be made to ensure adequate coverage. Identified priority species (activity 1.3) should be used as a basis of these communications, recognising that there may be regional or local priorities that should be focused on.

Outputs

Adequate resources and reporting mechanisms are in place to enable useful passive surveillance for marine pests.

Suggested projects

2.6.1   Develop materials for the aquaculture industry, primarily the sea cage and rope culture system sectors.

2.6.2   Develop materials for the shipping sectors, particularly international shipping.

2.6.3   Develop identification materials for port operators, divers, slipway operators and remotely operated vehicle (ROV) operators to increase awareness of pests they might observe.

Key stakeholders

- Aquaculture industry
- Commercial divers
- Defence
- Port and marina operators
- Shipping industry
- Slipway/ship cleaning operators
- Training organisations.

Priority

Medium. Stakeholders have requested material for identification of pests that they may encounter in their areas. Other stakeholders will also require visual cues to help identify risks.

Activity 2.7 Develop and implement a national marine pest surveillance data repository

Need

Considerable marine pest surveillance has been conducted across Australia. Analysis of this data improves our understanding of pest status, identifies priority surveillance locations and can direct targeted biosecurity management.

Marine pest surveillance data has traditionally been managed, and primarily been available, to the organisation undertaking the surveillance activities. A national marine pest surveillance database that stores and publishes confirmed surveillance data will provide a holistic picture of marine pest detections within Australia and better support biosecurity management, stakeholder engagement and marine pest research.

Background

The [National Introduced Marine Pest Information System](#) (NIMPIS) has recently been updated and will serve as the platform for a national marine pest surveillance data repository. NIMPIS contains profiles for over 100 marine pest species and provides detailed information on the biology, ecology and potential impacts of these species. NIMPIS includes species profiles of both established and exotic marine pests. The system also includes data on confirmed marine pest detections that have been provided by government biosecurity and government research organisations for example CSIRO. Only data that have been confirmed by government biosecurity organisations are included in NIMPIS. Only jurisdictions from which surveillance data are recorded can submit the data, to ensure that jurisdictions are confident that the data being reported from their area of responsibility are accurate.

The updated NIMPIS platform was published online in 2020, with a majority of the surveillance data being publicly accessible. Initial stakeholder engagement has identified opportunities to enhance the database; these are listed as suggested projects.

Outputs

NIMPIS is enhanced to provide marine pest stakeholders with greater access to surveillance data, ecological information and improved database functionality.

Suggested projects

2.7.1   Publish the remaining historic marine pest surveillance data collected by the former CSIRO Centre for Research on Introduced Marine Pests on NIMPIS. Including these data would improve the spatial and temporal resolution of the surveillance data on NIMPIS.

2.7.2   Review and update species profiles on a priority basis. Ecological and management data for priority marine pest species have been updated based on reviews of the scientific literature.

2.7.3   Enable the capture and presentation of transient marine pest detection data on NIMPIS to improve the analytics and management of associated vectors. Transient marine pest detection data (for example the detection of pests on a vessel) cannot currently be captured or presented in NIMPIS. These data may be valuable in vector risk analysis or tracing of marine pest detections in the environment.

2.7.4   Update NIMPIS to incorporate proof of freedom data. Proof of freedom data cannot currently be captured or presented in NIMPIS. National policy has been proposed to define and provide guidance on determining proof of freedom for marine pest biosecurity. Once this work is complete NIMPIS should be updated to incorporate proof of freedom data (dependent on activities 2.3.7, 2.3.8 and 2.3.9).

2.7.5   Enhance the functionality of the database based on MPSC and stakeholder feedback on ways that NIMPIS could be improved to enhance the functionality of the database. This feedback is currently being considered for incorporation into NIMPIS.

Key stakeholders

- DAWE
- MPSC
- State and territory agriculture/biosecurity agencies
- Universities and other research organisations.

DAWE hosts and manages the NIMPIS database. DAWE will consult with MPSC and other national marine pest biosecurity stakeholders to identify priority areas to improve the database.

Updates to the database should be communicated to stakeholders and implemented in consultation with stakeholders where possible.

Priority

High. The maintenance and continued development of NIMPIS is a high priority, as the database plays a crucial role in supporting other activities within the Strategy including activity 1.2, activity 2.1, activity 2.6, , activity 3.2, activity 4.1 and activity 4.2).

Objective 3: To outline a nationally agreed approach to marine pest surveillance

Activity 3.1 Develop a national marine pest surveillance Work Plan

Complete. For information on the need and background to this activity, see the [National marine pest surveillance strategy](#).

Activity 3.2 Review marine pest surveillance activities and data sets relevant to Australia

Need

A diverse range of organisations generate, own and maintain marine pest surveillance data sets that are relevant to Australia's biosecurity system. Much of these data are not shared outside of these organisations in a timely or efficient manner. National co-ordination and publication (where appropriate) of these data would assist biosecurity managers, industry, research and community stakeholders to make better informed decisions on surveillance and management of marine pests.

Background

Marine pest surveillance data are generated for a wide range of reasons including for many purposes not relating to biosecurity. Nationally co-ordinated marine pest surveillance data, such as the information published on NIMPIS, predominantly captures data generated by government biosecurity agencies and other forms of data are not being fully utilised to inform marine pest management.

Examples of marine pest surveillance data that are currently being underutilised include:

- historic marine pest surveillance data that have not been incorporated into NIMPIS
- environmental impact assessments, environmental monitoring or similar ecological assessments generated as part of development and industrial operating requirements in marine environments (such information is often submitted to government environment agencies and may not always be shared with government biosecurity organisations)
- marine ecological data generated by researchers and not always shared with government biosecurity organisations
- data generated by citizen scientists, volunteer or community groups that are operating in marine environments.

The collection and utilisation of these additional forms of marine pest surveillance data is a swift and cost-effective method to enhance the available data on which management decisions are made.

While it will not be appropriate to publish all forms of additional data collected as part of this activity, efforts should be made to share information with national marine pest stakeholders where possible.

Outputs

A national audit of marine pest surveillance data sets relevant to Australia. This audit will provide biosecurity managers with better information on which to make management decisions. Where appropriate, information should be published, or shared with national stakeholders such as industry and research organisations to support their business objectives. This activity has linkages to activity 2.7, however is primarily focused on collecting and utilising surveillance data not currently captured in the NIMPIS database. Activity 2.7 is primarily focused on enhancing NIMPIS through updating marine pest species information and improving the database functionality.

Suggested projects

A national audit of marine pest surveillance data.

3.2.1   Collate surveillance data endorsed by government biosecurity agencies that can therefore be published on NIMPIS, including

a) historic CRIMP port survey data
b) data generated as part of the National System for the Prevention and Management of Marine Pest Incursions.

3.2.2   Engage non-biosecurity government departments (for example national parks, fisheries and environment departments) to request surveillance data relevant to marine pest biosecurity.

3.2.3   Collate and publish, where appropriate, marine pest surveillance data generated by non-government stakeholders including

a) industry surveillance data not submitted to government agencies
b) research data from peer reviewed publications, grey literature and personal communications with researchers
c) surveillance data from other groups such as citizen science groups and eNGOs.

Key stakeholders

- Aquaculture industry
- Citizen science and other community groups
- CSIRO
- DAWE
- Defence
- Fisheries authorities
- Gas and oil industry
- Marine industries
- Marine research organisations
- NGOs
- Other government agencies with access to relevant marine pest surveillance data
- Parks Australia
- Port and marina operators
- Shipping industry
- State and territory agriculture/biosecurity agencies
- State and territory park authorities
- Universities and other research organisations.

It is recommended that this project is undertaken by MPSC, its member organisations or their delegated representatives.

Priority

High. The outputs from this activity will potentially inform other Strategy activities including activity 1.1, activity 1.2, activity 2.7 and activity 4.2. Therefore, this activity is a high priority and should be undertaken early in the Strategy implementation process.

Objective 4: To outline stakeholder responsibilities including identification of lead agencies responsible for undertaking surveillance and communications

Activity 4.1 Identify and engage stakeholder groups (including government) and educate on the importance of marine pest surveillance

Need

Biosecurity is a shared responsibility and this is particularly true for marine pest surveillance. Due to Australia's vast coastline and the limited resourcing available for targeted marine biosecurity surveillance programs, education and ongoing engagement of marine stakeholder groups is necessary to maximise marine pest surveillance capacity.

Benchmarking of stakeholder marine pest knowledge and level of engagement in surveillance activities is necessary to identify knowledge and engagement gaps, apply tailored education and engagement programs and assess the efficacy of these programs.

Background

Significant work has been undertaken as part of the implementation of MarinePestPlan to identify and engage marine pest stakeholder groups (MarinePestPlan activities 2.3, 5.1, 5.2 and 5.3). MPSC also strives to maintain and enhance stakeholder engagement in marine pest management. Through jurisdiction based and national campaigns to raise marine pest awareness, the opportunity exists to educate stakeholders on priority marine pest species and encourage their participation in marine pest surveillance.

Marine pest stakeholders encompass a diverse range of groups such as school groups, port and marina operators, commercial and recreational vessel owners and operators, fishers, divers and corporate and government organisations engaged in marine operations or environmental management. Stakeholder groups' level of marine pest knowledge and involvement in management activities is constantly evolving. Education and engagement programs need to be responsive, agile and adaptable to these changes.

Feedback from existing engagement activities indicates high levels of stakeholder interest in marine pest biosecurity issues and a willingness to be involved in marine pest management. However, in certain stakeholder groups, awareness of marine pest biosecurity is limited. Ongoing engagement and education of stakeholder groups is critical to ensure meaningful contribution in marine pest management, including participation in marine pest surveillance. Benchmarking is critical to quantify current knowledge and participation rates of stakeholders and to enable assessment of the effectiveness of stakeholder education and engagement activities.

There is significant potential to enhance Australia's marine pest surveillance capacity by leveraging off existing national and local marine pest engagement programs to educate stakeholders on the importance of marine pest surveillance and how they can support the biosecurity system.

Outputs

Benchmarking of stakeholder groups' marine pest knowledge, management practices and involvement in marine pest surveillance activities.

Identified stakeholder groups (including to those already engaged in passive surveillance) educated on marine pest surveillance to encourage behavioural changes to achieve enhanced marine pest surveillance outcomes.

Suggested projects

4.1.1   Develop stakeholder surveys to tailor existing and future marine pest education and engagement activities, to enable benchmarking of stakeholder knowledge and participation levels.

4.1.2   Further engagement of ports and marinas (either at a national or local level) to encourage participation in structured surveillance programs (such as SWASP and Q-SEAS).

4.1.3   Collaborate with educators to develop surveillance education material for students.

4.1.4   Collaborate with existing government supported surveillance programs (such as indigenous ranger programs) by providing education resources to enhance marine pest surveillance capabilities.

4.1.5   Collaborate with existing marine pest stakeholder engagement projects to support education and awareness about priority marine pests and how to take part in surveillance.

Key stakeholders

- Aboriginal and Torres Strait Islander Traditional Owners and Ranger Groups
- Citizen science and other community groups
- CSIRO
- DAWE
- Fisheries authorities
- Gas and oil industry
- MPSC
- Museums
- National Resource Management Groups
- NGOs
- Other relevant government agencies for example EPA, Infrastructure, Defence, FRDC
- Parks Australia
- Port and marina operators
- State and territory agriculture/biosecurity agencies
- State and territory park authorities
- Universities and other research organisations

MPSC is in the process of engaging stakeholder groups to encourage participation in passive surveillance (MarinePestPlan activity 2.3). MPSC is therefore well placed to oversee the development of national stakeholder education and engagement programs and benchmarking as part of the Strategy. Implementation may involve jurisdictional biosecurity agencies working in collaboration with stakeholder groups to tailor and deliver information that meet the needs of the recipients.

Priority

High. Effective education and engagement of stakeholder groups in marine pest surveillance can significantly boost Australia's marine pest surveillance capacity and capabilities. Education and engagement programs have the added benefit of fostering interest and investment in marine biosecurity management. Benchmarking of stakeholder levels of knowledge and engagement in surveillance is critical to assess and effectively adapt education and engagement programs to meet stakeholders needs.

Activity 4.2 Develop and maintain relationships with stakeholders to encourage surveillance, data sharing and early reporting

Need

As mentioned in [activity 4.1](#), significant work has been undertaken and is planned to identify and engage stakeholder groups in aspects of marine pest management including surveillance. It is critical for continued engagement with stakeholder groups to encourage on-going participation and capability development. Benefits of maintaining stakeholder relationships and engagement include increased marine pest data sharing, consistency in methods used, early reporting and intelligence gathering.

Background

Every year there are detections of priority marine pests in Australian waters, including on international or domestic vessels. While a majority of these events are communicated in a timely manner through the correct marine pest reporting processes, some detections are not formally reported, or are reported in timeframes that limit management options.

Reasons for slow, incomplete or non-reporting of marine pest surveillance data may include a lack of stakeholder awareness of biosecurity responsibilities, intellectual property concerns and poor two-way communication of how reporting surveillance data contributes to marine pest management.

In 2020, a surveillance submission protocol to submit surveillance data onto the NIMPIS was introduced and jurisdiction biosecurity officers were trained in data submission. Maintenance of close working relationships with these stakeholders is essential to ensuring that data submissions are made and are kept up to date.

A wider network of collaboration with researchers and other stakeholders generating surveillance data is also essential as they play a crucial role in early detection of marine pests as well as improving the temporal resolution of surveillance data, through long-term monitoring projects that include marine pest surveillance.

On a national scale, the development and maintenance of partnerships and communication between research institutions and governments is necessary to minimise duplication, enhance cooperation and collaboration, and improve the consistency of data collected to enable meaningful comparisons. The Marine Pest Research Network was established with these goals in mind. The Marine Pest Research Network aims to enable better communication and data sharing, while acknowledging that in the research world there are often competing interests meaning that enhancing cooperation may be challenging in some areas.

Outputs

Relationships between marine pest biosecurity stakeholders are maintained and strengthened, resulting in open and timely intelligence and data sharing as well as improved accessibility to surveillance data through publication on national databases and other mediums.

Suggested projects

4.2.1   Ensure greater marine pest representation and promotion in environmental research and management organisations (for example National Marine Science Committee) with the aim of ensuring that marine pest surveillance is considered and prioritised in research projects and policy development.

4.2.2   Identify and resource methods to support the Marine Pest Research Network in improving stakeholder engagement and information sharing.

4.2.3   Review the National Priorities for Introduced Marine Pest Research and Development 2013-2023 and use it to engage researchers in marine pest surveillance projects and gain access to resourcing.

4.2.4   Target stakeholder engagement through official communication, such as biosecurity information being included in licence packages. Engage in forums such as conferences and workshops to show leadership in surveillance data sharing, encourage participation in marine pest surveillance activities and educate on biosecurity reporting requirements.

Key stakeholders

- Aboriginal and Torres Strait Islander Traditional Owners and Ranger Groups
- DAWE
- Government agencies involved with biosecurity and environmental management
- Licence issuers and holders (for example transport and fisheries agencies and aquaculture or boat licence holders)
- Marine Pest Research Network
- MPSC
- Private consultants
- State and territory agriculture/biosecurity agencies
- Universities and other research organisations.

Priority

High. Maintenance and progressive growth of stakeholder relationships is a fundamental component of a robust biosecurity surveillance system. This activity is a high priority to ensure that marine pest surveillance is prioritised in environmental research and management programs, and that stakeholders collaborate and share information.

Activity 4.3 Support and develop international partnerships, to improve surveillance tools and capability

Need

Australia is a global leader in marine pest biosecurity management. To maintain an effective marine pest surveillance system, Australia must contribute to, and leverage off, international partnerships to stay at the forefront of marine pest surveillance techniques, policies, information sharing, ecological

research and risk identification. This will ensure best value for resources invested in marine pest surveillance and management.

Developments in surveillance technology are rapid, as can be the emergence of new invasive marine pests. International partnerships with researchers and managers are essential to support information and intelligence sharing and ensure the latest technological and ecological developments are identified and their implications understood. It will also allow collaboration to reduce duplication and enhance the power of data collection essential for tasks such as validation of molecular tests.

International agreements (such as the BWM Convention) and foreign nation's regulatory decisions (such as the New Zealand Craft Risk Management Standard) have marine pest surveillance implications for Australia. Different marine pest surveillance and management approaches also act as test cases on which informed policy decisions can be made within Australia. Participation with international organisations and collaboration with international biosecurity managers promotes the sharing of information and ideas that are essential to improving Australia's marine pest surveillance system.

Background

Australia's marine pest managers have well established relationships with their international counterparts. Government biosecurity agencies participate in formal international forums (such as the International Maritime Organization) that support management of marine pests, and bilaterally with New Zealand in a commitment to Trans-Tasman consistency in marine biosecurity. Additionally, scientific cooperation has been established with the Quadrilateral Animal and Plant Health Groups (QAADs) countries (Australia, Canada, New Zealand and the United States). The QAADs relationships have focussed on use of molecular techniques and cooperation to ensure accuracy of tests being used to identify pests. National marine pest stakeholders also engage in informal international partnerships such as information sharing and research collaborations.

Use of emerging and developing technologies in marine pest surveillance promises more effective, sensitive and specific surveillance outcomes with reduced costs in time and resources compared to current methods. For example, developments in ROV technologies have been rapid in recent years, and comparison of the models available on the market would be an expensive and time-consuming commitment. However, collaboration with overseas partners has allowed more effective comparison of ROVs suitable for marine pest surveillance with mutual benefits for all collaborating parties. Sharing of hardware or ease of arranging for comparisons is much easier when partnerships and common interests are well developed.

The development and effective use of molecular techniques in marine pest surveillance is also advancing rapidly. However, with vast amounts of data required for validation of tests to ensure their accuracy and to provide accurate data on sensitivity and specificity, collaboration is essential to developing the large sequence data banks required. Collaboration to ensure that data generated is comparable and of highest quality, and to maximise efficient use of processing power, is critical to make best use of these tools in their current states and to build on future developments.

Sharing of surveillance information is also necessary, particularly between Australian and regional areas, to enhance knowledge of emerging pests. It will allow more accurate assessment of risks presented from those countries.

Outputs

Improved international partnerships will result in more effective use of resources and knowledge and improved surveillance technologies.

Suggested projects

4.3.1   Develop or adopt an interoperable metabarcoding library that is internationally shared and maintained.

4.3.2   Develop a multinational Marine Biosecurity ROV Hub to encourage information sharing and research collaboration.

4.3.3   Identify and resource methods to support the multinational co-operation and engagement with marine pest biosecurity stakeholders through QAADS.

4.3.4   Identify and resource methods to support co-operation and engagement with marine pest biosecurity stakeholders through the Marine Pest Research Network.

4.3.5   Promote Australia's marine pest surveillance programs at international events such as the International Marine Bioinvasions Conferences, to foster partnerships and garner new information sharing on research into surveillance techniques.

4.3.6   Identify and engage marine biosecurity agencies/organisation in the Asia-Pacific region to further develop working relationships and support biosecurity intelligence and knowledge sharing.

Key stakeholders

- International biosecurity organisations (particularly in the Asia-Pacific region)
- International NGOs
- International port and marina operators
- International research organisations
- Marine Pest Research Network
- QAADs
- Shipping industry.

Priority

Medium. International vectors such as shipping are the most likely pathway for the introduction of new marine pest species to Australia. Intelligence sharing with international partners is an effective and low investment method to manage part of the risk associated with the vectors.

Supporting international information sharing on ecological, technological and policy based methods to improve marine pest surveillance also provides opportunities to enhance Australia's surveillance system with minimal investment.

Australia already plays a leadership role in marine pest biosecurity. This activity will support Australia's role on the international stage and further develop our relationships with international partners to further common interests.

Stakeholder list

Broad stakeholder industries/groups

- Aboriginal and Torres Strait Islander Traditional Owners and Ranger Groups
- Aquaculture industry
- Aquarium trade
- Australian Marine Science Association
- Biosecurity organisations
- Citizen science and other community groups
- Commercial and recreational divers
- Commercial and recreational fishing groups
- Environment agencies
- Fisheries authorities
- Gas and oil industry
- Government agencies involved with biosecurity and environmental management
- International biosecurity organisations
- International port and marina operators
- International research organisations
- Marina industry
- Museums
- National Resource Management Groups
- Non-Government Organisations (NGOs)
- Port and marina operators
- Private consultants
- Recreational boating industry
- Recreational fisheries groups
- Shipping industry
- Defence
- State and Territory governments
- Universities and other research organisations

Specific organisations/departments

- Australian Government Department of Agriculture, Water and the Environment (DAWE)
- Australian Bureau of Agricultural and Resource Economics (ABARES)
- Commonwealth Science and Industrial Research Organisation (CSIRO)
- Geoscience Australia
- Marine Pest Research Network
- Marine Pest Sectoral Committee (MPSC)
- National Biosecurity Committee (NBC)
- Parks Australia
- Quadrilateral Animal and Plant Health Groups (QUADs)—Australia, Canada, United States and New Zealand
- State and territory agriculture/biosecurity agencies:
  - NSW (DPI, EPA)
  - QLD (DAF, DES)
  - SA (PIRSA, SARDI)
  - WA (DPIRD)
  - NT (DITT)
  - VIC (DJPR)
  - TAS (DPIPWE).
- State and territory park authorities

Glossary

Term	Definition
Biosecurity	The management measures applied to reduce the likelihood of pest species being able to enter, establish or spread within a defined area or region.
Containment	Restriction of a pest species potential range to a defined region through the establishment and maintenance of biosecurity conditions.
Detection sensitivity	The probability that a surveillance method will correctly detect the presence of the target organism in a sample or area where they are known to occur. Sensitivity is expressed as the proportion of samples containing the target organism or originating from a known infected area (S+) that produce a positive test result (T+), for example, Pr Sens.=T+/S+. Sensitivity may also be referred as 'test sensitivity' or 'diagnostic sensitivity'.
Detection specificity	The probability that a surveillance method will correctly indicate absence of a target organism in an area or sample where they are known to be absent. Specificity is expressed as the number of samples not containing the target organism or originating from a known free area (S-) that test negative (T-), for example Pr Spec.=T-/S-. Specificity may also be referred as 'test specificity' or 'diagnostic specificity'.
Eradication	Elimination of a pest species from a defined region. Eradication may be to an agreed level of confidence.
Fitness for purpose	A measure that assesses the suitability of a surveillance test or method. Fitness-for-purpose takes into account the stated objective, test accuracy and robustness, as well as the conditions in which it will be applied.
Marine pest	Marine pests are non-native marine species that may harm Australia's marine environment, social amenity or industries that use the marine environment, or species that have the potential to do so if they were to be introduced, established (that is, forming self-sustaining populations) or spread in Australia's marine environment.
Monitoring	The structured collection of data for the purposes of assessing changes in the density or distribution of known pests in a defined area. The main distinction between surveillance and monitoring is that surveillance is concerned with new pests or recently introduced pest species, whilst monitoring is concerned with changes in the population structure and distribution of an established pest species.
Proof of freedom	The probability, based on analysis of available data, that a defined geographic area is free of a marine pest.
Remote sensing	The acquisition of information about an object or phenomenon without making physical contact with the object and thus in contrast to on-site observation (for example, the use of ROVs for underwater visual assessments).
Risk-based approach	A quantitative methodology that aims to understand the overall risk for the purpose of reducing likelihood of an incursion and/or mitigating impact. The approach acknowledges that risk can rarely be eliminated completely, but instead should manage key introduction pathways and/or mitigate impact through management procedures
Surveillance	The structured collection and analysis of data for the purpose of detecting the presence or demonstrating absence of a marine pest in a given environment. Surveillance may be further classified into 'active' and 'passive' activities or 'general' and 'targeted' activities: • active surveillance—collection of data specifically for marine pest surveillance purpose, usually to answer a certain question (for example are particular marine pests present in this port?) • passive surveillance—observer-initiated (for example, when a recreational diver sees an unusual animal (a potential marine pest) while out diving and reports it to the marine authority) or the result of sample collection for another purpose (for example marine ecology research) • targeted surveillance—surveillance activities targeted at a specific pest species (for example, eDNA surveillance programs using PCR will only provide data on a single or limited number of selected species)

Term	Definition
	• general surveillance—surveillance activities not specifically focused on a single or small number of pest species.
Surveillance procedure	The combined surveillance process used to provide data on presence or absence of a pest species. The surveillance procedure includes the surveillance tool and surveillance test. May also be referred to as 'surveillance method', 'surveillance activity' or 'surveillance technique'.
Surveillance test	An analytical process used to provide a quantifiable result. Usually laboratory based, but may include field tests.
Surveillance tool	A process or method used to collect samples for testing. For example, use of plankton tows, settlement arrays or divers to collect samples for testing.
Validation	A process that determines fitness-for-purpose of a specific test or assay. The validation process takes into account test sensitivity, specificity, repeatability and robustness. The process is described in detail within the Guidelines for Validation of Tests for Marine Pests.
Vessel	Any ship, boat or other description of a craft used in marine environments. Includes ships, floating platforms, boats and barges (structures that can float and be steered or moved by their own means or by other means, such as if towed). Also, specifically includes smaller craft including recreational boats and other craft.

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