

National System for the Prevention and Management of Marine Pest Incursions

**NATIONAL STRATEGY FOR
INTRODUCED MARINE PEST
RESEARCH AND DEVELOPMENT
2006 -2016**

Developed by the National Introduced Marine Pests Coordination Group
(NIMPCG)

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EXECUTIVE SUMMARY

The National Strategy for Introduced Marine Pest Research and Development 2006-2016 was developed by the National Introduced Marine Pests Coordination Group in consultation with the Australian marine science community.

Marine pests have had major environmental, economic and social, including human health impacts worldwide. The National System for the Prevention and Management of Marine Pest Incursions takes a comprehensive approach to addressing all potential marine pests and their vectors. However, our understanding of marine pests and how they invade is far from perfect and further R&D is required to improve the way we manage marine pests.

This document is designed to provide strategic direction for R&D investment and thereby ensure that R&D outcomes provided by all researchers provides timely and relevant advice to underpin marine pest management.

R&D projects covered in this document are divided into four priority areas:

- Vector Management;
- Species and Ecological Information for Management;
- Monitoring, Evaluation and Review; and
- Information, Communication and Education.

The projects outlined in the strategy are also classified by their priority (high, medium or low) and the length of time required (short, intermediate or long). Implementation of the strategy will be regularly reviewed and the strategy revised to ensure that the priorities are current and informed by new information and challenges.

The objective of the strategy is to underpin a comprehensive national research and development program which promotes coordinated and collaborative research and enables the prioritisation and implementation of research to support the National System and its ongoing integrity, ultimately leading to better marine pest management.

1. PURPOSE OF THE DOCUMENT

This document is designed to provide strategic direction for introduced marine pest research and development activities. Managers, policy makers, marine industries, conservationists and researchers and the general community will be able to use the Strategy to guide effort and expenditure on research and development activities that will contribute to meeting national objectives. The aim of the Strategy is to ensure that R&D provided by all research partners and stakeholders provides timely and relevant advice to underpin marine pest management.

While the Strategy aims to provide direction for the next ten years, specific requirements for research and development are likely to change as new knowledge and technologies become available, both in Australia and overseas. Accordingly, this Strategy will be a living document and will be updated as research and development projects are completed and as new priorities are identified or existing priorities are changed.

2. CONTEXT FOR MARINE PEST R&D

2.1 The Marine Pest Problem

Australian scientists have identified over 129 exotic marine species and 209 cryptogenic (of unknown origin) species in our waters, most of which have been transported from overseas ports to Australian ports via shipping (Hayes *et al.*, 2005). Some have caused serious economic, environmental and public health concerns, amongst them, the Northern Pacific Seastar, the Black Striped Mussel which was eradicated in Darwin in 1999, and some toxic dinoflagellates. The Intergovernmental Agreement on a National System for the Prevention and Management of Marine Pest Incursions includes three definitions for non-native species which reflect the impacts they may have and agreed management responses:

- **agreed pest of concern:** any marine pest that is agreed, through formal processes established by the Parties under this Agreement, to pose a significant potential or actual threat to any part of Australia's marine environment or industry, if introduced, established or translocated
- **marine pest:** any exotic marine species, that may pose a threat to Australia's marine environment or industry, if introduced, established or translocated
- **exotic marine species:** any species not normally considered to occur and that may or may not be present in Australia's marine environment

These definitions highlight that marine pests are a subset of exotic marine species, however it is difficult to predict which species will become pests in Australian waters and the National System approach is to minimise the introduction to Australia of all exotic marine species.

Marine pests may be suspended in ballast water or attached to hulls and other niche areas of a range of vessels (collectively known as biofouling). Other ways in which marine pests may be introduced include accidental and deliberate introduction associated with fisheries and aquaculture stock, and release of aquarium trade species. For the past fifteen years Australia has been working in international fora and domestically to improve the effectiveness of voluntary and regulatory measures to reduce the risk of unwanted marine pest introductions. Australia implemented ballast water management arrangements for visiting ships in 2001

The Australian Government, Northern Territory and state governments have made strong commitments to putting in place efficient and effective arrangements to strengthen Australia's

marine biosecurity. This will be met through the National System for the Prevention and Management of Marine Pest Incursions (the National System) that is being collaboratively developed with the involvement of governments, industry, conservation groups and researchers.

This version (2.0) of the R&D Strategy was developed in consultation with the Australian Marine Science Community and the National Introduced Marine Pests Coordination Group.

2.2 The National System

In 1999 the National Taskforce on the Prevention and Management of Marine Pest Incursions was established to propose strategies to address marine pest incursions. The Taskforce was established by the Ministerial Council on Forestry, Fisheries and Aquaculture (MCFFA) and the Australian and New Zealand Environment and Conservation Council (ANZECC) and submitted a report to these Councils proposing a National System for the Prevention and Management of Introduced Marine Pests (the National System). The report detailed recommendations to establish the three main components of the National System:

- **Prevention:** Prevention systems to reduce the risk of introduction and translocation of marine pests;
- **Emergency management (preparedness and response):** A coordinated emergency response to new incursions and translocations;
- **Ongoing management and control:** Managing introduced marine pests already in Australia.

In addition to these three main components, the Taskforce recommended four components to support the development of the National System:

- **Monitoring:** species targeted ongoing national monitoring strategy
- **Communications:** industry and community awareness and education
- **Evaluation and Review:** developing a strategy to evaluate the effectiveness of the National System; and
- **Research and Development:** targeted research to underpin policy and management

In 2005 an Intergovernmental Agreement supporting the National System was signed by the Australian Government, the Northern Territory, Tasmania, Victoria, South Australia, Queensland and Western Australia (New South Wales is yet to sign). The National System will address all vectors for marine pests, following a staged, risk management approach. All elements of the National System will be developed by October 2006 with progressive implementation.

This Strategy recognises that ongoing research and development initiatives are required to finalise development and support implementation of the National System.

2.3 Objective of the Strategy

The overall objective for the Research and Development Strategy is to develop a comprehensive national research and development program which promotes coordinated and collaborative research and enables the prioritisation and implementation of research to support the National System and its ongoing integrity.

This is distilled from section 17.1 of the Intergovernmental Agreement on a National System for the Prevention and Management of Marine Pest Incursions 2005 (IGA) (below). The IGA provides the framework for the development, implementation and evaluation of the National System.

17.1 The Parties will establish agreed supporting arrangements, including:

- (c) A national research and development program to support the development, implementation and periodic evaluation of the National System, in order to maintain its ongoing integrity including:*
 - i. arrangements to prioritise and implement research under the National Research Plan, as agreed by Ministerial Council; and*
 - ii. mechanisms to promote co-ordination and collaboration between researchers and the adoption of research results.*

2.4 Guiding Principles for Marine Pest R&D

Research and development and the ongoing implementation and revision of the National Strategy for Introduced Marine Pest Research and Development should be guided by the following principles:

1. **A long-term, commitment and integrated, partnership approach** from governments, industry, recreational groups, conservation groups and researchers. This is essential for achieving an effective holistic national approach to the prevention and management of introduced marine pests.
2. **Regular communication and collaborative research** among local, state, national and international jurisdictions, industry, recreational groups, conservation groups and research providers. This will assist in minimising unnecessary duplication of research and development activities and ensuring that the overall research effort is complementary.
3. **A triple bottom line approach** should be taken to developing prevention and management measures to address marine pest issues i.e. considering environmental, social and economic impacts of both pests and management. Such an approach should ensure prevention and management measures are economically justified, socially acceptable, safe, practicable, technically achievable and environmentally sound.
4. **Best available scientific and technical advice**, including risk assessment and analyses of potential impacts, should form the basis of all decisions (to the extent practicable). Similarly, research should be conducted by the most appropriate and cost effective provider.
5. **A risk management approach** to reducing the likelihood of introducing and translocating marine pests. Preventing marine pest incursions is often more cost effective, technically feasible and practicable than attempting to control and eradicate new or long-established populations.

3. RESEARCH PRIORITY AREAS FOR THE NATIONAL SYSTEM

Based on the key knowledge gaps and areas of research that need further effort, five key areas have been identified as priorities for further research.

These areas are:

- governance systems
- vector management
- species and ecological information for management
- information, communication and education; and
- evaluation and review

These five key areas cut across the three main elements of the National System (prevention, emergency management and ongoing management and control).

Governance system R&D priorities are being addressed through the National Introduced Marine Pests Coordination Group under the Natural Resource Management Ministerial Council. The primary strategic objective of the work is to establish clear and transparent governance systems to support the development, implementation and improvement of the National System that will include:

- Clear and transparent processes for making decisions about marine pest management from national to local levels
- a comprehensive risk-based framework to manage all species of concern and their vectors
- National control plans for agreed pests of concern
- Best practice biofouling guidelines or codes of practice for all relevant marine sectors; and
- A framework for antifouling paint application and efficacy

Research and development requirements under the remaining four themes have been grouped by theme in the following sections, noting that individual projects may contribute to multiple areas. The research topics for each key area are grouped by their priority - high, medium or low – and their duration - short (1-2 years), intermediate (2-5 years) or long-term (5-10 years).

3.1 R&D Priority: Vector Management

Strategic Objectives

Ensure potential and actual vectors of marine pests (such as vessels used in the shipping, fishing, boating, and petroleum sectors, and gear or stock used in the aquaculture and aquarium sectors) are managed to effectively minimise the risk of introduced marine pest incursions and translocations.

To achieve the strategic objective, R&D on vector management will focus on: understanding vectors and the way they may transfer marine pests; and development of workable and effective best management practices for all vectors.

Table 1: Vector Management R&D requirements

ID	R&D needs	Priority	Duration
V1	Enhance understanding of the risks and risk taxa associated with non-ballast vectors (including the aquarium trade)	High	Short
V2	Improve understanding of fouling composition associated with different vectors and their niche areas and gear and develop quantitative risk factors	High	Intermediate
V3	Pathway analysis <ul style="list-style-type: none"> ▪ relating vector characteristics and patterns to current and potential pest numbers and risk) ▪ traffic patterns and introduction spread ▪ vector distance (speed/duration) ▪ assessing comparative risk of vectors and pathways 	High	Intermediate
V4	Assess effectiveness of current treatment options for non-ballast vectors (e.g. antifouling paints and marine growth protection systems)	High	Short
V5	Develop new treatment options for non-ballast vectors and methods to assess their effectiveness	High	Intermediate
V6	Develop, refine and verify technology and methods for ballast water treatment	High	Intermediate
V7	Include marine pest management in integrated coastal zone management plans to reduce interactions between high risk nodes and domestic vectors e.g. the proximity of ports to other significant areas such as aquaculture, fisheries, and conservation areas	High	Intermediate
V8	Test the validity of the risk assessment underpinning the national ballast water framework in terms of survival in ballast tanks, and potential for viable introduction and establishment.	High	Intermediate
V9	Quantify and develop criteria to differentiate between translocation (human mediated) and range extension (natural processes) to inform emergency response activities	Medium	Intermediate
V10	Develop guidelines/criteria for establishing quarantine arrangements for new marine pest incursions	Medium	Short
V11	Investigate potential for introduction of viruses via live animal trade e.g. fish, prawns, corals and other aquarium species.	Medium	Intermediate
V12	Undertake delineation surveys to increase the resolution of invasive species distribution	Medium	Intermediate - Long

Note: - short (1-2 years), intermediate (2-5 years) or long-term (5-10 years).

3.2 R&D Priority: Species and Ecological Information for Management

Strategic Objective

To prevent marine pests from entering Australian waters and effectively eradicate or manage established marine pest populations.

To achieve the strategic objective, R&D on species and ecological information will focus on: ensuring that information on invasive species, their ecology and impacts is available to inform decision making and the risk management approach of the National System.

Table 2: Species and Ecological Information for Management R&D requirements

ID	R&D need	Priority	Duration
S1	Investigate life cycle parameters for key species under Australian conditions including physical tolerances, spawning timing, duration of larval stages	High	Intermediate
S2	Develop molecular probes for marine pests	High	Short-Intermediate
S3	Identify high risk habitats, their value and impacts of degradation on invasibility	High	Intermediate
S4	Conduct studies of the life history/ecology of priority invasive species including studies to: <ul style="list-style-type: none"> ▪ Understand reproductive strategies and dispersal mechanisms ▪ Determine the diet of invasive species (generalist or specialist) ▪ Understand growth rates and competitive ability ▪ Identify interactions with native species (competition, predation etc) 	High	Intermediate
S5	Use ecological information to assess the level of threat from IMPs – i.e. ecological risk assessment	High	Short- Intermediate
S6	Determine receiving environment resistance, complexity and turnover rates of species, and system level impacts of agreed pests of concern	High	Intermediate- Long
S7	Assess, and quantify socio-economic impacts of invasive species	High	Intermediate
S8	Develop and/or test techniques to control or eradicate new incursions of marine pests (in particular agreed target species for monitoring)	High	Intermediate
S9	Investigate and test effectiveness of options for control (or eradication) of widely distributed agreed pests of concern	High	Intermediate
S10	Enhance taxonomic expertise nationally for identification of invasive species	High	Long
S11	Increase understanding of the characteristics of successful invaders world-wide in terms of their life history, environmental tolerance and biology to aid prediction of which species are likely to become marine pests	Medium	Intermediate
S12	Investigate potential for range extensions of invasive species due to climate change	Low	Long
S13	Investigate the genetic adaptability of invasive species	Low	Long

Note: - short (1-2 years), intermediate (2-5 years) or long-term (5-10 years).

3.3 R&D Priority: Monitoring, Evaluation and Review

Strategic Objective

Effective monitoring of Australian waters to detect marine pest incursions and translocations, and inform emergency response and ongoing management and control processes.

Effective and efficient evaluation of marine pest management, to ensure continuous and adaptive improvement of the National System.

To achieve the strategic objectives, R&D on monitoring, evaluation and review will focus on: improving monitoring design and techniques; understanding the associations between habitat and marine pests; and developing new methods for evaluating management strategies.

Table 3: Monitoring, Evaluation and Review R&D Requirements

ID	R&D need	Priority	Duration
M1	Develop (and/or validate for Australian use) practical tools for monitoring	High	Short
M2	Develop high throughput single platform technology for simultaneous detection of multiple marine pests using molecular techniques – building on molecular tool development for individual species (S1)	High	Medium
M3	Develop effective monitoring/inspection tools for remotely assessing the extent of biofouling on a range of vessels, in particular for niche areas	High	Medium
M4	Develop species area curves for scraping samples to determine appropriate replication and depth distribution, considering potential latitudinal variation	High	Short
M5	Develop parataxonomic tools for marine pests to support monitoring programs and ensure reasonable confidence in samples requiring expert taxonomic verification (in particular target species for monitoring)	High	Short
M6	Apply management strategy evaluation methods to management of agreed pests of concern, considering management of all potential vectors – these methods are required to help assess the level of risk reduction possible using different strategies and considering environmental, social and economic impacts.	High	Short-Intermediate
M7	Determine the optimal sample size, replication, depth, etc for maximising the likelihood of detecting pest species (different times of year, different locations, different functional groups)	High	Intermediate
M8	Develop improved / more robust analyses for the assessment of cost-effectiveness of methods for monitoring different target species	High	Intermediate
M9	Investigate spawning time and longevity of marine pests (in particular target species for monitoring) in the water column to better inform frequency and periodicity of sampling	High	Intermediate
M10	Research and collate habitat types within locations that make up the national monitoring network	High	Short - Intermediate
M11	Develop survey techniques to define eradication endpoint	High	Long
M12	Assess number of individuals in pest populations to inform monitoring detection densities	Medium	Intermediate
M13	Determine spatial distribution of pest species in early stages of invasion to inform monitoring and response processes e.g. random vs. clumped	Medium	Intermediate

Note: - short (1-2 years), intermediate (2-5 years) or long-term (5-10 years).

3.4 R&D Priority: Information, Communication and Education

Strategic Objective

Inform governments, industry and the community at the national, regional and local levels of the importance of all three elements of the National System and encourage or facilitate the uptake of voluntary and/or mandatory measures within relevant sectors and communities.

To achieve the strategic objective, R&D on information, communication and education will focus on: ensuring that information on invasive species and their management is accessible, useable, and current for all stakeholders; and the development of tools and networks to support the implementation of the National System Communications Strategy.

Table 3: Information, Communication and Education R&D requirements

ID	R&D need	Priority	Duration
C1	Develop training and capacity building initiatives such as marine pest training modules for extension officers, liaison officers and NRM Coastcare facilitators	High	Intermediate
C2	Increase public awareness of invasive species research outcomes through a centralised database	High	Intermediate
C3	Establish National System databases and websites with identified host(s) and ongoing funding	High	Intermediate
C4	Develop targeted resources for identifying invasive species (for a range of sectors under the National System)	High	Intermediate
C5	Identify appropriate delivery pathways for information to all relevant sectors	High	Intermediate
C6	Develop a research and development network to enhance information flow building on current arrangements and including: <ul style="list-style-type: none"> - A centralised source of information on current projects and published results - Establishing a list of student research projects and building student/researcher networks - Providing publicly accessible research priorities and funding opportunities (in part through this strategy) 	High	Intermediate
C7	Measure uptake of National System codes of practice in all relevant sectors	High	Intermediate
C8	Institute international cooperation on management of all vectors	Medium	Intermediate
C9	Link Australian information to international information and databases	Medium	Long
C10	Contribute to international forums including through provision of training / capacity building	Medium	Long
C11	Address Intellectual Property issues with respect to invasive species data internationally	Low	Intermediate

Note: - short (1-2 years), intermediate (2-5 years) or long-term (5-10 years).

REFERENCES

The Report of the National Taskforce on the Prevention and Management of Marine Pest Incursions (2000).

The National System for the Prevention and Management of Marine Pest Incursions Australian Strategic Plan 2004 -2006 developed by the National Introduced Marine Pests Coordination Group.

The Report of the High Level Officials Working Group Report on Governance, Legislative and Funding Arrangements (2003).

The Intergovernmental Agreement on the National System for the Prevention and Management of Marine Pest Incursions (2005).