An Australian Government Initiative

THE NATIONAL SYSTEM FOR THE PREVENTION AND MANAGEMENT OF MARINE PEST INCURSIONS

Australian marine pest monitoring guidelines

Version 2.0

Keeping marine pests out of Australian waters

Important

The Australian Government Department of Agriculture, Fisheries and Forestry advises that the information contained within the *Australian marine pest monitoring guidelines* provides the rationale and approach for the routine collection of marine pest monitoring data and is intended to inform decision making.

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Australian marine pest monitoring guidelines

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1. Executive summary

The Australian governments (Commonwealth, state and Northern Territory) recognise the importance of ongoing monitoring and surveillance in managing marine pest risks. They have agreed to a species targeted ongoing National Monitoring Strategy (NMS).

This strategy forms an integral part of Australia's National System for the Prevention and Management of Marine Pest Incursions (National System) and provides for standardised monitoring to detect high risk species at priority locations around Australia.

In the context of the NMS, monitoring means regular ongoing sampling of the marine environment to collect information on the presence and absence of target species and to detect species that exhibit invasive characteristics.

Monitoring data will help guide marine pest management actions that:

- trigger and inform emergency response arrangements
- make decisions on the ongoing management and control of established marine pest populations, including informing National System risk assessments
- review and improve other measures that form part of the National System
- inform broader policy decisions.

The *Australian marine pest monitoring guidelines* outline Australia's policy approach for marine pest monitoring. They provide the rationale for the routine collection of monitoring data, governance arrangements and how the data collected will be used to inform decision making.

The guidelines:

- outline the decision process for selecting the priority locations and monitoring target species in Australia
- outline the governance arrangements for the implementation of monitoring programs
- provide the decision pathways and management actions stemming from monitoring results
- outline the review process to ensure future improvements of the monitoring programs, the manual and guidelines and the NMS.

The *Australian marine pest monitoring guidelines* complements the *Australian marine pest monitoring manual* which is a 'how to guide' to monitoring in the context for the National System.

2. Introduction

Australia has a coastline of approximately 60 000 km and a marine jurisdiction of some 16 million km^2. These environments are susceptible to invasion by marine pests with the potential to seriously impact the marine environment, marine industries and coastal communities.

To reduce the risks posed by marine pests, the Australian governments (Commonwealth, state, and Northern Territory) have agreed to a comprehensive national approach known as the National System for the Prevention and Management of Marine Pest Incursions (the National System).

The National System includes a national monitoring strategy (NMS) that provides for targeted monitoring of species most likely to have a significant impact and the locations most likely to be invaded.

The NMS is based on the recommendations of *The Report of the High Level Officials Working Group on Governance, Legislative and Funding arrangements* (HLG report, Oct 2003 recommendation 10).

These guidelines provide the rationale for the approach to the routine collection of monitoring data and how it will be used to inform decision making in Australia. They also:

- explain the decision process for selecting the target species and locations for monitoring in Australia
- outline the governance arrangements for the implementation of monitoring programs and their progressive improvement with time
- provide the decision pathways and management actions stemming from monitoring results.

The arrangements described in these guidelines (and the companion 'how to' manual the *Australian marine pest monitoring manual* (the manual) have been agreed to by the Australian Government and the state and Northern Territory governments.

The states and Northern Territory (the jurisdictions) are responsible for implementing monitoring programs within their jurisdiction in accordance with the requirements outlined in the manual.

The Australian Government will provide an overarching coordination role while the Consultative Committee on Introduced Marine Pest Emergencies (CCIMPE) will be responsible for initiating action in response to any new or suspected new incursions of marine pests according to CCIMPE agreed protocols.

Data arising from monitoring programs will be freely and publicly available via the National Introduced Marine Pest Information System (www.marinepests.gov.au/nimpis).

Decision making arising from the monitoring results will follow the CCIMPE agreed National System post-border management processes. Results from the monitoring program will support the prevention and emergency preparedness and response elements of the National System. In particular, monitoring data will help guide marine pest management actions to:

- inform the risk assessment of vectors to inform National System prevention measures (pre-border controls)
- provide earliest detection possible to trigger and inform emergency response arrangements in the event of an incursion
- inform decision making for the ongoing management and control of established marine pest populations, including informing risk assessments
- inform broader policy decisions on marine pest management.

Evaluation and review of the NMS will provide an adaptive management framework for continuous improvement. An ongoing review cycle for the NMS will encompass a review of monitoring locations, the monitoring program designs, the manual and guidelines, and a review of the NMS as a whole in meeting the needs of the National System.

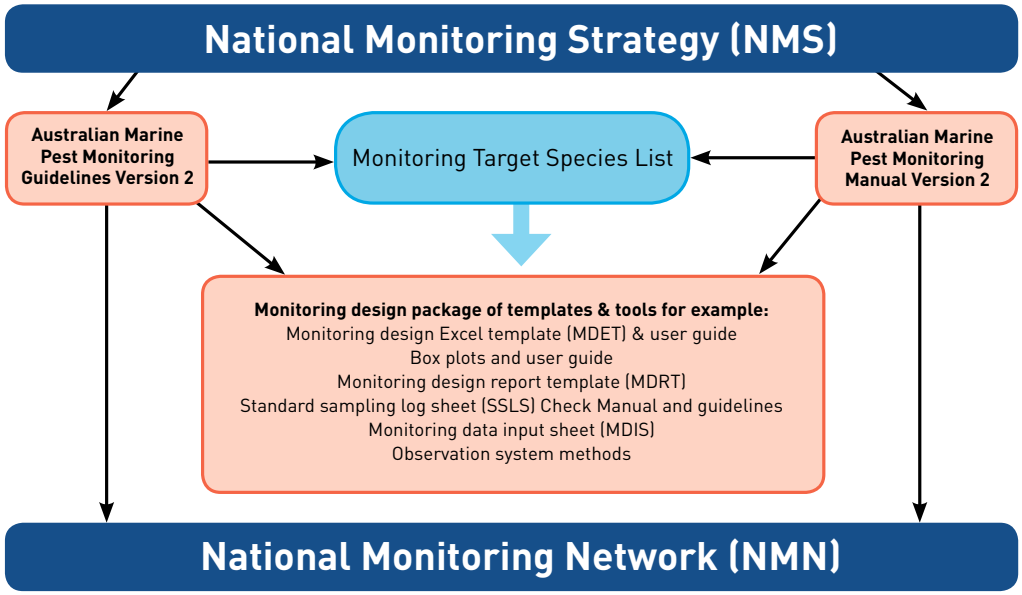
3. Principles for monitoring

The *Australian marine pest monitoring manual* establishes minimum quality principles to ensure that monitoring data is collected using rigorous, consistent methods and is of a suitable quality for informed and scientifically-sound decision making. The standard method enables nation-wide comparison over time.

All monitoring data that meets the requirements outlined in the manual can be used in national decision making processes, including results from locations outside the national monitoring network (NMN).

Any monitoring data, regardless of source, that does not meet the requirements outlined in the manual cannot be used in national decision making processes.

4. Governance and funding



4.1 Governance

These guidelines and the companion document the *Australian marine pest monitoring manual* have been developed by the National Introduced Marine Pest Coordination Group (NIMPCG).

The National System has formally established an ongoing national program of targeted monitoring for marine pests to an agreed minimum standard.

NIMPCG has agreed the minimum monitoring locations (i.e. the NMN) at which ongoing monitoring must take place. The NMN will be reviewed every four years with the comprehensive review of the manual.

The jurisdictions are responsible for implementing monitoring programs for the NMN in accordance with the requirements outlined in the manual.

This section outlines the roles and responsibilities for implementing monitoring arrangements.

4.1.1 National coordination

The Australian Government through the Invasive Marine Species Program in the Department of Agriculture, Fisheries and Forestry (DAFF):

- provides a central point (the Monitoring Coordination Point) for information about national monitoring arrangements and requirements

- coordinates decision making processes with jurisdictional representatives and other responsible parties
- participates in the approval processes for monitoring designs and implementation plans in conjunction with the jurisdictions, as a key member of the Monitoring Design Assessment Panel (MDAP)
- provides receipt of all monitoring reports
- administers the centralised monitoring results database, including the public access interface
- coordinates evaluation and review processes in conjunction with the jurisdictions
- liaises with monitoring agents, stakeholders, CCIMPE and jurisdictional government representatives, as required.

4.1.2 Jurisdictional coordination

Within the jurisdictions both NIMPCG and CCIMPE representatives have a role. NIMPCG representatives are responsible for coordinating the ongoing monitoring approach as a whole, including outcomes based coordination of all jurisdictional agencies and other responsible parties.

CCIMPE representatives are responsible for responding to reports of new incursions or translocations (ad hoc reporting) and any required emergency action.

Contact details for each jurisdiction's lead agency can be found at www.marinepests.gov.au/national_system/partners. The agency will provide the contact details for their relevant staff. The reporting channels that provide information to each representative are explained in section 7.

Jurisdictional NIMPCG representatives

NIMPCG representatives are responsible for the implementation of the monitoring strategy in their jurisdiction. Key roles include:

- coordination of all state/territory agencies and other responsible parties in implementing the NMS
- participation in decision making processes in conjunction with the Monitoring Coordination Point
- delineation of the area to be monitored within each NMN location, in their jurisdiction, in conjunction with other jurisdictional representatives responsible for monitoring and according to the manual (manual, section 2)

- participation in approval processes for monitoring designs and implementation plans in conjunction with the Monitoring Coordination Point
- coordination of tender and contract processes for the design and implementation of the monitoring program
- participation in evaluation and review processes in conjunction with the Monitoring Coordination Point
- receipt of monitoring reports for their jurisdiction
- ensuring, where possible, that any existing monitoring outside the monitoring network is brought into line with the principles outlined in the manual.

Jurisdictional CCIMPE representatives

CCIMPE representatives will receive all reports of new incursions and/or translocations and are responsible for any subsequent action according to agreed CCIMPE protocols.

4.1.3 Stakeholder engagement

Critical to the success of the national monitoring arrangements is the identification and engagement of each government agency and all stakeholders operating or involved at each monitoring location. At any monitoring location there may be a range of 'vector nodes' and therefore stakeholders whose input may be required when designing and implementing an ongoing monitoring program. Table 1 shows the range of 'vector nodes' that may be present at a monitoring location.

Administrative and legal arrangements are likely to vary in the management of each 'vector node' from location to location. For example, some commercial ports may be managed by the Port Authority whereas others may be privately managed; some boat ramps may fall under the Port Authority's jurisdiction whereas other may be managed by the local council or other private organisation. It is vital that the ultimate responsibility is determined for each 'vector node'.

Table 1. Potential vector nodes in a monitoring location

NODE
Commercial trading port
Wharves
Anchorages
Channel
Tug base / Pilot base
Bunker and barges
Other services, patrol boats and navy areas
Marinas
Boat ramps
Recreational anchorages
Boat yards
Slipways
Drydocks
Aquaculture leases
Ferry wharves
Navigational buoys

To obtain an indication of the responsibilities for 'vector nodes' nationally, each jurisdiction has collected information on the general allocation of responsibility across their jurisdiction and in greater detail for the monitoring network locations that fall within their jurisdiction. A summary of this information is provided at Attachment A. This information may be useful in determining the management responsibilities and therefore developing consultative arrangements within a monitoring location.

The management responsibilities of areas and usage within a monitoring location also need to be determined e.g. Port Authority limits, and industrial, government and private areas. Refer to the manual about how this information should be presented in monitoring designs.

4.2 Funding

Funding for the implementation of the National System will need to be provided in cash and in kind by all parties in accordance with the respective responsibilities of each party in developing, establishing and implementing the National System.

Those who contribute to the risk of a marine pest incursion or benefit from the implementation of the National System should contribute to the funding of the National System. Under the National System each jurisdiction is responsible for implementation of monitoring activities conducted in their jurisdiction. The Australian Government provides national coordination and reporting.

Funding contributions from stakeholders who either contribute to the risk of a marine pest incursion or benefit from the implementation of the National System will be sought in specific situations.

The jurisdictions are responsible for ensuring that the initial survey design and ongoing monitoring for each of the NMN locations in their jurisdiction is implemented. Individual jurisdictions will determine where the funds are sourced. The Australian Government is responsible for collating, coordinating and reporting on monitoring outcomes.

Additional monitoring sites outside the NMN will be funded by parties who identify a benefit from completing the monitoring.

4.3 Implementing monitoring

The jurisdictions are responsible for the implementation of the monitoring programs at NMN locations within their jurisdiction. There are two contracting stages identified in the manual differentiated by the tasks, issues involved and the skills required:

1. monitoring design
2. implementation of the monitoring program.

In most cases it is advised that two independent tendering and contracting processes be done to match these two stages. If contracting is involved it will be carried out according to the legislation and requirements in each jurisdiction.

Using and building on local knowledge and experience is important and enhancing capacity for monitoring work within jurisdictions should be encouraged, especially for implementation of monitoring programs. It is recommended that if possible, the contracting for the implementation step is done on a multi-year basis to encourage progressive improvement of the approach and understanding of the environment.

4.4 Templates and tools for monitoring designers

The MDP has been developed as a companion to the manual to standardise and better facilitate the monitoring process. Survey designers should contact the Monitoring Coordination Point at DAFF for a copy of the latest version of the MDP. The MDP includes a number of design templates, user guides and tools, including:

- Monitoring design Excel template (MDET) *& Monitoring design Excel template user guide*. The MDET provides outputs for key aspects of the survey design to meet minimum requirements. The spreadsheets and macros incorporated within the MDET can be used to determine:
  (i) the target species list
  (ii) observation systems and sample sizes
  (iii) survey costs
- Monitoring design report template (MDRT). The MDRT provides a useful template for preparation of the monitoring design report and is complementary to the MDET
- Boxplots and *Documentation guide for use of boxplots*. The formulas used in the boxplots spreadsheet assist in the production of annual sea surface temperature and salinity boxplot graphs
- *Observation system methods*. The field guide summarises the various observation systems and how and when they should be used
- Standard sampling log sheet. The data sheet ensures the information collected during field surveys is recorded in a consistent manner
- Monitoring data input sheet. The electronic data sheet is used to collate results following processing, analysis and identification of samples.

Use of the MDET, MDRT and boxplots templates are not mandatory but recommended to facilitate the design and assessment process. The Standard sampling log sheet and Monitoring data input sheet must be used to ensure data is collected consistently and uploaded to the National monitoring database.

4.5 Monitoring approval/accreditation processes

There are several approval processes that must be completed before monitoring can commence.

Monitoring design accreditation

As outlined in the manual, the survey design must be accredited before monitoring can commence. The Monitoring Coordination Point and the relevant jurisdictional body is responsible for coordinating consistent accreditation of monitoring designs (through the monitoring design report (manual section 2.7) for each location in their jurisdiction.

Each design must be peer reviewed. MDAP independently evaluates monitoring program designs. MDAP ensures consistency in the assessment approach across Australia and allows the workload of the assessments to be shared reducing the chance of delays to the monitoring process. MDAP will consist of four people (representatives from the Commonwealth and jurisdictions, with technical expertise as necessary) nominated to facilitate timely and effective assessments of submitted monitoring designs.

MDAP developed criteria to be used in the assessment of monitoring designs. The criteria assume that surveys have been designed using the MDRT and MDET. The specific elements required for monitoring design reports are presented in the manual (manual, section 2.7). These elements along with the MDRT and MDET will be considered during assessment by MDAP.

MDAP will assess NMN location designs. Other monitoring designs may be considered for assessment by MDAP on a case by case basis (e.g. from other Australian stakeholders and consultants). Under these circumstances, any related assessment costs may need to be determined and recovered.

At least three weeks notice must be provided to the Monitoring Coordination Point for the assessment of monitoring designs.

Survey implementation should not proceed until accreditation has been granted (pending approval). Once the monitoring design is accredited the monitoring process can continue onto the planning phase. If the monitoring design does not pass the accreditation process then there are two courses of action.

1. The monitoring design report and comments from MDAP may be returned to the party contracted to design the program. Once concerns have been addressed, the revised design may then be resubmitted for accreditation
2. The monitoring design is rejected and re-tendered. This action should only be taken in the event that there are major flaws in the monitoring design.

Implementation plan approval

The implementation plan (manual, section 3.0) is to ensure that the practical components of a monitoring program, such as personnel and equipment, are ready for commencement. The implementation plan approval is to confirm the transition of the monitoring design to the party contracted to implement the program (Note: may not be one and the same). The implementation plan should be submitted as an attachment to the monitoring design report.

The implementation plans are assessed by MDAP in consultation with the relevant jurisdictional body. Implementation plans are approved if:

- all sections of the report have been completed
- all relevant quality assurance and quality control (QAQC) principles have been met.

Once the implementation plan is approved the monitoring process continues onto the implementation phase. If the implementation plan is not approved then the plan will be returned with comments and can be resubmitted when the comments have been addressed.

5. Monitoring locations

The HLG report (recommendation 10) recommended that the ongoing monitoring program be based on the probability of introduction for a given location and the feasibility of detecting pest introductions to inform risk or emergency management assessments.

The recommendations recognise that an ongoing monitoring strategy for marine pests cannot sample all of Australia's waters and effort must therefore be targeted at those locations where an invasion is most likely. This approach forms the basis for identifying locations that form the NMN.

5.1 National monitoring network

Eighteen locations around Australia have been agreed as the minimum sites for ongoing monitoring to take place. These sites were identified by analysing the high risk locations for:

1. introductions and translocations of new pests
2. translocations of existing pests.

The results of ongoing monitoring in agreed locations and additional locations will be reviewed after three years to ensure that the program is targeting the areas of highest introduction and translocation risk.

The data used in the analyses was the best available for a consistent and robust Australia wide analysis. Data on the hazard (i.e. long range vectors of marine pests) and where available the risk (based on environmental matching between source and destination locations) of introductions was used (details of data sources are provided at Attachment B).

The data used in the analyses, and the rationale for their inclusion, are listed below:

a. Number of international ship visits to Australian locations – the risk of pest incursion (from biofouling and/or ballast water) is expected to be greater the more ships visit a location.
b. Estimated international ballast water discharge to Australian locations – the risk of pest incursion is expected to be greater the more ballast water discharged.
c. Number of international yacht visits to Australian locations – the risk of pest incursion from biofouling is expected to be greater the more international yachts visit a location.

d. Number of international fishing vessel visits to Australian locations – the risk of pest incursion from biofouling is expected to be greater the more international fishing vessels visit a location.
e. A connectivity score that represents the degree to which each location in Australia is connected to all other locations – locations more strongly connected to other locations are likely to have a higher risk of an undetected pest spreading.
f. Environmental data on the mean temperatures in the locations and bioregions of Australia and the world to identify locations with a mean temperature difference of greater than 8 °C – the likelihood of an incursion is likely to be less for those locations where the environmental match conditions are significantly different between source and destination locations. The 8 °C cut-off was chosen to represent the approximate difference between a temperate location (e.g. Melbourne) and a subtropical location (e.g. Brisbane).
g. Data on known pest distributions in Australia and domestic shipping traffic patterns to develop a translocation risk score – locations with few or no pests which share traffic with locations that contain pests are expected to be more susceptible to secondary invasion by existing pests.

This overall approach reflects current understanding that vessels are the largest vector for introduction of species to the marine environment (including both those transported through ballast water and in biofouling communities).

5.1.1 Rankings for introductions and translocations of new pests

To determine where a pest introduction is most likely to occur, the locations were ranked using a principal component analysis (PCA), a statistical method which in this analysis was used to rank several variables at once (*a* through *e* as listed above).

The environmental match (based on annual mean water temperature) between the source and destination locations (*f* above) was used to restrict the Client Place Move data (from Lloyds Maritime Information Unit) used in the analysis.

The detailed analysis process and results for locations to monitor introductions is provided at Attachment B.

The different variables assessed in the PCA had very similar characteristics in that most of the variation in the variable was explained by 15 to 20 locations (see Attachment B). When this data was plotted together it was found that:

- the top 10 per cent of locations accounted for approximately 55 per cent of the 'risk' factors assessed
- the top 20 per cent of locations accounted for approximately 80 per cent of the 'risk' factors assessed
- the top 50 per cent of locations accounted for approximately 98 per cent of the 'risk' factors assessed.

Therefore, after a certain point, adding additional locations takes into account less and less of the total risk factors i.e. diminishing returns on investment in monitoring. Accounting for 80 per cent of the risk factors was equivalent to the top 17 locations (see Attachment B).

5.1.2 Rankings for translocations of existing pests

Monitoring the translocation of existing pests requires identification of the locations with the highest chance of receiving an existing pest and the pest surviving. To determine where the translocation of a pest is most likely to occur, the number of pest incursions each location could be expected to obtain over a ten-year period was calculated (taking into consideration the pests already known to be present in each location).

As surveys had not been conducted for all Australian locations, the results were generated assuming both presence and absence of species for those locations with missing information – in both cases the top ten locations were the same. The detailed analysis process and results for locations to monitor translocations is provided at Attachment C.

The cumulative frequency graphs of the translocation scores also indicated diminishing returns in terms of the number of locations monitored:

- the top 10 per cent of locations accounted for approximately 65 per cent of the translocation risk
- the top 20 per cent of locations accounted for approximately 85 per cent of the translocation risk
- the top 50 per cent of locations accounted for approximately 99 per cent of the translocation risk.

Accounting for 80 per cent of the translocation risk was equivalent to the top 11 locations (presence) or the top 13 locations (absence) (see Attachment C).

It was agreed that to optimise the effectiveness and efficiency of the National System, the final list of priority locations for monitoring should focus on the risk of new introductions as the first tier of defence but should also take into account monitoring for translocations. The monitoring network also needed to provide a good geographical spread of locations around Australia to take into account some of the uncertainty in our understanding of invasion.

Considering these criteria the following list of 18 locations (see also Figure 1) was agreed to comprise the NMN:

Adelaide, Botany Bay, Brisbane, Bundaberg, Cairns, Hay Point (including Dalrymple Bay), Dampier, Darwin, Fremantle, Gladstone, Hobart, Melbourne, Newcastle, Portland, Port Kembla, Port Hedland, Sydney and Townsville.

Figure 1. Locations for the National Monitoring Network

5.2 Regional and local needs

Although the NMN provides the minimum monitoring required for national arrangements, programs that respond to local issues, assets of importance and priorities may supplement the results collected from the NMN. The responsibility for undertaking additional monitoring (i.e. outside the NMN) rests with the local jurisdiction or other interested parties. Additional monitoring may be undertaken:

- during an emergency response – supplementary monitoring measures may be required e.g. when undertaking an eradication to prove success
- in high value locations – either economic or environmental such as aquaculture sites, benthic fisheries, marine parks or world heritage areas
- for specific pests already present in Australia – this could be used to determine their distribution and inform the risk tables (i.e. tables that describe which routes are high or low risk for certain pests) – there may be a clear economic benefit in undertaking such surveys.

While the processes outlined in the manual and guidelines have been designed primarily for these NMN locations, they can also be applied to monitoring locations outside the NMN. Adherence to the complete monitoring process as outlined in the manual and guidelines is not recommended for small-scale surveys with limited budgets, due to the complex processes and stringent QAQC requirements involved.

The principles outlined in the manual are for presence/absence surveys designed to detect target species. Monitoring for other purposes, such as species abundance, is likely to require a different approach and in these circumstances the guidelines and the manual should only be used as a guide.

6. Species to monitor

6.1 Classification of species in the National System

Under the National System three classes of species relevant to monitoring are defined:

Exotic marine species - any species not normally considered to occur, and which may or may not be present, in Australia's marine environment.

Marine pests - any exotic marine species that may pose a threat to Australia's marine environment or industry if introduced, established or translocated.

Agreed pests of concern† - any marine pest agreed through formal processes within the National System to pose a significant potential or actual threat to any part of Australia's marine environment or industry if introduced, established or translocated. In Australia, national control plans will be developed for each agreed pest of concern, following its designation as such.

6.2 Selecting species to target

The following process will be used to determine the species to be included on the monitoring target species list.

Process for determining the monitoring target species list

Species to be recommended for monitoring will be identified by screening the following lists according to the steps outlined below:

1. Species for which ballast water management is required as determined through the business cases for national control plans, with the addition of *Crassostrea gigas* which is also managed under the current ballast water arrangements
2. Species on the priority pest list (domestic list) of recommended target species for management from the *National Priority pests: part II Ranking of Australian Marine Pests Final Report for the Department of the Environment and Heritage* (Hayes et al. 2005) that are ranked:
    a. a high priority or medium priority for management
    b. a low priority with a human health impact.*

† Hayes, K., Sliwa, C., McEnnulty, F., Dunstan, P. (2005) *National priority pests: Part 11 Ranking of Australia marine pests*. CSIRO Division of Marine Research final report for the Australian Government Department of Environment and Heritage. Available at **www.marine.csiro.au/crimp/reports/PriorityPestsFinalreport.pdf**.

3. Species on the next pest list (international list) of recommended target species for management from the *National Priority pests: part II Ranking of Australian Marine Pests Final Report for the Department of the Environment and Heritage* (Hayes et al. 2005) that are ranked:
    a. a high priority or medium priority for management;
    b. a low priority with a human health impact.*

*based on decision at NIMPCG 13 to adopt a precautionary approach to selecting the species for management.

4. Species on the Trigger List of Introduced Marine Pests used in emergency management (preparedness and response) by the CCIMPE.

Amending the monitoring target species list

The target species list can only be amended through agreed revision processes of the existing lists if the species undergoes the rigorous analysis as set out in the *National Priority Pests* report or with new scientific evidence that is adequately referenced.

NIMPCG is responsible for considering and agreeing amendments to this list that arise out of review processes as outlined in section 8 and in the National System Evaluation and Review Strategy.

The list of species that must be considered when designing an ongoing monitoring program is at Attachment D.

6.3 Other species

In addition to monitoring for target species it is necessary to recognise that we can not predict all species that have the potential to become invasive in Australian waters. A secondary benefit of monitoring may be the detection of species that are new and display invasive characteristics (e.g. rapid colonisation of substrate, high reproduction or growth rate).

Below is a list of some observations that might indicate the presence of an unknown invasive species. Note: any one of these observations may immediately indicate an unknown invasive species however others, such as abundance or distribution, may only become apparent after further monitoring. Observations include:

- tendency towards monoculture or high local abundance
- association with degraded habitats
- sudden appearance in this monitoring location^
- strong association with artificial substrate#
- rapid increase in abundance^.

^ assumes prior knowledge of taxa in monitoring location.
# assumes comparable sampling of artificial and natural substrata has occurred.

7. Reporting channels and decision making

7.1 National monitoring database

DAFF, through the Monitoring Coordination Point, will maintain a National monitoring database. All monitoring results will be stored in this database. To ensure data consistency, the 'Standard sampling log sheet' and 'Monitoring data input sheet' are provided in the MDP. Use of these standard data sheets is mandatory and will allow the information to be efficiently uploaded into the database.

For the NMN locations, reporting on monitoring results is required. The required elements of the monitoring report are detailed in the manual (manual, section 5.1). Monitoring reports are to be submitted to the Monitoring Coordination Point and the relevant jurisdictional body. MDAP will review monitoring reports.

Where a new marine pest incursion has been reported and CCIMPE action has been triggered, the data will be tagged as a new record and that management action is being considered. The tag will be removed when the results of any management action has been confirmed.

Information on current responses will be available through the marine pest website at www.marinepests.gov.au/pest_outbreaks.

7.1.1 Intellectual property rights

Data arising from monitoring programs will be freely and publicly available via the National Introduced Marine Pests Information System at www.marinepests.gov.au/nimpis. It is recognised that the data may be 'owned' by a number of bodies but free access to the data pertaining to species and sites will be part of contractual agreements, subject to confidentiality clauses that may be specific for particular parties.

7.1.2 Liability

It is important to ensure that there are no negative repercussions of reporting marine pest incursions for both the group undertaking the monitoring and the party commissioning the monitoring.

7.1.3 Data validity

NMN locations will be monitored on at least a biennial basis (every two years). Other non-NMN locations should also be monitored on a regular and if possible biennial basis.

Monitoring results from monitoring programs that meet the agreed minimum requirements will be valid for three years. Any new results that meet agreed minimum quality principles for monitoring will supersede the previous data. The data validity period allows sufficient time for data processing, acceptance of the monitoring results, and any other resulting administrative processes (e.g. approval and uploading of ballast water risk tables). The monitoring data will be valid for three years from the date of the last sampling day in the first sampling event of the survey period.

The integrity and reliability of the data is important regardless of age. Therefore in some cases the validity of data may be assessed on a case by case basis by DAFF through the Monitoring Coordination Point and the relevant jurisdictional body. For example, it is not necessary to continue to monitor for well established obvious populations. The Monitoring Coordination Point is involved to ensure consistent assessment and decision making at a national level.

7.2 Reporting and review responsibilities

Clear and direct reporting channels will be essential in ensuring that monitoring results and reports are received by the correct people in a timely manner allowing any appropriate management action to be initiated. This is particularly important for reporting suspected new incursions or translocations to CCIMPE so emergency response measures can commence. The following sections provide details on the proposed points of contact for reporting monitoring results and the decision making processes.

7.2.1 Contacts for monitoring

There will be two groups that will receive monitoring results and/or reports during the monitoring process:

1. the Monitoring Coordination Point (email – IMS-Program@daff.gov.au)
2. the relevant jurisdictional body.

Specific roles and responsibilities are outlined in section 4.1 Governance.

Notification of monitoring results, in particular ad hoc reporting, is critical to ensuring the emergency response element of the National System is triggered effectively when required.

Monitoring results will not be directly communicated to CCIMPE but to the coordination point and the jurisdictional body as with all other reporting. Limiting the number of reporting points reduces the risk of monitoring results being communicated to the incorrect person and in the worst case the report not making it to the correct person.

Clearly defined internal communication channels will be established between the Monitoring Coordination Point, jurisdictional bodies and CCIMPE to ensure that all monitoring information and results are shared in a timely manner.

Reports of suspected incursions will be communicated to CCIMPE by the jurisdictional body within 24 hours. These reports will be fed into CCIMPE's emergency action decision making processes as outlined in the *Emergency Marine Pest Plan*.

7.3 Reporting channels

7.3.1 Reporting requirements

A number of reports must be submitted throughout the monitoring design and implementation processes (see Table 2). All reports will be submitted electronically or in hard copy to the relevant jurisdictional body and the Monitoring Coordination Point. The only exception is the 'Suspected marine incursion – verbal' report (see below) that must initially be submitted verbally or electronically and then followed up with an electronic or hard copy report.

Table 2. Required reports and due dates

REPORT	TIMING
Monitoring design report#	At completion of design phase
Implementation plan#	Before commencing monitoring
Interim report - post sample collection	Within 48 hrs of completion of all field trips to collect samples
Suspected marine incursion - verbal report	Within 48 hrs of verifying new incursion
Suspected marine incursion - written report	Within 4 weeks of verbal report
Monitoring report	Within 1 month of completing monitoring program

To facilitate the assessment process, it is recommended that the implementation plan be submitted as an attachment with the monitoring design report.

Reporting new incursions (ad hoc reporting)

Within 48 hours of verifying a new incursion monitoring agents must verbally or electronically notify the Monitoring Coordination Point and relevant jurisdictional body. Monitoring agents report incursions using the ad hoc reporting process (see manual, section 4.8). The formal written report of the incursion must be forwarded to the Monitoring Coordination Point and relevant jurisdictional body in electronic or in hard copy within four weeks of the initial report.

It is the responsibility of the jurisdictional body's primary person (in most cases the NIMPCG representative) to contact the appropriate CCIMPE representative within 24 hours of receiving the verbal report.

7.4 Monitoring results

Monitoring data will help guide marine pest management actions including:

- updating assessments of the risk status of vectors, including ballast water risk assessments
- triggering emergency response action
- informing management practises for controlling established pest populations
- reviewing and improving measures that form part of the National System
- informing broader policy decisions on marine pest management.

The QAQC principles of the national ongoing monitoring strategy will help ensure a consistent, robust and transparent basis for decisions in relation to monitoring results and the ensuing management action. This section explains the protocols for making decisions based on monitoring reports and data.

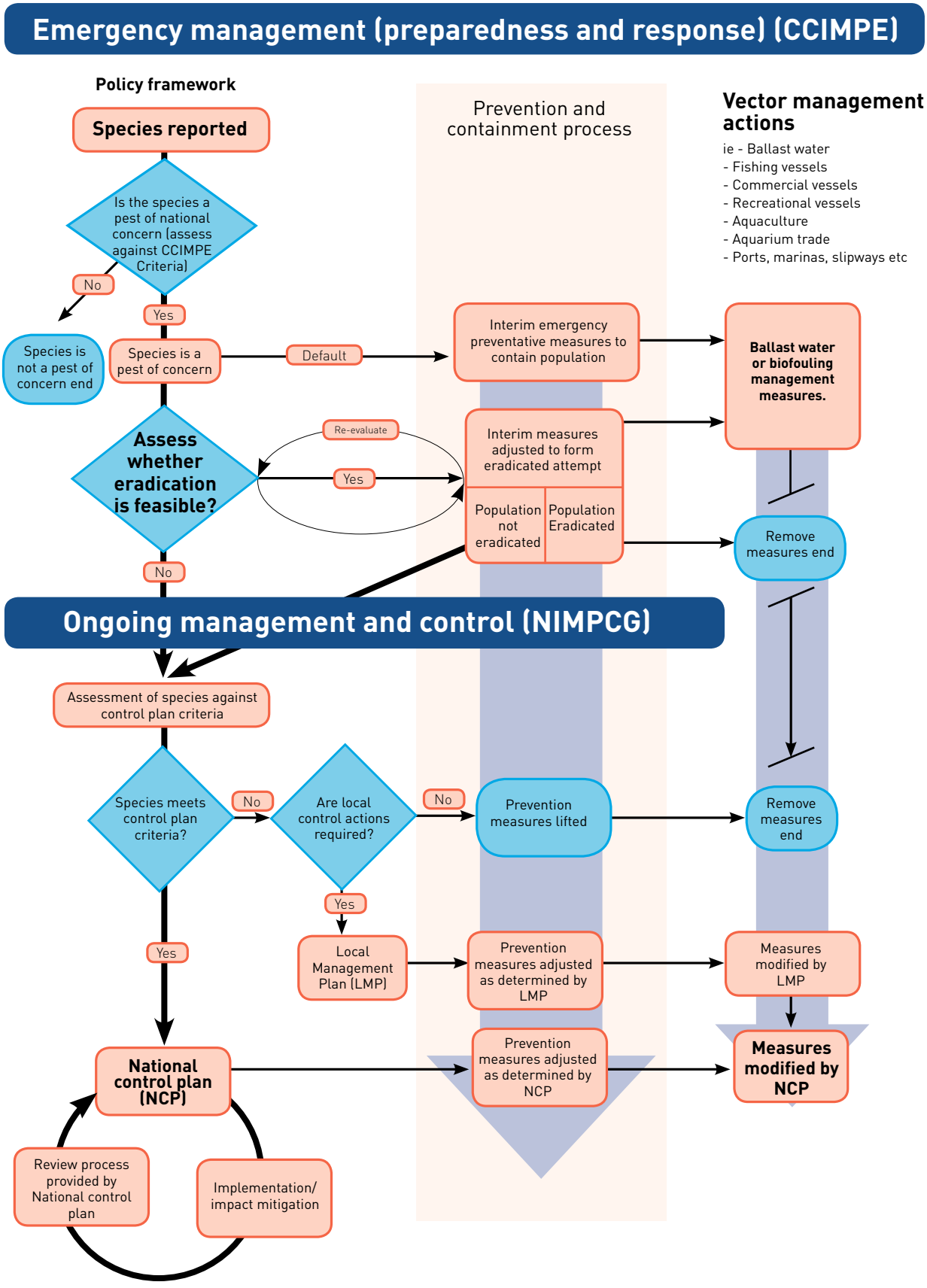
For monitoring data to be considered in national decision making processes the monitoring program must meet all the QAQC principles as set out in the manual. If all the QAQC principles are met then decision makers can have confidence in the accuracy of the monitoring data.

Monitoring data collected from monitoring activities over and above the minimum monitoring network locations must also meet all the QAQC principles as set out in the manual if it is to be considered in national decision making processes.

7.4.1 Using monitoring results

When an ongoing monitoring program detects evidence of a new species or suspected species the CCIMPE should be notified as soon as possible. CCIMPE must be provided with the correct evidence to support the report, i.e. a preserved specimen, taxonomic verification and the date and location details (see manual, section 4.7.2). CCIMPE will then follow the National System process outlined in Figure 2.

Figure 2. National system post-border management



7.4.1.1 Monitoring results that meet the minimum QAQC requirements

If the monitoring results meet the minimum QAQC principles as outlined in the manual, the monitoring report and incorporated results and conclusions will be accepted for entry into the National monitoring database and may be used in national decision making including decision making for elements of the National System.

Where the results and conclusions from the monitoring indicate a new detection‡ (or a result that differs from previous records) for the location, CCIMPE should be provided with all relevant information (see manual, section 4.8), including a summary of whether the program meets the minimum QAQC principles of the manual. CCIMPE will use this information to determine the presence or absence status of the species for that location and will respond as appropriate (which may include emergency response, containment and prevention measures).

Once the presence/absence status of the species is confirmed by CCIMPE, these results will be updated in the monitoring database.

7.4.1.2 Monitoring results that do not meet the minimum QAQC requirements

If the monitoring results do not meet the minimum QAQC principles CCIMPE should still be notified as soon as possible and provided with as much of the relevant information as possible (see manual, section 4.8). CCIMPE will use the results to determine the presence or absence status of the species for that location. This may involve requesting additional monitoring that meets the minimum requirements be undertaken to confirm or refute the original report. CCIMPE will respond as appropriate (which may include emergency response, containment and prevention measures).

If the monitoring results do not meet the agreed minimum requirements as outlined in the manual, the monitoring results will not be automatically accepted for entry into the National monitoring database. Only when the presence/absence status of the species is confirmed by CCIMPE will these results be updated in the monitoring database.

‡ It should be noted that even if one individual (alive or dead), or a part or shell/exuviae of an individual is detected and adequately verified as the suspected species, then CCIMPE should be notified.

7.4.1.3 Implications of monitoring results for ongoing monitoring programs

The outcomes from the CCIMPE process or from the monitoring results may require the monitoring design and targeting of species for monitoring to be reviewed. Species previously detected in the monitoring location should be initially included in the monitoring design process. However, if such species are driving survey costs, their status should be assessed in consultation with the relevant state/territory government representative. If recent data indicates a previously reported species is well established in the monitoring location, it should not be included in the design process but should still be reported on during the survey.

A species that is confirmed no longer present should continue to be included in the ongoing monitoring program to validate its 'absence' status and to allow monitoring to continue in case the species is reintroduced in the future. Figure 3 illustrates the process for ongoing monitoring program coordinators to undertake where species are detected or not detected.

Figure 3. Decision pathways stemming from monitoring data

Target Species not detected

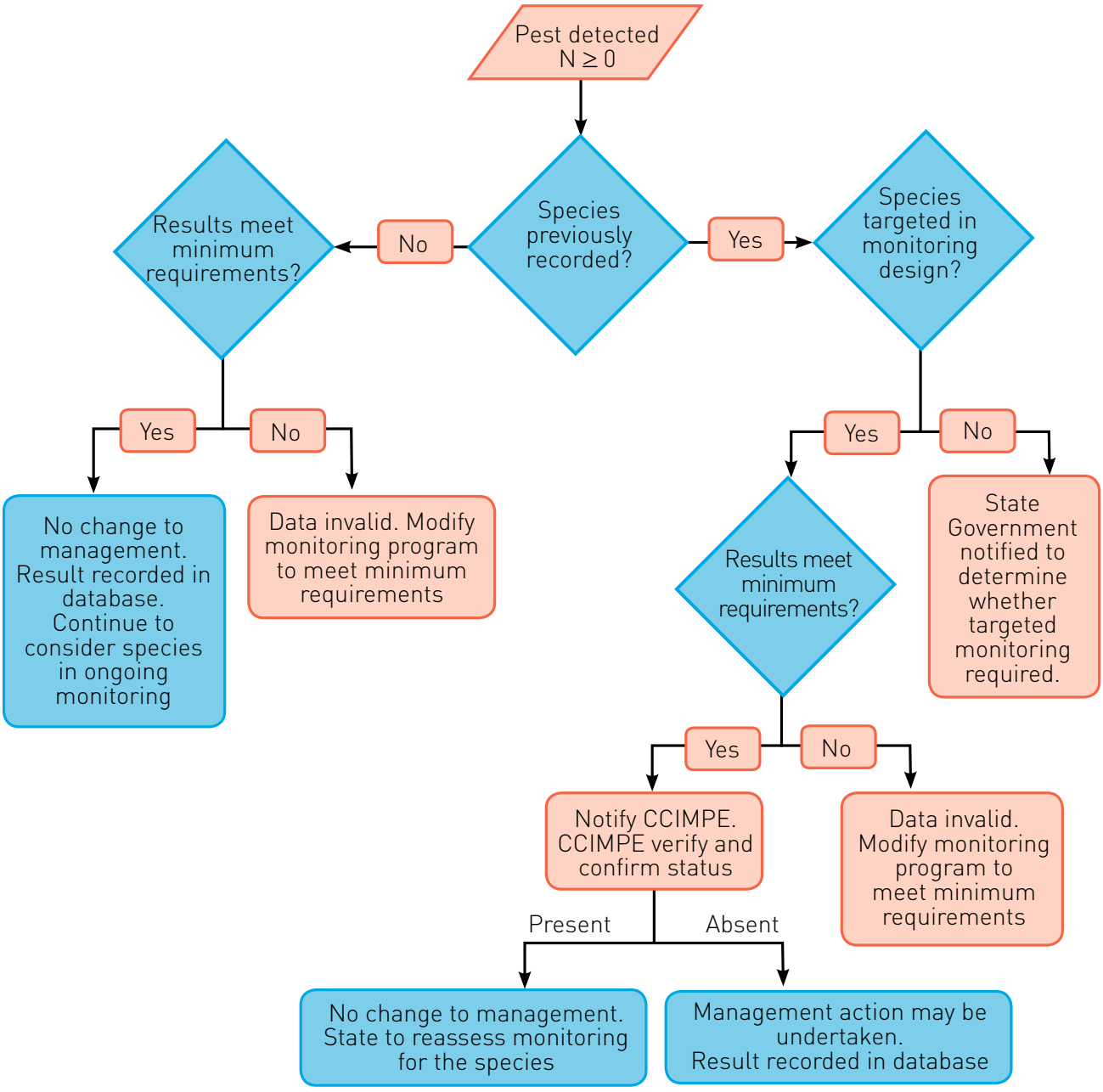
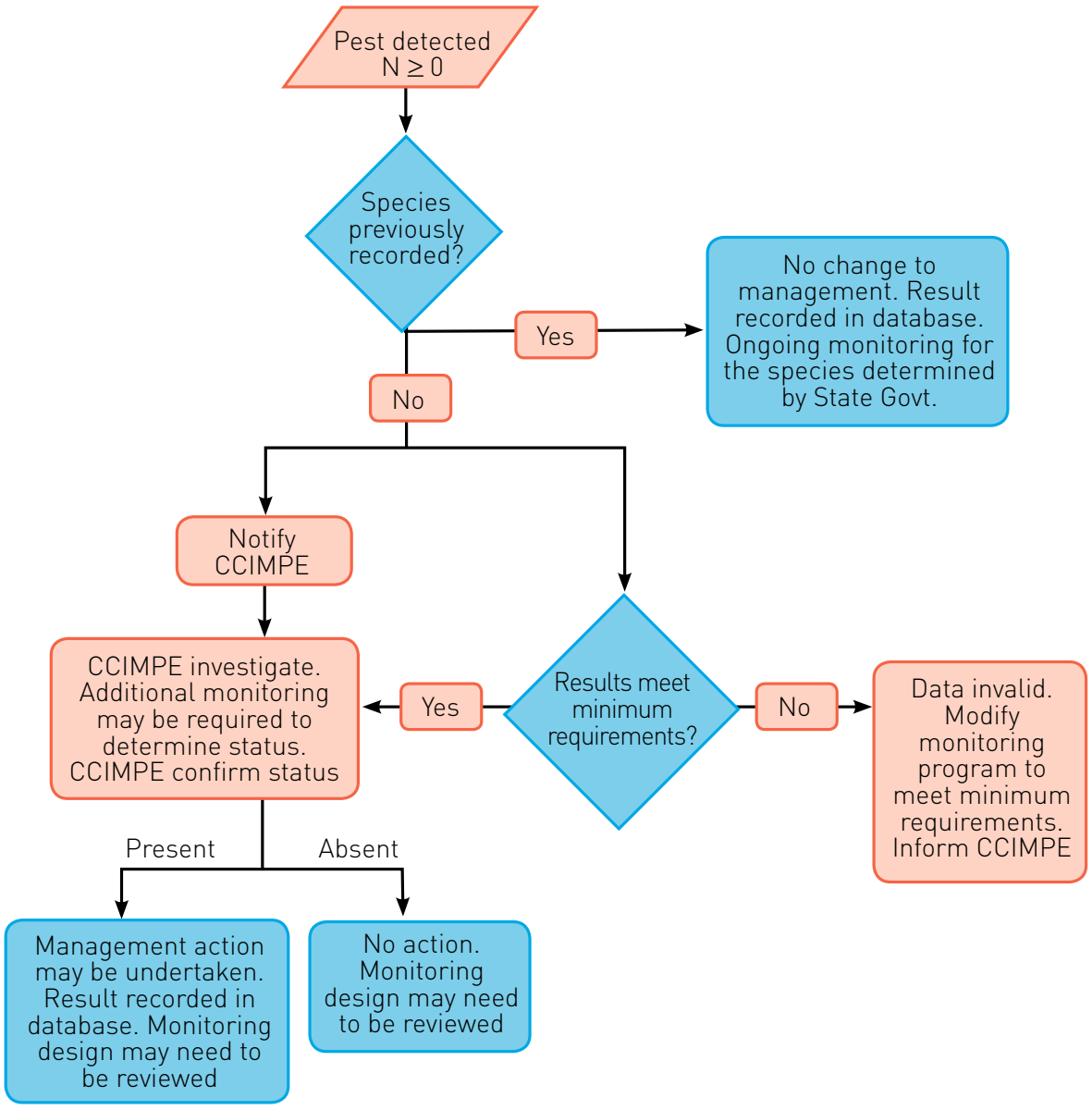


Figure 3 continued

Target Species detected



8. Strategy review

8.1 Review of the national monitoring arrangements

This section outlines the overall review process and how results from monitoring activities will be used to evaluate and review monitoring programs, the manual and the overall monitoring approach. It also provides insight into how review outcomes may affect monitoring programs in future years. Table 3 outlines the review steps for the NMS.

Table 3. Review steps for the NMS

WHAT	WHO	WHEN
Design and implementation	MDAP and service providers undertaking monitoring and providers commissioned to design program	Biennially if any significant changes have been made to the design or implementation plan
Manual	Monitoring Coordination Point	Every four years with a comprehensive review
Strategy, including • Monitoring guidelines document • Target species list • National Monitoring Network locations	Monitoring Coordination Point	Every four years with the comprehensive review of the manual

8.1.2 Evaluation and review of the NMS

Evaluation and review of the monitoring guidelines will assess the high level policy objectives and decisions for ongoing monitoring in Australia. While these processes will be separate, collaboration between countries may be needed to maintain international consistency for ongoing targeted monitoring. At its broadest level, any review would involve determining which locations had set up monitoring programs and which of these met the QAQC principles. The next level of review would then involve investigation of the following areas:

- objectives for identifying potential target species – are the predictions for species correct in terms of e.g. temperature and salinity association, seasonal association (temporal abundance), functional group habitat association (spatial distribution), sediment grain size association/other?

- objectives for the minimum level at which we need to detect a species to inform decision-making – are we detecting target species when we know they're there? i.e. do results match previous observations and if not, why not?
- objectives for spatial and temporal targeting – is the area covered sufficient? Are the times of year when monitoring is being undertaken the most appropriate? Note: the best times for sampling might not be the best times for species detection (i.e. cyclone season may not be good for sampling but does coincide with species being in the water)
- objectives about reporting – does the reporting provide timely and sufficient advice to inform management responses?
- objectives about QAQC – are the principles clear and sufficient?
- objectives about cost-effectiveness – is the approximate cost sufficient to undertake the monitoring program?

8.2 Research and development

In many ways our understanding of marine invasion processes is still incomplete. For example, why a particular environment becomes subject to invasion or why a particular species becomes invasive. Such research questions are included in the long-term research and development strategy for the National System and this research is needed to inform the ongoing review and revision of the monitoring system to ensure continuous improvement.

9. References

Hayes KR, Sliwa C, Migus S, McEnnulty FR and Dunstan P (2005), *National priority pests – Part II Ranking of Australian marine pests.* Final report for the Australian Government Department of Environment and Heritage, CSIRO Division of Marine Research, Hobart, Australia, 99 pp.

National System for the Prevention and Management of Marine Pest Incursions. The Report of the High Level Officials Working Group on Governance, Legislative and Funding Arrangements, August 2003 www.marinepests.gov.au

Australian marine pest monitoring manual: version 2.0. Australian Government Department of Agriculture, Fisheries and Forestry, pp.92, April 2009 www.marinepests.gov.au

The Intergovernmental Agreement on a National System for the Prevention and Management of Marine Pest Incursions April 2005 www.marinepests.gov.au

Glossary

TERM	DEFINITIONS
Ballast water	Water (including sediment that is or has been contained in water) held in tanks and cargo holds of ships to increase stability and manoeuvrability during transit
Biofouling	The attachment of marine organisms to any part of a vessel, or any equipment attached to or on board the vessel, aquaculture equipment, mooring devices and the like
BRS	Bureau of Rural Sciences
CCIMPE	The Consultative Committee on Introduced Marine Pest Emergencies
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAFF	Australian Government Department of Agriculture, Fisheries and Forestry
Detection	The interception of a suspected pest species or its identification in a location following incursion
Established population	A self sustaining population of an introduced species
Incursion	The unauthorised entrance or movement of a suspected pest species into a region where it is not already established
Interception	The identification of a suspected pest species on a vessel or other vector prior to transfer to another vessel, vector or local habitat
Introduction	The transport of an exotic marine species to a location within Australia's marine environment from a source beyond Australia's marine environment
Jurisdictions	All the relevant states and territories of Australia
MDET	Monitoring design Excel template
MDRT	Monitoring design report template
MDAP	Monitoring Design Assessment Panel
MDP	Monitoring design package
Measure	An action undertaken to prevent or limit damage to Australia's marine environment or industry

Glossary continued

TERM	DEFINITIONS
Ministerial Council	The Natural Resource Management Ministerial Council
Monitoring Coordination Point	The central contact point for information about national monitoring arrangements and requirements (email – IMS-Program@daff.gov.au).
NMS	The National Monitoring Strategy of the National System
National System	The National System for the Prevention and Management of Marine Pest Incursions
Natural Resource Management Ministerial Council	The group of Australian Government, state and territory ministers who have responsibility for natural resource matters
NIMPCG	National Introduced Marine Pest Coordination Group
NIMPIS	National Introduced Marine Pest Information System
NMN	National Monitoring Network
Quality assurance	The integrated system to ensure data (and its use) meets pre-defined standards of quality with a stated level of confidence
Quality control	The system of technical activities whose purpose is to measure and control the quality of the data
Translocation	The transport of an exotic marine species from one area of Australia's marine environment to another
Vector	Anything capable of introducing or translocating an exotic marine species
Vessel	Any ship, boat or other description of vessel used in navigation by sea

Attachments

Attachment A – Jurisdictional management responsibilities for 'vector nodes'

	MANAGEMENT AUTHORITY							
NODE	**NT**	**QLD**	**WA**	**TAS**	**NSW**	**SA**	**VIC**	**SUMMARY**
Commercial trading port	Port Corp.	Port Corp.	Port Corp.	Port Corp.	Port Corp. Private	Port Corp.	Port Corp.	Port Corp. Private
Wharves	Port Corp.	Port Corp. Private	Port Corp. Private	Port Corp. Private	Port Corp. Private (on leases) State Govt. Local council	Port Corp. Private	Port Corp.	Port Corp. Private State Govt Local councils
Anchorages	Port Corp.	State Govt. Port Corp.	Port Corp.	Port Corp. State Govt	Port Corp. Navy State Govt	State Govt	Port Corp.	Port Corp. State Gov Navy
Channel	Port Corp.	Port Corp. State Govt.	Port Corp.	Port Corp. State Govt.	Port Corp. State Govt.	Port Corp. State Govt.	Port Corp.	Port Corp. State Govt.
Tug base / pilot base	Port Corp.	Port Corp. State Govt. Tugs - Private Pilot base – State Govt.	Private (Port Corp. lease)	Tug - private Pilot - Port Corp.	Pilot - Port Corp. Tugs – private	Pilot – Port Corp. Tugs – private	Port Corp. State Govt.	Port Corp. State Govt. Private Tugs – private Pilot – Port Corp.
Bunker and barges		Private Port Corp Barges – private	Private	Barges - private	Private (on leases)	Private	Port Corp.	Private (barges) Port Corp.
Other services, patrol boats and navy areas	Defence	Police Port Corp. Navy State Govt. Customs (patrol boats)	Navy	Private Port Corp.	Navy NSW Police	Private	Port Corp.	Defence Police Port Corp. State Govt. Customs Private
Marinas		Port Corp. Private	State Govt.	Port Corp. Private / boat clubs	Private (on leases)	Private Port Corp.	State Govt.	Port Corp. Private State Govt.
Boat ramps	State Govt.	State Govt. Port Corp. Local councils	Port Corp. State Govt.	State Govt.	Local councils State Govt.	State Govt. Local councils	State Govt.	State Govt. Port Corp. Local councils
Recreational anchorages		State Govt.	State Govt.	State Govt.	State Govt.		State Govt.	State Govt.
Boat yards	Private	Private		Private	Private (on leases)	Private	State Govt.	Private State Govt.
Slipways	Private	Private		Port Corp. Private	Private (on leases)	Private	State Govt. Port Corp.	Private Port Corp. State Govt.
Dry docks		Private			Navy Private		N/A	Private Navy
Aquaculture leases	State Govt.	Private	State Govt.	Private	Private State Govt.	Private State Govt.	State Govt.	State Govt. Private
Ferry wharves	Port Corp.	Port Corp State Govt. Local authority	Port Corp.	Port Corp. Private	Private Local councils State Govt.	Private	State Govt.	Port Corp. State Govt. Local authority/council Private
Navigational buoys	Port Corp.	State Govt.	Port Corp. Commonwealth Govt.	Port Corp. State Govt.	Port Corp. State Govt.	Port Corp. State Govt.	Port Corp.	Port Corp. State Govt. Cwlth Govt.
Other		Private berths and facilities Fisherman's bases, pile moorings – Port Corp.	Commercial Fishing – State Govt. Private berths		Fishing boat moorings, water taxi, commercial leases – State Govt.	Power stations - private	State Govt.	Private (berths, facilities, power station) Port Corp. (fisherman's bases, pile moorings) State Govt. (commercial fishing boat moorings, water taxi, commercial leases)

Attachment B – Analysis for rankings of locations around Australia for introductions and translocations of new pests

The ranking of locations for the introduction of marine pests was conducted using the following data sources:

1. Client Place Move data from Lloyds Maritime Information Unit from 1998 to 2002
2. AQIS Vessel Monitoring System data on international yachts and fishing vessels from 1992 to 2004
3. climate data from the International Decision Support System (as developed by CSIRO)
4. bioregion data supplied by CSIRO.

The mean annual sea surface temperature and IUCN bioregion data were used to restrict the 'Lloyds' data to include only those records corresponding to a visit where the previous location was an international location with an average annual water temperature within 8 °C of the average annual temperature at the destination location. The purpose of removing those records with large temperature differences was to make provision for situations where there is a significant 'mismatch' in environments between the source and destination location. The 8 °C cut-off is the difference in average temperature between the locations of Melbourne and Brisbane which represents sub-tropical and temperate environments respectively, however 2, 4 and 5 °C cut-offs were also assessed and did not substantially alter the results.

In developing the analysis more complex options for assessing temperature parameters (such as using maximum and minimum temperatures rather than averages) were considered. These options were not pursued on the basis that the implications of a more complex dataset were not warranted given our current understanding.

The variables used in the ranking process (taken from the above sources) were:

- number of international ship visits to Australian locations – the risk of pest incursion (from biofouling and/or ballast) is expected to be greater the more ships visit a location
- estimated international ballast water discharge to Australian locations – the risk of pest incursion is expected to be greater the more ballast water discharged

- number of international yacht visits to Australian locations – the risk of pest incursion from biofouling is expected to be greater the more international yachts visit a location
- number of international fishing vessel visits to Australian locations – the risk of pest incursion from biofouling is expected to be greater the more international fishing vessels visit a location
- a connectivity score that represents the degree to which each location in Australia is connected to all other locations within Australia – those locations which are more strongly connected to other Australian locations are likely to have a higher risk of an undetected pest spreading to other locations within Australia.

The connectivity scores were calculated for each location i, using the following algorithm:

1. Every location except location i was set to 'uninfected'
2. Ten years of journeys were simulated, by repeating the journeys that actually occurred in a given year 10 times. For each journey, if the location of departure was infected, then the probability that the location of arrival became infected (if it was not already) was p
3. At the end of the 10 years, the number of locations infected was C_{i1}
4. Steps 1~3 were repeated one thousand times, generating C_{ij} for $k = 1, 2, 3, ...1000$
5. The connectivity score (expected number of locations that will become infected in a 10 year period, beginning when location i becomes infected) was calculated using $\overline{C}_i = \Sigma_{j=1}^{1000} C_{ik} / 1000$.

The location rankings for introductions were performed based on a principal component analysis of the data outlined above. This analysis is a standard technique for summarising multivariate data. From the analysis it was found that the first principal component ranked the locations approximately in order of strength of the vectors and their relationships. As demonstrated by the figures that follow, the chosen method of ranking was successful in identifying the locations with the greatest values for each of the variables mentioned above (Note: each of the cumulative graphs increases quickly and then begin to flatten with the addition of each new location).

The sensitivity of the location rankings provided in Table 1 was investigated with respect to:

- the temperature difference cut-off: other cut-offs (five, four and two degrees) were examined and had little influence on the top 15 locations (a cut-off of 5 degrees resulted in the same top 15 locations with some small ordering differences)
- the value of p and year used in connectivity calculations: to generate the connectivity scores used in the location rankings, the value of p was 0.001 and the year used was 2001. However, a number of other values of p (0.1 and 0.01) and years (1999 and 2000) were tested with the connectivity rankings being unchanged with small variation in values
- inclusion/exclusion of variables: due to the correlation between the five variables incorporated in the analysis, the addition/removal of a single variable had little effect on the overall rankings. While not all of the variables are correlated, some of the groups of the variables are correlated and thus the addition/removal of a single variable had little effect on the overall rankings e.g. ship visits and ballast water volumes are well correlated so removing one of these variables is not going to impact significantly on the rankings. Note: all figures show good accumulation of risk i.e. no one variable drove the analysis and thus there was no need to remove any of the variables from the analysis.

Table B1. Location rankings for introductions and translocations of new pests

RANK	LOCATION	CUMULATIVE PERCENTAGE OF VISITS	CUMULATIVE PERCENTAGE OF BALLAST	CUMULATIVE PERCENTAGE OF FISHING VESSELS	CUMULATIVE PERCENTAGE OF YACHTS	CUMULATIVE PERCENTAGE OF CONNECTIVITY SCORE	AVERAGE CUMULATIVE PERCENTAGE ACROSS FACTORS
1	Brisbane	10.0 *** (2)	1.8 *** (9)	2.8 *** (7)	23.2 *** (1)	9.6 *** (2)	9.48
2	Fremantle	21.1 *** (1)	4.0 *** (7)	25.8 *** (2)	24.4 ** (12)	15.2 *** (8)	18.1
3	Darwin	25.3 *** (9)	4.4 * (23)	52.9 *** (1)	34.6 *** (4)	16.3 * (21)	26.7
4	Newcastle	34.0 *** (3)	19.7 *** (3)	52.9 (30)	35.0 ** (17)	20.3 ** (11)	32.38
5	Sydney	37.7 ** (12)	20.1 * (21)	65.5 *** (3)	41.7 *** (5)	26.4 *** (6)	38.28
6	Dampier	45.0 *** (4)	37.5 *** (2)	65.5 * (21)	42.3 ** (16)	27.9 ** (15)	43.64
7	Melbourne	49.1 ** (11)	38.0 ** (18)	65.9 ** (13)	42.4 * (20)	41.6 *** (1)	47.4
8	Hay Point#	55.8 *** (5)	52.6 *** (4)	65.9 (40)	42.4 (30)	42.9 ** (18)	51.92
9	Port Hedland	62.0 *** (6)	70.2 *** (1)	66.2 ** (17)	42.5 * (25)	43.3 (32)	56.84
10	Cairns	63.0 * (20)	70.3 (39)	74.8 *** (5)	59.3 *** (2)	44.8 ** (16)	62.44
11	Gladstone	67.5 *** (8)	76.9 *** (6)	74.8 * (23)	63.3 *** (9)	48.8 ** (10)	66.26
12	Botany Bay	73.5 *** (7)	77.3 ** (17)	74.9 (36)	63.3 (47)	55.5 *** (3)	68.9
13	Townsville	77.6 ** (10)	78.1 ** (15)	75.2 ** (14)	67.7 *** (8)	58.1 ** (13)	71.34
14	Port Kembla	79.8 ** (13)	79.9 ** (10)	75.5 ** (18)	67.8 (41)	62.2 *** (9)	73.04
15	Bundaberg	80.0 (44)	80.0 (46)	76.2 ** (12)	80.9 *** (3)	62.3 (48)	75.88
16	Adelaide	80.7 * (24)	80.1 (31)	76.3 (38)	80.9 * (28)	68.5 *** (5)	77.3
17	Hobart	81.4 * (25)	80.5 * (24)	85.5 *** (4)	81.7 ** (15)	69.9 ** (17)	79.8
18	Port Walcott	83.6 ** (14)	88.8 *** (5)	85.5 (71)	81.7 (72)	70.0 (50)	81.92
19	Devonport	83.6 (55)	88.8 (65)	85.8 ** (15)	81.7 (36)	76.5 *** (4)	83.28
20	Thursday Island	83.6 (74)	88.8 (75)	93.1 *** (6)	86.7 *** (7)	76.8 (31)	85.8
21	Burnie	84.0 (29)	89.0 (32)	93.2 * (24)	86.7 (89)	82.7 *** (7)	87.12
22	Geelong	85.5 ** (17)	89.4 * (19)	93.2 * (26)	86.7 (43)	86.3 ** (12)	88.22
23	Gove	86.8 ** (18)	90.6 ** (11)	95.1 *** (8)	87.8 ** (14)	86.3 (51)	89.32
24	Bunbury	88.4 ** (16)	91.7 ** (12)	95.2 * (27)	87.8 (33)	87.3 * (23)	90.08
25	Launceston##	89.6 * (19)	91.9 (34)	95.2 (34)	87.8 (65)	88.8 ** (14)	90.66
26	Mackay	90.1 * (26)	92.1 * (27)	95.3 * (22)	91.1 ** (10)	89.4 * (28)	91.6
27	Geraldton	91.8 ** (15)	93.0 ** (13)	95.4 (33)	91.1 (32)	89.6 (37)	92.18
28	Coffs Harbour	91.8 (87)	93.0 (85)	95.4 (59)	96.1 *** (6)	89.6 (85)	93.18
29	Weipa	92.6 * (23)	93.9 ** (14)	95.5 * (20)	96.2 * (22)	90.7 * (22)	93.78
30	Portland	93.4 * (22)	94.3 * (20)	95.6 * (19)	96.2 (34)	91.9 * (20)	94.28
31	Abbot Point	94.2 * (21)	96.2 *** (8)	95.6 (50)	96.2 (85)	91.9 (52)	94.82
32	Port Lincoln	94.3 (47)	96.3 (41)	97.1 ** (9)	96.3 (31)	92.8 * (26)	95.36
33	Thevenard	94.4 (54)	96.3 (54)	97.1 (49)	96.3 (44)	94.0 * (19)	95.62
34	Albany	94.7 (33)	96.5 (29)	98.5 ** (10)	96.4 * (23)	94.1 (44)	96.04

Table B1. continued

RANK	LOCATION	CUMULATIVE PERCENTAGE OF VISITS	CUMULATIVE PERCENTAGE OF BALLAST	CUMULATIVE PERCENTAGE OF FISHING VESSELS	CUMULATIVE PERCENTAGE OF YACHTS	CUMULATIVE PERCENTAGE OF CONNECTIVITY SCORE	AVERAGE CUMULATIVE PERCENTAGE ACROSS FACTORS
35	Westernport	94.9 (41)	96.6 (37)	98.5 (51)	96.4 (69)	95.0 * (24)	96.28
36	Port Stanvac	95.1 (39)	97.0 * (22)	98.5 (55)	96.4 (76)	95.8 * (27)	96.56
37	Esperance	95.6 * (27)	97.5 ** (16)	98.5 (53)	96.4 (67)	96.1 (33)	96.82
38	Port Pirie	95.7 (53)	97.6 (58)	98.5 (41)	96.4 (63)	97.0 * (25)	97.04
39	Christmas Island	95.7 (85)	97.6 (82)	98.5 (68)	98.1 ** (11)	97.0 (64)	97.38
40	Groote Eylandt	96.1 * (28)	97.9 * (25)	98.5 (42)	98.1 (90)	97.0 (71)	97.52
41	Wyndham	96.5 (31)	97.9 (56)	98.5 (31)	98.1 (83)	97.2 (38)	97.64
42	Wallaroo	96.7 (37)	98.1 (33)	98.5 (85)	98.1 (48)	97.5 (34)	97.78
43	Broome	97.1 (30)	98.1 (61)	98.6 * (25)	98.2 * (21)	97.6 (45)	97.92
44	Whyalla	97.2 (48)	98.2 (44)	98.6 (62)	98.2 (70)	98.1 (29)	98.06
45	Lord Howe Island	97.2 (70)	98.2 (77)	98.6 (63)	99.3 ** (13)	98.1 (89)	98.28
46	Cape Cuvier	97.5 (32)	98.4 * (26)	98.6 (70)	99.3 (78)	98.1 (79)	98.38
47	Cape Flattery	97.8 (34)	98.7 * (28)	98.6 (82)	99.3 (77)	98.1 (47)	98.5
48	Mourilyan	98.1 (38)	98.8 (35)	98.6 (39)	99.3 (38)	98.3 (40)	98.62
49	Twofold Bay	98.1 (81)	98.8 (91)	99.4 ** (11)	99.6 ** (18)	98.3 (62)	98.84
50	Port Latta	98.2 (46)	98.9 (40)	99.4 (60)	99.6 (55)	98.6 (36)	98.94
51	Port Bony-thon	98.3 (51)	99.0 (43)	99.4 (69)	99.6 (61)	98.9 (30)	99.04
52	Karumba	98.5 (35)	99.0 (45)	99.5 (37)	99.6 (87)	99.0 (54)	99.12
53	Port Giles	98.6 (52)	99.1 (42)	99.5 (65)	99.6 (54)	99.3 (35)	99.22
54	Lucinda	98.7 (45)	99.2 (36)	99.5 (64)	99.6 (88)	99.4 (41)	99.28
55	Derby	99.0 (36)	99.3 (38)	99.5 (79)	99.6 (84)	99.4 (82)	99.36
56	Shark Bay	99.2 (42)	99.3 (47)	99.5 (74)	99.6 (74)	99.5 (46)	99.42
57	Eden	99.3 (43)	99.6 (30)	99.5 (88)	99.6 (53)	99.5 (74)	99.5
58	Rockhampton	99.5 (40)	99.6 (48)	99.5 (52)	99.6 (62)	99.5 (73)	99.54
59	Varanus Island Terminal	99.5 (63)	99.6 (60)	99.5 (78)	99.6 (51)	99.7 (39)	99.58
60	Ardrossan	99.6 (56)	99.7 (59)	99.5 (44)	99.6 (49)	99.8 (42)	99.64
61	Cossack Field	99.6 (59)	99.7 (51)	99.5 (86)	99.6 (58)	99.9 (43)	99.66
62	Mascot	99.6 (90)	99.7 (88)	99.8 ** (16)	99.6 (29)	99.9 (83)	99.72
63	Bing Bong	99.7 (50)	99.8 (49)	99.8 (81)	99.6 (71)	99.9 (68)	99.76
64	Yamba	99.8 (49)	99.8 (73)	99.8 (46)	99.6 (64)	99.9 (70)	99.78
65	Wandoo Terminal	99.8 (60)	99.8 (55)	99.8 (67)	99.6 (66)	99.9 (53)	99.78
66	Stag Terminal	99.9 (62)	99.8 (57)	99.8 (87)	99.6 (52)	100.0 (49)	99.82

Table B1. continued

RANK	LOCATION	CUMULATIVE PERCENTAGE OF VISITS	CUMULATIVE PERCENTAGE OF BALLAST	CUMULATIVE PERCENTAGE OF FISHING VESSELS	CUMULATIVE PERCENTAGE OF YACHTS	CUMULATIVE PERCENTAGE OF CONNECTIVITY SCORE	AVERAGE CUMULATIVE PERCENTAGE ACROSS FACTORS
67	Carnarvon	99.9 (91)	99.8 (79)	99.8 (72)	99.8 * (19)	100.0 (55)	99.86
68	Bowen	99.9 (76)	99.8 (78)	99.8 (84)	99.8 * (24)	100.0 (56)	99.86
69	Griffin Terminal	99.9 (57)	99.8 (52)	99.8 (83)	99.8 (60)	100.0 (63)	99.86
70	Jabiru Terminal	99.9 (58)	99.9 (53)	99.8 (90)	99.8 (59)	100.0 (69)	99.88
71	Laminaria-Corallina Field	99.9 (61)	99.9 (50)	99.8 (89)	99.8 (56)	100.0 (66)	99.88
72	Port Botany	99.9 (79)	99.9 (89)	99.9 * (28)	99.8 (57)	100.0 (88)	99.9
73	Yorkey's Knob	99.9 (84)	99.9 (80)	99.9 (76)	99.9 * (26)	100.0 (57)	99.92
74	Spring Bay	99.9 (75)	99.9 (71)	99.9 (29)	99.9 (40)	100.0 (81)	99.92
75	Beauty Point	99.9 (80)	99.9 (84)	100.0 (32)	99.9 (37)	100.0 (90)	99.94
76	Barrow Island Terminal	99.9 (64)	99.9 (62)	100.0 (75)	99.9 (91)	100.0 (78)	99.94
77	Buffalo Terminal	99.9 (67)	100.0 (63)	100.0 (57)	99.9 (82)	100.0 (80)	99.96
78	Challis Terminal	100.0 (65)	100.0 (64)	100.0 (73)	99.9 (45)	100.0 (61)	99.98
79	Exmouth	100.0 (82)	100.0 (90)	100.0 (43)	100.0 * (27)	100.0 (91)	100
80	Bell Bay	100.0 (83)	100.0 (87)	100.0 (35)	100.0 (86)	100.0 (76)	100
81	Useless Loop	100.0 (66)	100.0 (70)	100.0 (54)	100.0 (68)	100.0 (84)	100
82	Kwinana	100.0 (69)	100.0 (66)	100.0 (91)	100.0 (80)	100.0 (86)	100
83	Macquarie Island	100.0 (68)	100.0 (74)	100.0 (58)	100.0 (46)	100.0 (77)	100
84	Saladin Terminal	100.0 (71)	100.0 (67)	100.0 (80)	100.0 (81)	100.0 (72)	100
85	Onslow	100.0 (72)	100.0 (69)	100.0 (61)	100.0 (50)	100.0 (75)	100
86	Cocos Island	100.0 (88)	100.0 (86)	100.0 (48)	100.0 (42)	100.0 (59)	100
87	Goodwood Island	100.0 (86)	100.0 (81)	100.0 (45)	100.0 (39)	100.0 (87)	100
88	Port Douglas	100.0 (89)	100.0 (83)	100.0 (56)	100.0 (35)	100.0 (65)	100
89	Legendre Terminal	100.0 (73)	100.0 (68)	100.0 (77)	100.0 (73)	100.0 (60)	100
90	Yampi Sound	100.0 (78)	100.0 (72)	100.0 (66)	100.0 (75)	100.0 (58)	100
91	River Tamar	100.0 (77)	100.0 (76)	100.0 (47)	100.0 (79)	100.0 (67)	100

Legend: *** Top 10 per cent of values ** Top 20 per cent of values * Top 30 per cent of values( ) Rank for that variable
Eg. (5) for fishing vessels means that the location had the 5th highest number of fishing vessels.
Note: # Hay Point also includes Dalrymple Bay for the purpose of this analysis
Launceston remains at rank 25 regardless of whether George Town, River Tamar, Bell Bay and Beauty Point are included

Figure B1. Cumulative percentage of international visits

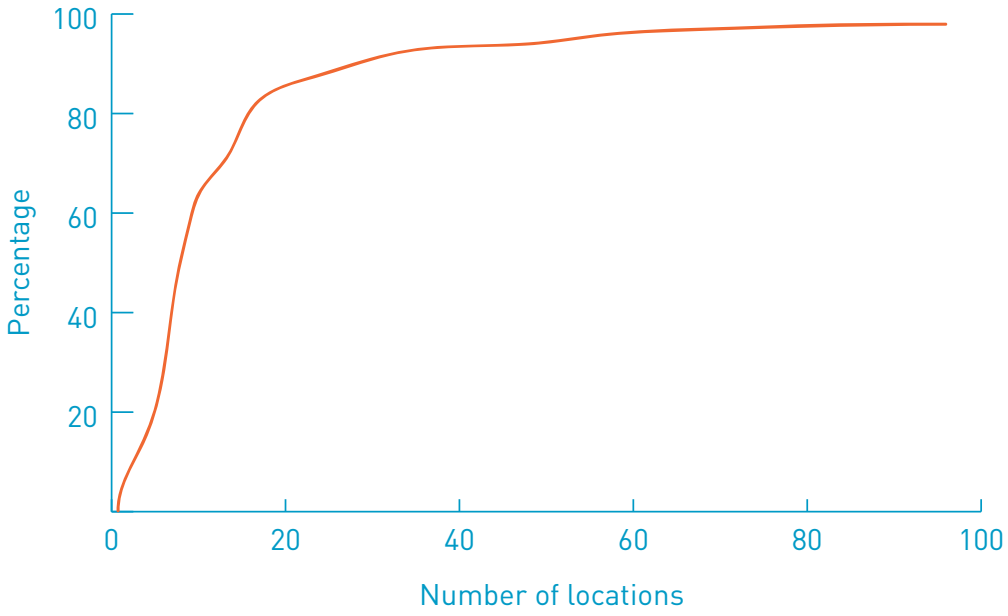


Figure B2. Cumulative percentage of estimated ballast discharge

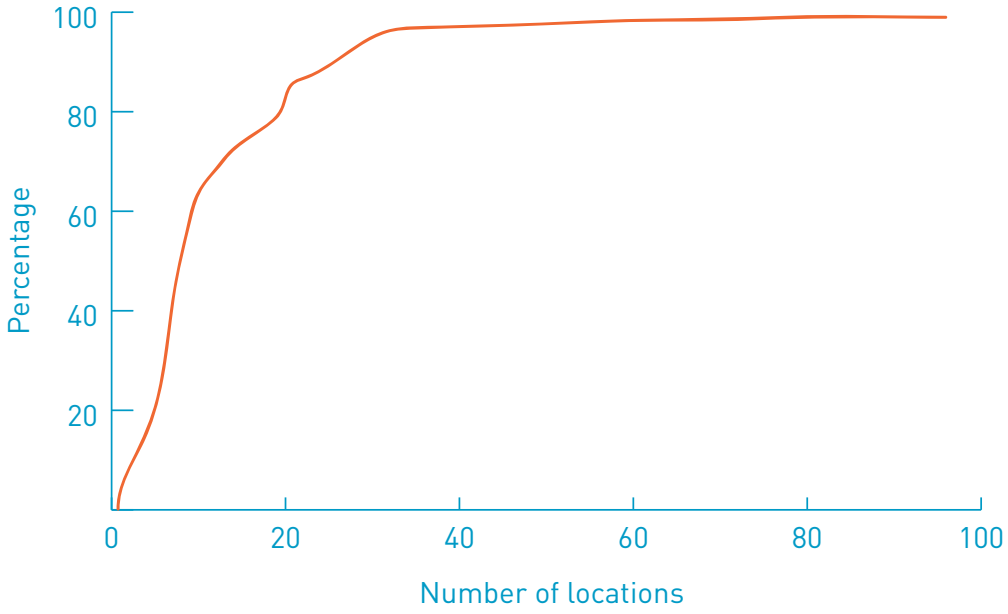


Figure B3. Cumulative percentage of international fishing vessels

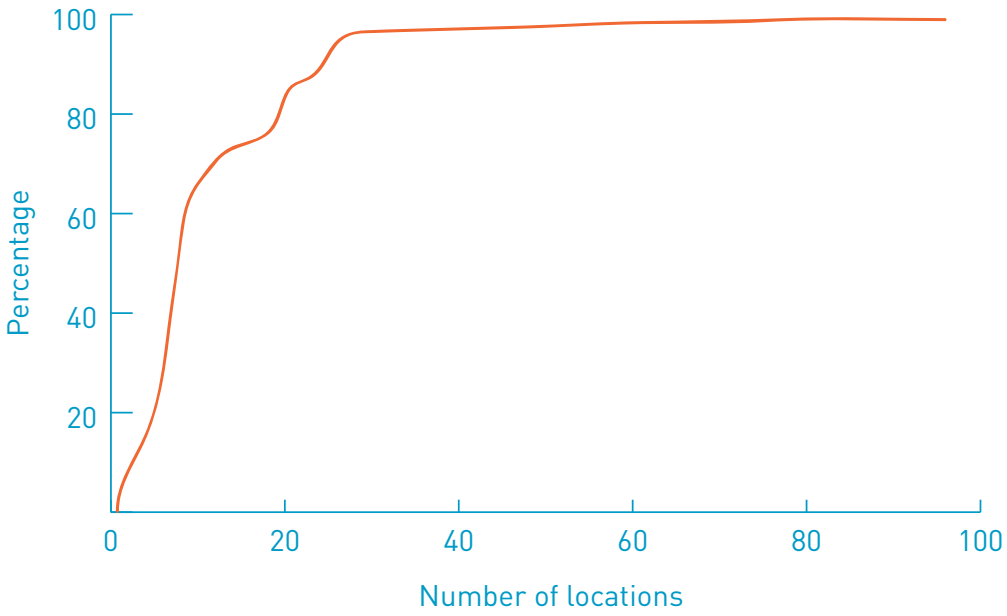


Figure B4. Cumulative percentage of international yachts

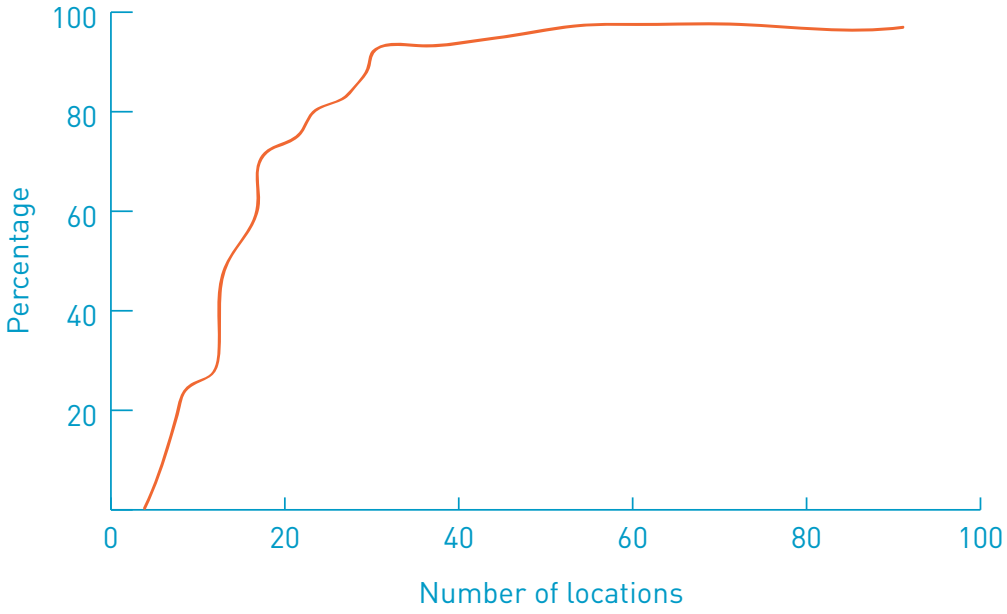
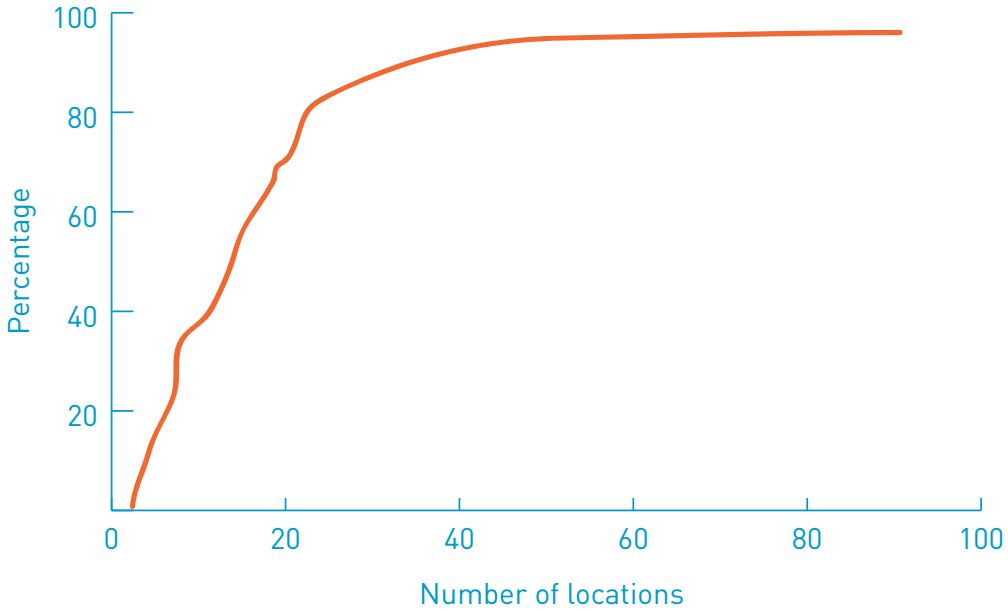


Figure B5. Cumulative percentage of connectivity scores



Attachment C – Analysis for rankings of locations around Australia for existing pests

The ranking of locations for the translocation of existing pests was conducted using two sources of data:

1. Client Place Move data from Lloyds Maritime Information Unit from 1998 to 2002
2. port survey data.

The 'Lloyds' data was used to simulate a table of probabilities, indicating the likelihood over a ten-year period that pests that are currently in one location will be translocated to any other location in Australia. For each location i, the probabilities were calculated using the following algorithm:

1. Every location except location i was set to uninfected
2. Ten years of journeys were simulated, by repeating the journeys that actually occurred in a given year 10 times. For each journey, if the location of departure was infected, then the probability that the location of arrival became infected (if it was not already) was $p(0.0001)$
3. At the end of the 10 years, the locations that were infected were recorded as $C_{i1} = (c_{i11}, ..., c_{in1})$; a vector with elements C_{ij1} , which equal 1 if the location j was infected, and 0 if it was not
4. Steps 1-3 were repeated five hundred thousand times, generating C_{ik} for $k = 1, 2, 3, ...500000$
5. The probability of translocation was calculated as:
   $\overline{C}_i = (c_{i1}, ..., c_{in}) = (\Sigma_{k=1}^{500000} c_{i1k} /500000, ..., \Sigma_{k=1}^{500000} c_{ink}/500000)$

i.e. the percentage of times over the 500000 simulations that location j was infected, given location i was originally infected.

Thus, the probabilities of translocation are based on the volume of shipping traffic between locations that occurred during a given year. These probabilities can be interpreted as the chance that location j will become infected during the 10-year period beginning when location i becomes infected (when location i is the first location infected).

The following is an example of the probabilities generated by the algorithm:

	SYDNEY	BOTANY BAY	DEVONPORT	MELBOURNE
Adelaide	0.09	0.10	0.11	0.33
Brisbane	0.24	0.25	0.10	0.35
Burnie	0.12	0.11	0.10	0.36
Cairns	0.01	0.00	0.00	0.01

This indicates that if Brisbane were infected by a certain pest, over a 10 year period, Sydney would have a 24 per cent chance of infection, Botany Bay 25 per cent, Devonport 10 per cent and Melbourne 35 per cent. Environmental similarity was not included in this analysis because the final risk tables for existing pests are yet to be finalised. Once the risk tables for species to be included in the domestic ballast water management system are finalised this analysis could be undertaken and used to refine the monitoring network. Given the locations selected, it is not anticipated that the final risk tables will significantly change the final ranking.

The simulated probabilities, in conjunction with the port survey data (i.e. data relating to infection status for the 12 pests of concern), were then applied to obtain the number of pest incursions each location could be expected to obtain over a 10-year period. The calculations were based on the probabilities and number of pests a given location could obtain from another location (taking into consideration the pests already known to be present in that location). For example, if Adelaide has five pests, Brisbane has no pests, Burnie has one pest and Cairns has no pests, that Sydney don't have, based on the probabilities above it is expected that Sydney will be infected by
5 x 0.09 + 0 x 0.24 + 1 x 0.12 + 0 x 0.01 = 0.57 pests over a 10-year period.

As surveys have not been conducted for all Australian locations, the results were generated under two scenarios:

- locations without survey data were assumed to have all pests present (Table 1)
- locations without survey data were assumed not to have any pests (Table 2).

Note: it was assumed that all species of marine pests could survive in all Australian locations, as location survival data was not available (see above).

Tables C1 and C2 demonstrate that those locations with the highest risk of translocation are the same regardless of whether presence or absence of species is assumed for those locations without survey data (the top 10 locations are common to both lists with some ordering differences) and also show the cumulative percentage of the translocation score.

Table C1. Location rankings for translocations of existing pests (assuming presence of species for unsurveyed locations)

Note: Highest ranking locations are those with highest risk for receiving pests, not for donating them

RANK	LOCATION	TRANSLOCATION SCORE	CUMULATIVE PERCENTAGE OF TRANSLOCATION SCORE
1	Botany Bay	6.39	14.6%
2	Sydney	5.78	27.8%
3	Brisbane	4.84	38.9%
4	Burnie	4.65	49.5%
5	Devonport	3.34	57.2%
6	Fremantle	2.82	63.6%
7	Port Kembla	1.77	67.7%
8	Melbourne	1.74	71.6%
9	Newcastle	1.42	74.9%
10	Gladstone	1.16	77.5%
11	Townsville	1.10	80.0%
12	Adelaide	1.09	82.5%
13	Portland	0.95	84.7%
14	Port Stanvac	0.92	86.8%
15	Darwin	0.83	88.7%
16	Mackay	0.70	90.3%
17	Launceston	0.69	91.9%
18	Thevenard	0.58	93.2%
19	Bunbury	0.43	94.2%
20	Port Hedland	0.41	95.1%
21	Geelong	0.34	95.9%
22	Hobart	0.32	96.7%
23	Westernport	0.30	97.4%
24	Esperance	0.28	98.0%
25	Port Lincoln	0.22	98.5%
26	Weipa	0.21	99.0%
27	Albany	0.15	99.3%
28	Hay Point#	0.09	99.5%

Table C1. continued

RANK	LOCATION	TRANSLOCATION SCORE	CUMULATIVE PERCENTAGE OF TRANSLOCATION SCORE
29	Port Latta	0.08	99.7%
30	Karumba	0.05	99.8%
31	Mourilyan	0.03	99.9%
32	Eden	0.02	99.9%
33	Lucinda	0.01	99.9%
34	Kwinana	0.01	100.0%
35	Abbot Point	0.01	100.0%
36	Ardrossan	0.00	100.0%
37	Barrow Island Terminal	0.00	100.0%
38	Bing Bong	0.00	100.0%
39	Broome	0.00	100.0%
40	Bundaberg	0.00	100.0%
41	Cairns	0.00	100.0%
42	Cape Cuvier	0.00	100.0%
43	Cape Flattery	0.00	100.0%
44	Cossack Field	0.00	100.0%
45	Dampier	0.00	100.0%
46	Derby	0.00	100.0%
47	Georgetown	0.00	100.0%
48	Geraldton	0.00	100.0%
49	Gove	0.00	100.0%
50	Grassy	0.00	100.0%
51	Griffin Terminal	0.00	100.0%
52	Groote Eylandt	0.00	100.0%
53	Jabiru Terminal	0.00	100.0%
54	Legendre Terminal	0.00	100.0%
55	Lord Howe Island	0.00	100.0%
56	Port Alma	0.00	100.0%
57	Port Bonython	0.00	100.0%
58	Port Giles	0.00	100.0%
59	Port Phillip Bay	0.00	100.0%
60	Port Pirie	0.00	100.0%
61	Port Walcott	0.00	100.0%
62	Shark Bay	0.00	100.0%
63	Stag Terminal	0.00	100.0%
64	Thursday Island	0.00	100.0%

Table C1. continued

RANK	LOCATION	TRANSLOCATION SCORE	CUMULATIVE PERCENTAGE OF TRANSLOCATION SCORE
65	Varanus Island Terminal	0.00	100.0%
66	Wallaroo	0.00	100.0%
67	Wandoo Terminal	0.00	100.0%
68	Whyalla	0.00	100.0%
69	Wyndham	0.00	100.0%

[#] Hay Point also includes Dalrymple Bay for the purpose of this analysis

Figure C1. Cumulative percentage of translocation scores (assuming presence for unknown)

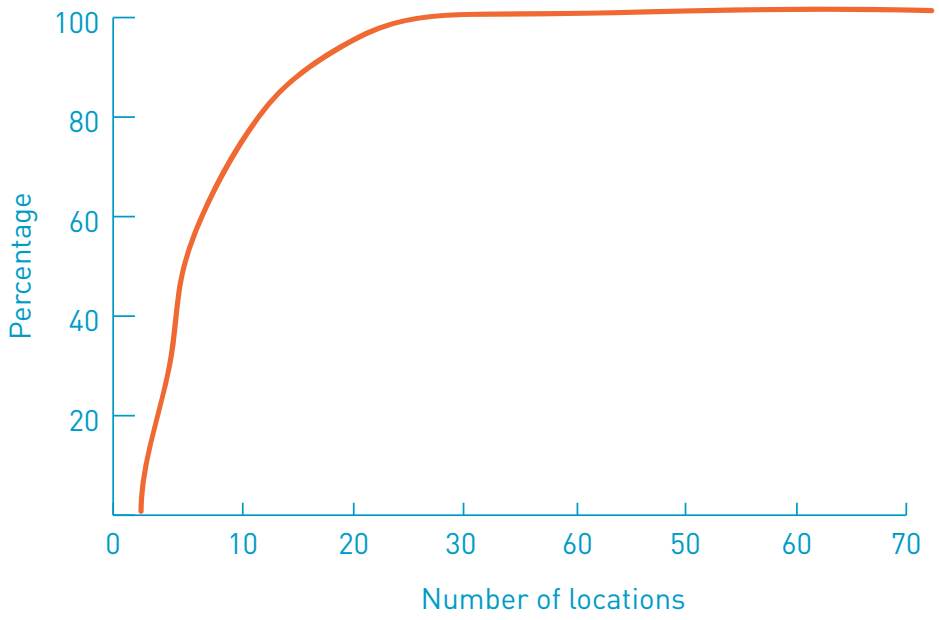


Table C2. Location rankings for translocations of existing pests (assuming absence of species for unsurveyed locations)

RANK	LOCATION	TRANSLOCATION SCORE	CUMULATIVE PERCENTAGE OF TRANSLOCATION SCORE
1	Botany Bay	5.92	15.1%
2	Sydney	5.33	28.6%
3	Burnie	4.47	40.0%
4	Brisbane	3.84	49.8%
5	Devonport	3.20	57.9%
6	Fremantle	1.92	62.8%
7	Melbourne	1.58	66.8%
8	Port Kembla	1.25	70.0%
9	Newcastle	1.24	73.2%
10	Gladstone	0.82	75.3%
11	Port Stanvac	0.82	77.4%
12	Portland	0.78	79.3%
13	Adelaide	0.77	81.3%
14	Launceston	0.60	82.8%
15	Port Pirie	0.60	84.4%
16	Thevenard	0.52	85.7%
17	Townsville	0.50	87.0%
18	Mackay	0.48	88.2%
19	Dampier	0.41	89.2%
20	Thursday Island	0.34	90.1%
21	Geraldton	0.33	90.9%
22	Esperance	0.30	91.7%
23	Bunbury	0.29	92.4%
24	Hobart	0.27	93.1%
25	Westernport	0.27	93.8%
26	Darwin	0.24	94.4%
27	Wallaroo	0.22	95.0%
28	Geelong	0.21	95.5%
29	Port Hedland	0.18	96.0%
30	Georgetown	0.16	96.4%
31	Port Lincoln	0.16	96.8%
32	Port Bonython	0.13	97.1%
33	Whyalla	0.12	97.5%
34	Cairns	0.12	97.8%
35	Albany	0.11	98.0%
36	Port Alma	0.09	98.3%

Table C2. continued

RANK	LOCATION	TRANSLOCATION SCORE	CUMULATIVE PERCENTAGE OF TRANSLOCATION SCORE
37	Hay Point[#]	0.07	98.5%
38	Derby	0.07	98.6%
39	Port Latta	0.06	98.8%
40	Broome	0.06	98.9%
41	Groote Eylandt	0.06	99.1%
42	Weipa	0.05	99.2%
43	Grassy	0.05	99.3%
44	Cossack Field	0.03	99.4%
45	Ardrossan	0.03	99.5%
46	Bundaberg	0.03	99.5%
47	Port Giles	0.02	99.6%
48	Karumba	0.02	99.6%
49	Gove	0.02	99.7%
50	Eden	0.02	99.7%
51	Port Phillip Bay	0.02	99.8%
52	Bing Bong	0.01	99.8%
53	Wyndham	0.01	99.9%
54	Stag Terminal	0.01	99.9%
55	Abbot Point	0.01	99.9%
56	Varanus Island Terminal	0.01	99.9%
57	Legendre Terminal	0.01	99.9%
58	Griffin Terminal	0.01	100.0%
59	Kwinana	0.00	100.0%
60	Cape Cuvier	0.00	100.0%
61	Port Walcott	0.00	100.0%
62	Jabiru Terminal	0.00	100.0%
63	Mourilyan	0.00	100.0%
64	Lucinda	0.00	100.0%
65	Barrow Island Terminal	0.00	100.0%
66	Cape Flattery	0.00	100.0%
67	Lord Howe Island	0.00	100.0%
68	Shark Bay	0.00	100.0%
69	Wandoo Terminal	0.00	100.0%

[#] Hay Point also includes Dalrymple Bay for the purpose of this analysis

Attachment D – Monitoring target species

The target species that must be considered for a monitoring program for a given location in Australia are listed in this table. This list (endorsed by NIMPCG) has been compiled from a number of reports that considered the invasion potential and impact potential of a large range of species. The analysis and selection processes are detailed in the *Australian marine pest monitoring guidelines*. Note: this list will be incorporated into the MDP when reviewed.

Table D1. Monitoring target species list

	SPECIES NAME	COMMON NAME
1	*Acartia tonsa*	Calanoid copepod
2	*Alexandrium catenella* *	Toxic dinoflagellate
3	*Alexandrium minutum* *	Toxic dinoflagellate
4	*Alexandrium monilatum*	Toxic dinoflagellate
5	*Alexandrium tamarense*	Toxic dinoflagellate
6	*Asterias amurensis* *	Northern Pacific seastar
7	*Balanus eburneus*	Ivory barnacle
8	*Balanus improvisus (marine/ estuarine incursions only)*	Bay barnacle
9	*Beroe ovata*	Comb jelly
10	*Blackfordia virginica*	Black Sea jelly
11	*Bonnemaisonia hamifera*	Red macroalga
12	*Callinectes sapidus*	Blue crab
13	*Carcinus maenas* *	European shore crab
14	*Caulerpa racemosa (Australian native question)*	Green macroalga
15	*Caulerpa taxifolia (exotic strains only)*	Green macroalga
16	*Chaetoceros concavicornis*	Centric diatom
17	*Chaetoceros convolutus*	Centric diatom
18	*Charybdis japonica* *	Asian paddle/lady crab
19	*Codium fragile spp. fragile*[1]	Green macroalga
20	*Corbula (Potamocorbula) amurensis*	Brackish-water/Asian clam
21	*Crassostrea gigas* *	Pacific oyster
22	*Crepidula fornicata*	American slipper limpet
23	*Didemnum spp. (exotic invasive species only)*	Tunicate – sea squirt
24	*Dinophysis norvegica*	Toxic dinoflagellate

Table D1. continued

	SPECIES NAME	COMMON NAME
25	*Ensis directus*	Jack-knife clam
26	*Eriocheir spp.*	Mitten crabs
27	*Grateloupia turuturu*	Red macroalga
28	*Gymnodinium catenatum* *	Toxic dinoflagellate
29	*Hemigrapsus sanguineus*	Japanese shore crab
30	*Hemigrapsus takanoi / penicillatus*	Pacific crab
31	*Hydroides dianthus*	Tube worm
32	*Limnoperna fortunei*	Golden mussel
33	*Marenzelleria spp. (invasive species and marine/estuarine incursions only)*	Red-gilled mud worm
34	*Mnemiopsis leidyi*	Comb jelly
35	*Musculista senhousia* *	Asian bag/date mussel
36	*Mya arenaria*	Soft shell clam
37	*Mytilopsis sallei*	Black-striped mussel
38	*Neogobius melanostomus (marine/ estuarine incursions only)*	Round goby
39	*Perna perna*	South African brown mussel
40	*Perna viridis* *	Asian green mussel
41	*Pfiesteria piscicida* *	Dinoflagellate
42	*Pseudodiaptomus marinus*	Asian copepod
43	*Pseudo-nitzschia seriata*	Pennate diatom
44	*Rapana venosa*	Asian/veined rapa whelk
45	*Rhithropanopeus harrisii*	Harris mud crab
46	*Sabella spallanzanii* *	European/Mediterranean fan worm
47	*Sargasso muticum*	Asian seaweed
48	*Siganus luridus*	Dusky spinefoot
49	*Siganus rivulatus*	Marbled spine foot/rabbit fish
50	*Tortanus dextrilobatus*	Asian copepod
51	*Tridentiger bifasciatus*	Shimofuri goby
52	*Tridentiger barbatus*	Shokohazi goby
53	*Undaria pinnatifida* *	Japanese seaweed
54	*Varicorbula (Corbula) gibba* *	European clam
55	*Womersleyella setacea*	Red seaweed

[1] Codium fragile spp. fragile is on the Interim CCIMPE Trigger List. Noting that the CCIMPE criteria for removal requires that data indicates that impacts overseas/in Australia are likely to be less than previously thought or it becomes widely distributed in Australia, it does not seem likely at this time that justification could be provided to remove this species from the CCIMPE Trigger List.

* = species with a genetic/molecular probe or barcoded (see Doblin & Bolch 2008)