Australian Government

National Land & Water Resources Audit

An initiative of the Australian Government

ESTUARINE, COASTAL AND MARINE HABITAT INTEGRITY

INDICATOR HEADING

Estuarine, coastal and marine habitat condition

INDICATOR GUIDELINE

Pest species

Pest species

Recommended by the Audit for further consideration

This version of the guideline has been developed through the National Land and Water Resources Audit and was informed by expert review and broad consultation on national indicators via national coordination committees and their associates. Version 1 – June 2008 does not yet have the final endorsement of any jurisdiction. The document is for guidance only and is presented to provide a basis for on-going discussion. It may require further consideration by a jurisdictional based reference group before national endorsement.

www.nlwra.gov.au

Status of indicator agreement

The National Land & Water Resources Audit (the Audit) coordinates the collation of data to support reporting on natural resource condition required under the National NRM Monitoring and Evaluation Framework (National M&E Framework).

The National M&E Framework identifies three requirements for monitoring natural resource condition:

- a set of resource condition indicators to measure progress toward the agreed national outcomes on a medium and long term basis
- a set of indicators for monitoring community and social processes relevant to or affected by NRM programs, as well as measures of the adoption of sustainable development and production techniques
- contextual data pertinent to the indicator being considered.

The Audit Advisory Council has agreed to a process for achieving a practical set of indicators under the National Monitoring and Evaluation Framework.

This process is to:

- obtain on-going **recommendations** from the relevant **National Coordination Committees** for each thematic area (including "Matters for Target") on appropriate indicators, protocols and information needs
- seek **endorsement** from the **Audit Advisory Council** that the indicators and protocols can be implemented at the national, state / territory and regional levels
- seek **agreement** from the Natural Resource Policies and Programs Committee (**NRPPC)** (or the Marine and Coastal Committee –**MACC**- for Estuarine, Coastal and Marine) that the indicators will be used and promoted by jurisdictions to underpin evaluations of NRM initiatives.

The NRPPC and MACC report to the Natural Resource Management Ministerial Council (NRMMC).

Introduction

This suite of "indicator guidelines" is relevant to the Estuarine, Coastal and Marine Habitat Integrity Matter for Target.

Two indicator headings are identified:

1. Estuarine, coastal and marine habitat extent and distribution
2. Estuarine, coastal and marine habitat condition.

Initially, 31 potential indicators were developed to measure the effect of the stressors on ecosystem condition (physical/chemical and biological) and habitat extent (Scheltinga et al., 2004). These indicators were reviewed at a national workshop (Souter and McKenzie, 2006) and further refined to 19 nationally agreed indicators (Table 1).

Drawing on a series of state/territory trials and national consultations; the documentation for the indicators has been modified from a "protocol" format that sought to define both measurement standards and reporting (information) products to one that presents "guidelines" for the collection and storage of monitoring data.

> These "indicator guidelines" should be used as standards for the collection, collation and storage of data in order to assist NRM service providers and community groups make observations that can potentially be pooled and re-used at a later date.

Ten ECM indicators were prioritised and guidelines have been developed through extensive consultation and reviewed by key experts in the field.

Table 1. Nationally agreed ECM Resource Condition Indicators. Indicators prioritised for documentation and included in this document are shown with an asterisk.

Indicator heading	Indicator
Estuarine, coastal and marine habitat extent and distribution	1. Extent and distribution of key habitat types*****
Estuarine, coastal and marine habitat condition	Biological condition 2. Algal blooms 3. Animal or plant species abundance***** 4. Chlorophyll a***** 5. Coral bleaching 6. Mass mortality events 7. Pest species (number, density, distribution)***** 8. Targeted pathogen counts 9. Vertebrates impacted by human activities Physical/chemical condition 10. Dissolved oxygen***** 11. Nutrients***** 12. pH 13. Presence / extent of litter (marine debris)***** 14. Salinity (EC) 15. Sedimentation/erosion rates***** 16. Shoreline position 17. Temperature 18. Toxicants (in water / sediments / biota)* 19. Turbidity / water clarity*****

Pest species

Matter for target:

Estuarine, coastal and marine.

Indicator heading:

Estuarine, coastal and marine habitat condition

Indicator name:

Pest species

This document presents the recommended monitoring guidelines for collecting, collating and reporting information on pest species for national, state/territory and regional application.

1. Definition

Pests are classed as:

- animal or plant species that have been introduced by humans to a new location, outside their natural range
- native species that have dramatically increased in numbers to the detriment of other species.

This indicator may be applied to **intertidal** and **subtidal** (ie estuarine and marine) areas, where pest species are called 'marine pests' and include flora and fauna, both introduced (exotic) and native.

For marine pests, 'presence', 'absence' or 'unknown' should be recorded for each region of interest, such as IMCRA bioregion or NRM region. If possible, pest numbers (abundance), identities (taxon) and area infested should be summarised by location and recorded for each region. The difference between these estimates and any previous (or baseline) estimates should then be expressed as an estimate of change. For example, a change in the number of pest taxons can be expressed as an 'invasion rate'.

The indicator may also be applied to **onshore** (ie terrestrial) parts of the coast, where pest species are usually divided into 'invasive vegetation species' (ie weeds) and 'invasive vertebrate pests' (ie pests). The pest species that are known here as 'onshore pest species' are a subset of the species defined for the NRM matter for target (MfT): Ecologically significant pest species. The definition of weed and vertebrate pest indicators are provided in the indicator guideliness for that MfT (see the NRM Indicators: *Distribution and abundance of significant invasive vertebrate pests* and *Extent, density and distribution of weeds*). Onshore pest species are characterised as being highly significant to the ecological functioning of the onshore part of the coast.

2. Rationale

2.1 Why do we want to know it?

Pests may pose the most important long-term threat to coastal ecosystems (Cappo et al 1995).

They are destructive to native biodiversity, harvested resources and cultured species, and potentially harmful to humans because of a reduction in recreational amenity. There are considerable economic and social consequences if destructive pest species become established.

The introduction of marine pest species is mainly due to:

- transport of marine pests attached to vessel hulls, equipment and other infrastructure, and in ballast water (about 66%)
- translocation of marine pest species either deliberately for aquaculture purposes or accidentally with deliberate translocation of aquaculture species (about 28%)
- aquarium species releases or escapes (about 1%)
- unknown release methods (about 4%) (Hayes et al., 2005).

Up to 250 exotic species have already been introduced into Australian waters.

By monitoring changes in the incursion rate and distribution of pest species, we will be able to assess whether we are doing enough to control their introduction and spread. Marine pests are an important indicator for 'state of the environment'reporting (Ward et al., 1998), and were used as one determinant of ecosystem integrity in the National Estuary Assessment (Stage 2: modified estuaries) completed for the National Land and Water Resources Audit (NLWRA, 2002).

Further information on how pests are introduced, locations susceptible to marine pests, the environmental significance, detecting and reporting of pests can be found at the OzEstuaries website <www.ozestuaries.org/indicators/econ_cons_marine_pest_invasions.jsp>. Information on specific marine pests in Australia can be accessed through the National Introduced Marine Pest Information System (NIMPIS) at <www.marine.csiro.au/crimp/nimpis>. Information about the National System for the Prevention and Management of Marine Pest Incursions (NSPMMPI) can be found at <www.marinepests.gov.au>.

[BT]2.2 Context in which the pest species Indicator has been measured with regard to national, state and regional resource management programs

[For a description of the context relating to **onshore** pest species, refer to the weed and the vertebrate pests indicators defined under the 'Ecologically significant pest species' matter for target.]

At the national and state level, **marine pest** species (intertidal and subtidal) are monitored under an Intergovernmental Agreement for the NSPMMPI. The National Introduced Marine Pests Coordination Group (NIMPCG) coordinates the NSPMMPI.

Controlling the introduction and spread of marine pest species, and assessing their impacts, requires a multi-disciplinary approach involving areas as diverse as economics, marine engineering, hydrodynamics, environmental impact assessment, eco-physiology and taxonomy. The Commonwealth Government therefore funded the establishment of a Centre for Research on Introduced Marine Pests (CRIMP) in 1994. The centre was based at the CSIRO Marine Laboratories in Hobart and draws on the broad skills of industry and scientific partners to facilitate cooperative research throughout Australia and with the international community.

Ten years later, in 2003, the threat to Australia from introduced marine species had been established, national databases were online, and a risk management approach had been adopted by AQIS to reduce the risk of new introductions through ballast water discharge. Over the same time, State/NT and Commonwealth capacity to respond to introduced marine pests had been markedly increased and the Centre for Research on Introduced Marine Pests was integrated with other research on sustainable marine ecosystems within CSIRO Marine Research. CRIMP now refers to CSIRO research on introduced marine pests.

The NSPMMPI, which began in 2005, aims to reduce the risk of introducing exotic marine pests to Australia, respond to marine pest incursions and manage already established pests.

The NSPMMPI has three major components:

- prevention systems to reduce the risk of introduction and translocation of marine pests (including management arrangements for ballast water and biofouling)
- a coordinated emergency response to new incursions and translocations
- ongoing control and management of introduced marine pests already in Australia.

It also has several supporting elements that are currently being developed. These include strategies for:

- research and development
- communications
- monitoring, and
- evaluation and review.

A number of activities have been undertaken in each state, with the emphasis on port surveys, and education and awareness. Port baseline surveys were undertaken using nationally agreed guideliness developed by CRIMP in all major ports as well as some minor ports and marinas. NIMPCG have developed a new manual for annual monitoring surveys for marine pests, which is in the final stages of development. The *Marine Pest Monitoring Manual* will replace the existing national port baseline survey guidelines with enhanced, more cost-effective and user-friendly methods for monitoring of marine pest incursions on an ongoing basis. Monitoring in accordance with the new manual has been trialled in several locations, with many other locations currently being developed.

The translocation of aquatic organisms relating to aquaculture is being addressed, primarily at the state level, although there is a *National Policy on the Translocation of Live Aquatic Organisms* (Ministerial Council on Forestry, Fisheries and Aquaculture, 1999). *Guidelines for Assessing Translocations of Live Aquatic Organisms in Victoria* was released in December 2003 and similar guidelines and protocols exist in the other states. In Tasmania, marine pests are also monitored under the marine farm monitoring permit conditions, required under the *Marine Farm Planning Act 1995* and the *Living Marine Resources Management Act 1995*.

3. Monitoring methodology

Methods for the collection of marine pest records should be consistent with those outlined in the *Marine Pest Monitoring Manual*.

As the main source of invasive species is shipping activities, baseline surveys of invasive species have focussed on the main ports. The baseline surveys were conducted using the

method developed by CRIMP. The new monitoring manual includes guideliness for monitoring invasive marine species, and will link to a database for collating all monitoring data.

The CRIMP marine pest database, NIMPIS has the capacity to accept records of marine pest sightings via a website interface (see <www.marine.csiro.au/crimp/nimpis>). A planned update of this database will enhance its capability and integrate it with new activities under the National System, including monitoring.

Experts at museums can assist with the identification of invasive marine species. It is preferable to involve the museum staff at the planning stage of any survey work, especially as museums are the preferred location for lodging voucher collection specimens. Any new discoveries of invasive species or extensions in distribution beyond the known range should be reported to the relevant state authorities (See NIMPIS website for contact details).

3.1 Monitoring location selection (scale & sampling)

High-risk areas (ie ports, harbours and marinas) are suggested as monitoring sites since establishment of exotic species is strongly influenced by the number of visits by international ships (ie import opportunities). Australia has about 78 commercial and semi-commercial ports and receives about 11,000 commercial ship visits per year in which ballast water is released. In addition,,Australia receives approximately 2,000 arrivals of other vessel types, including yachts, barges, dredges, tugs, and petroleum rigs and support vessels. Shoreline habitats such as salt marshes, mangroves and beach and dune areas (Hilton, 2002) can also be invaded by exotic species (Cappo et al., 1995).

A minimum of 18 priority National Monitoring Network locations will be targeted with annual surveys. Other locations are also likely to be monitored, possibly in partnership between industry, state governments, local port authorities and regional NRM groups.

3.2 Monitoring frequency required

Ideally, sites should be monitored for new pests at least every three months (ie summer, autumn, winter and spring), as the chances of their complete eradication once introduced are poor, particularly once they have become established. The NIMPCG monitoring manual recommends a minimum of annual monitoring. More intensive searches should be scheduled for time appropriate to the pest of concern. Many pest species become fertile relatively quickly and produce large numbers of young so early detection is essential for any chance of their successful removal. Monitoring of a well established pest may be less frequent..

3.3 Data measurement method

Specific guideliness depend on the development of measurement and tracking procedures in the monitoring manual. These can form the basis for national standard operating procedures for ‘state of the environment’ reporting of marine pests.

Monitoring for some pests, particularly macroscopic pests, might be assisted by organisation and management of volunteers within community-based groups. Volunteers need to use appropriate standard operating procedures.

Determining whether a species is a pest can be difficult. Criteria to determine if an out-of-the ordinary species is a pest are listed in Williams et al.(2002). Species identified as pests are likely to be responsible for detrimental effects on fishing, aquaculture and recreational amenity, and local biodiversity and ecological processes. Seven marine species established in Australia and 35 species not yet present in Australia have been identified as agreed pests of concern.

NIMPIS describes, illustrates and pictures more than 80 exotic pest species currently found in Australian waters (Hewitt et al, 2002). Information on another 35 species (agreed pests of concern), that are thought to pose a significant threat if introduced is also provided.

Relevant state/territory government agencies can also help with identification through the supply of pest guides and pamphlets.

3.4 Data collation / calculation method

Data should be collated and stored according to the procedures outlined in the monitoring manual.

3.5 Data storage and management

Data will be stored on the NIMPIS monitoring database, with other existing marine pest monitoring data and by the data collectors (if different). The public will have access to the data (and report summaries) through the following website http://www.marinepests.gov.au website, hosted by the Australian Government.

3.6 Data analysis and interpretation

Awareness of pest species and their associated problems is increasing as are the numbers of species classified as pests in regions and subregions. The number of pest species is a subset of the total number of introduced species. The number of introduced species is likely to be much larger than that of recognised pest species because many introduced species are likely to be cryptic, and become recognised only when they create ecological or other problems.

If population and spread rates are required within each location, changes in the number of documented pests and area of infestation should be assessed with univariate statistical approaches using explicit statistical models. The level of important change will be evaluated by assessment of the time-series of monitoring data, and an assessment of the trajectory of changes.

3.7 Reliability, validity and quality assurance

Specimens of suspected marine pests sampled should be provided to experts for confirmation of their identity. These lodged voucher collection specimens are valuable as they enable others to further evaluate the species, perhaps with more sophisticated analyticals techniques eg molecular probes and DNA sequencing.

3.8 Metadata

Metadata documentation should be completed for all datasets. The metadata statement should be consistent with current ANZLIC standards, which now comply with ISO 19115.

See the following website for the Metadata Profile:
<http://www.osdm.gov.au/ANZLIC_MetadataProfile_v1-1.pdf?ID=303>

For the Metadata Guidelines see:
<http://www.osdm.gov.au/ANZLIC_MetadataProfileGuidelines_v1-0.pdf?ID=397 >

4. Reporting / information products

4.1 Audiences

The audience for the information products of this indicator are broadly,natural resource managers with an interest in marine environments, particularly those managing ports and ecological assets in and around ports. There are many others who are affected by the

incursions of marine pests inlcuding industry, commercial fishing, tourism, aquaculture and recreational users of the sea and shoreline. Managers of conservation assets, such as marine protected areas, have a high level of interest in identifying threats to the condition of the assets.

4.2 Products

Pest numbers, identities and area infested should be estimated and summarised by location and recorded for each region together with estimates of estimate uncertainty (eg 80% detection sensitivity). The difference between these estimates and any previous (or baseline) estimates can then be expressed as an estimate of change, together with an estimate of the size of change that can be statistically detected using these particular methods.

Outputs should be presented as maps and tables summarising changes in pest numbers and area by subregion, together with tables summarising the percentages of significant change (positive or negative change of statistical significance), preferably as a cumulative frequency distribution based on the data for each subregion. The extent of areas affected should be summarised in tables accompanying each location represented in the maps.

4.3 Confidentiality

All participants agree that future monitoring data should be publicly available.

4.4 Data collation/calculation method

As the data are point observations, no transformation of the data is required.

4.5 Data analysis, integration and interpretation information

The data is organised as point (observation) records that can be queried by any agreed reporting region, typically IMCRA regions and port authority areas. NRM regional boundaries could also potentially be added. Care needs to be exercised with the selection of reporting regions as there may be aggregation problems where there are sparse records or small localised pest populations. It is challenging to show positive absence observations. As records and pest distributions can be sparse, both spatially and temporally, it is often assumed that a single positive presence record is enough to report that a pest species is established in the region, though this is often untrue for marine pests. Ongoing monitoring might also indicate whether species appear to have disappeared from a particular region.

4.6 Data access and storage

Open access is expected. The current NIMPIS database is providing ready access to the data via a web interface that is capable of delivering the data to other web portals (eg OzCoast and ARO). A major redevelopment of NIMPIS is planned.

4.7 Product definition statement

Each product should have a product definition statement. The product definition statement follows the same general format as the metadata statement referred to in 3.8.

5. Current national activities

There is a comprehensive national program for identifying and managing marine pest incursions into Australia.

6. Future development

Further development of community monitoring guidelines may be warranted to assist the delivery of additional observations into the national system.

An updated NIMPCG monitoring protocol manual incorporating the outcomes of the current round of trials is planned for late in 2008.

A major redevelopment of the NIMPIS database and website is planned.

7. Links to other indicators

Animal or plant species abundance (indicator)

Extent and distribution of key habitat types (indicator)

8. Further information

Cappo, M., Alongi, D.M., Williams, D. & Duke, N. 1995, *A review and synthesis of Australian Fisheries Habitat Research: Major threats, issues and gaps in knowledge of coastal and marine fisheries habitats,* Fisheries Research and Development Corporation, Canberra. Available at <www.aims.gov.au/pages/research/afhr/afhr-00.html>.

Hayes, K, C. Sliwa, S. Migus, F. McEnnulty and P. Dunstan (2005). National priority pests: Part II Ranking of Australian marine pests, CSIRO.

Hewitt C.L, Martin R.B, C. Sliwa, F. McEnnulty, N. Murphy, T. Jones and S. Cooper (2002). National Introduced Marine Pest Information System.

Hilton, M (2002). Management implications of exotic dune grasses on the Sir Richard Peninsula, South Australia. Proceedings of Coast to Coast 2002 - 'Source to Sea'. Tweed Heads, pp. 186-189. .

NLWRA (2002). 'Australian Catchment, River and Estuary Assessment 2002.' 1.

Ward, T.E., E. Butler and B. Hill (1998). Environmental indicators for national state of environment reporting - Estuaries and the sea. Canberra, Australia, Australia: State of the Environment (Environmental Indicator Reports), Department of the Environment.

www.marine.csiro.au/crimp/nimpis

www.marinepests.gov.au

http://www.osdm.gov.au/ANZLIC_MetadataProfile_v1-1.pdf?ID=303

http://www.osdm.gov.au/ANZLIC_MetadataProfileGuidelines_v1-0.pdf?ID=397

www.ozestuaries.org/indicators/econ_cons_marine_pest_invasions.jsp