1. What do you consider to be the main impacts (consequences) from marine pests to your business, industry, activities or the environment?

Marine pests, like their terrestrial counterparts pose a significant threat to the Australian environment and economy by disrupting ecological processes, posing risks to fish stocks and aquaculture operations, and threatening both the interstate and international trade. Once established, marine pests often have long lasting impacts, and they are usually impossible to eradicate.

2. What activities should the Australian Government do to manage the biosecurity risks associated with marine pests to an acceptable level (to protect your business, industry activities or the environment)?

We support the stakeholder view that areas of marine pest biosecurity which should be consistently resourced include research and development including long term monitoring, on-going management activities and public education. In particular AMSA recommends:

- The development of a national research centre/facility dedicated to identifying, preventing and eradicating marine pests, including contributing to national policy and contributing to smart ship and marine infrastructure design (e.g. a CRC-like arrangement would provide the across agency linkages required for such a complex, multidisciplinary national issue).

  •Address the critical skills shortage of marine taxonomists in Australian museum, research and academic institutions, including relevant curricula are available at tertiary level to encourage and support future generations of taxonomists.

  •Establish long-term, representative datasets via monitoring major ports and harbour facilities around the country on a regular basis. This would facilitate early detection of pests, and provide a baseline against which future environmental change (including that from climate change) may be assessed.

3. What information or data should the Australian Government collect to support ongoing national commitment to managing marine pest biosecurity?

Improved knowledge of the number of marine invaders will require more comprehensive surveys and a much better characterisation of Australia's marine biodiversity. There remain many organisms (eg plankton, meiofauna and parasites) where taxonomic knowledge is inadequate to determine how many species are exotic. It is generally accepted that in some major groups the vast majority of invertebrates in Australia's marine realm are as yet undescribed or undiscovered. In addition, Australia currently has a critical skills shortage of marine taxonomists, with little indication that the situation will improve in the near future. The scarce knowledge of Australia's marine biodiversity, along with the paucity of marine taxonomic expertise, together pose a major limitation for the detection and management of marine pests. The challenge may be even greater with the combined threat of climate change that may also

result in environmental disturbance (i.e. via changes to temperature, salinity, pH, foodwebs, habitats, etc) and facilitate the success of invasive species.

4. What are the best ways to manage and monitor the biosecurity risks of biofouling on vessels?

Biofouling is the colonisation ("fouling") of immersed surfaces by marine organisms, such as barnacles. Biofouling appears to translocate similar numbers of exotic species as ballast water. Anti-fouling systems need to be developed, documented and authorized for all vessel surfaces that can become fouled, including hulls, propellers, sea chests, internal pipes, anchor wells and mobile equipment (eg fishing gear) that is periodically immersed in water. The risk of a surface becoming fouled varies with the type of vessel and its recent history. Different strategies may have to be developed for commercial, fishing and recreational (in water and trailerable) vessels as well as mobile marine infrastructure such as rigs, barges, tugs and dry docks. Further research is required to ensure management of biofouling is well targeted. For example, it remains unclear whether most exotic species are transported on a small number of heavily fouled vessels, or as a result of the cumulative effect of many lightly fouled vessels.

Tin-based antifouling compounds are being phased out globally because of their toxicity to marine animals. Copper-based systems may follow. Research is required to develop, improve and implement effective (and preferably non-toxic) anti-fouling technologies. Successful antifouling management requires the certification of adequate anti-fouling systems and encouragement of their use. Assessing the benefits and detriments of anti-fouling systems is technically complicated, and Australia requires a single competent authority to assess and recommend systems for use. Until an effective nationally accredited system to control biofouling is implemented, there are a number of actions that should be implemented. Proof of adequate antifouling treatment within the recent past (1- 5 years depending on the treatment) should be provided before vessels enter Australian ports. Any international vessel found to be heavily fouled should not be allowed into Australian ports. Fouled Australian vessels should be cleaned before being transferred to another port, marina or mooring. In-water hull cleaning of vessels potentially carrying exotic species (except for propeller polishing and controlled cleaning of niche areas) should not be permitted in Australian waters and vessels should only be cleaned in dry docks, where all debris must be fully contained. Improved antifouling treatment must be applied to vessel niches. Such areas have often been ignored, because unlike hull fouling, fouling of these areas does not decrease fuel efficiency.

For recreational and small commercial vessels an ethic of cleaned vessels needs to be developed with the small boating community, to prevent the spread of exotic species between infested and uninfested waters. Strategies for the prevention and control of fouling in internal piping systems must also be developed. Commercial Marine Growth Protection Systems (MGPS) are available and commonly used on in some shipping and boating sectors, but a clearer understanding of their action and efficacy is needed. Effective and environmentally safe dosing or treatment methods to remove or kill biofouling in pipework on small craft or vessels without an effective MGPS are also needed. In the interim, the likelihood of fouling occurring in internal systems should be assessed and actions taken to isolate and clean the systems taken if a risk exists.

5. If the Commonwealth progresses to regulate the management of biofouling on international vessels, what role should it take in the development of domestic controls by the states and territories?

Shipping between domestic ports and marinas can function as a vector for dispersal of introduced species into Australian waters. A unified approach across all states and territories should be established to regulate the risk of biofouling. The Commonwealth should facilitate the development of a unified approach.

6. Should the department consider a regulatory framework for international biofouling management that is:
    - a species-based approach (as currently proposed in the Biofouling RIS) or
    - an approach based on a requirement for vessel operators to adopt IMO Biofouling Guidelines, including onboard biofouling management plan and record book

AMSA favours the 'species based approach' to regulation as proposed in the consultation RIS which includes both a biofouling risk assessment and an inspection to clear the vessel of all species on the SOC list. We note that two submissions made the claim that the SOC list is subjective and that species identification in real time is taxonomically challenging. The SOC list should be determined by a clear set of criteria and be evidence based, hence giving confidence that it is not subjective. In managing the risk posed by introduced species, it is essential to distinguish marine pests from native Australian species including as yet undescribed native species. Identification of species in real time is challenging, but this should not be a reason to seek short cuts to avoid the challenge. The solution to the taxonomic challenge lies in training, support for taxonomic research and the development of tools to facilitate identification (eg. Kupriyanova, E.K., Wong, E. & Hutchings, P.A. . 2013. Invasive Polychaete Identifier Version 1.1. 02 December 2013. Kupriyanova, E.K., Wong, E. & Hutchings, P.A. (ed). (http://polychaetes.australianmuseum.net.au/about-identifier). Australian Museum.).

7. How can the Australian Government cost-effectively manage domestic ballast water risks, while preventing the spread of established marine pests?

AMSA supports the Australian Government's intention to harmonise ballast water management requirements, and progress implementation of the International Convention for the Control and Management of Ships' Ballast Water and Sediments. Further research and development are required to refine risk assessment tools such as

- development of cost-effective treatment methods, either ship or port-based.
- assessment of integrated treatment and risk management systems such as the Ballast Water Risk Assessment (BWRA) tool which provides a risk based approach to managing the risk of pest introduction via ballast water.
- studies to ensure sites currently designated as "safe" deballasting areas are indeed safe.
- further development of techniques (including genetic probes) to verify the efficacy of ballast water treatment.
- improved ship design to facilitate ballast water management.

- research into life cycles, distribution and taxonomy of target species to support risk assessment tools.

8. Should species-specific assessments of port-to-port movements, with associated monitoring, be used?

The decision about the approach to be taken should be based on existing knowledge and risk. An evidence based approach should be used to assess risk and allocate resources for species specific assessments and associated monitoring when appropriate. The risk assessment should consider existing knowledge of the biology of target species including changing species distributions as a result of climate change, shipping movements, SOC in source ports etc.

9. Should we restrict ballast water movements between suitably determined regions?

Yes- the decision to do so should be based on risk and existing knowledge of the biology of target species including changing species distributions as a result of climate change, shipping movements, SOC in source ports etc.

10. What are the most important aim(s) for monitoring in a cost-effective national marine pest biosecurity system

One of the key aims of a monitoring program is early detection of pest introductions because eradication depends on early detection. Long term monitoring is required to assess impacts of exotic species on natural ecosystems, and to assess the effectiveness of new measures introduced to minimise new introductions. Monitoring programs must insure that specimens are deposited with institutions which maintain biodiversity collections and conduct long-term biodiversity research (usually museums, herbariums). Monitoring programs must involve Australia's marine taxonomists, most of whom are employed by museums and herbariums which are state funded. Greater cooperation is required between the states and the Commonwealth to ensure that relevant expertise, capacity and training is available.

The poor documentation of the rich Australian marine flora and fauna, and our increasing trade with regions of the world with even more poorly documented biotas, means that identification of new invaders requires adequate support for museums and research institutions to improve our knowledge of marine taxonomy. This is especially important for species of uncertain geographic origins. Taxonomic uncertainty may impede a rapid eradication response. For example, some pests (eg. *Codium fragile*, *Caulerpa taxifolia*) have both native and exotic/invasive subspecies/strains.

Monitoring programs should include the collection of empirical data to inform risk assessments and to evaluate the effectiveness of biosecurity protocols. We lack basic data about many high risk species including life histories and seasonal distribution patterns.

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11. How should this monitoring be achieved?

Submissions highlighted the challenge of meeting the existing National Monitoring Strategy (NMS) and that only five out of 18 priority locations have been monitored to the agreed standard. As monitoring is a critical component in early detection, the existing NMS should be reviewed. A workshop should be conducted with a range of stakeholders, including the marine science community, to examine why the NMS is not being implemented and to find solutions to implementation.

There is potential for the use of citizen science programs in long term monitoring programs as long as such a program includes adequate training, strict protocols and the involvement of expert taxonomists.

As well as focusing on natural habitats, these programs might target artificial structures, such as seawalls, pontoons and pilings, that often support high densities of non-native marine species due to their proximity to shipping and vessel facilities and their bare surfaces, available for colonization.