PARTNERING TO IMPROVE EARLY DETECTION OF MARINE PEST THREATS

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ABSTRACT

Biosecurity Queensland and Queensland port authorities are working together to develop and implement an effective and sustainable marine pest surveillance program to improve early detection of marine pest threats. The pilot surveillance program being implemented at five Queensland ports is part of the Queensland Marine Pest Prevention and Preparedness Project. Invasive marine pests can have significant environmental and economic impacts including out-competing or predating on native species and impacting marine-based industries including ports, marinas, tourism and commercial fisheries. Early detection and intervention provides the best chance of controlling and eradicating an incursion and minimising biosecurity impacts and disruption to business operations.

The Queensland Ports Marine Pest Surveillance Pilot Program includes the ports of Brisbane, Gladstone, Mackay, Townsville and Cairns and involves settlement plate monitoring, plankton sample collection and shoreline surveys. The surveillance pilot will use molecular diagnostics to identify the presence or absence of high-risk marine pest species. A partnership approach to development of the pilot has resulted in a program design that is both effective in meeting biosecurity objectives and is achievable with available resources. Sampling methodology and surveillance site selection for each port was based on a combination of site-specific characteristics, port risk profiles, resource availability and species-specific characteristics for the target marine pests. On-ground implementation of the pilot program is also a partnership with officers from Biosecurity Queensland working closely with port environmental and operational officers to ensure the mutual benefits of improved marine biosecurity are realised and continue beyond the life of the pilot program.

Keywords: marine, pest, biosecurity, ports, surveillance, detection.

INTRODUCTION

Invasive marine pests can have significant environmental and economic impacts including out-competing or predating on native species and impacting marine-based industries including ports and marinas, tourism and commercial fisheries. Marine pests can also impact amenity and our way of life. These pests can travel long distances attached to boats as biofouling or in internal seawater systems such as ballast water, resulting in high potential for translocation both internationally and domestically.

Queensland faces unique challenges related to the introduction of marine pests and their management such as a large coastline including many remote stretches and an extensive network of ports, with Queensland ports often being the first port of call for international shipping vessels on the east coast of Australia. An independent review of Queensland's biosecurity capability in 2015 identified marine pest biosecurity as an area that requires greater attention and investment in prevention and surveillance. The Marine Pest

Prevention and Preparedness Project is one of the projects currently underway to address the recommendations of the capability review. The Project aims to increase marine biosecurity capability and capacity in Queensland (within Biosecurity Queensland and in our partners) through a number of key deliverables including: Education and awareness to increase passive surveillance; port surveillance to improve early detection capabilities; and a marine pest response exercise to improve preparedness to respond to a marine pest event.

The vessel biofouling invasion pathway is currently unregulated increasing the risk of marine pest introduction and posing a biosecurity risk that warrants development of an early detection surveillance system at these high-risk nodes. The Queensland Ports Marine Pest Surveillance Pilot Program aims to address this risk and is the focus of this paper.

PILOT PROGRAM DEVELOPMENT

The pilot surveillance program concept originated as surveillance that would occur initially at one or two ports, however Queensland's port authorities were very supportive of the development of coordinated marine pest surveillance, and the level of interest resulted in collaboration with five of Queensland's key ports.

Biosecurity Queensland have worked closely with the five Queensland port authorities, Western Australia Department of Primary Industries and Regional Development (DPIRD) and Pilbara Ports through a series of meetings and discussions to develop the Queensland Ports Marine Pest Surveillance Pilot Program. This has allowed port authorities' expectations and resource constraints to be factored into program development from the beginning to ensure the pilot program implemented is effective, scalable, affordable and most importantly, achievable.

The Queensland pilot program is based on the award winning Western Australia State-Wide Array Surveillance Program (SWASP) and builds on the previous work and learnings from the Western Australia program. These surveillance programs move away from costly, labour intensive, traditional marine surveillance methods involving taxonomic identification, towards the use of simpler techniques and molecular diagnostics which are less resource intensive, can be undertaken by trained operational staff (do not require specialist scientists to collect samples), incur shorter turn around for results and are less costly.

SELECTION OF METHODOLOGIES

Marine pest target species and proposed surveillance locations for the pilot program were selected based on the level of risk of introduction at each port, and the likelihood of the target being detected at each location. The assessment included a review of vessel traffic and port profiles, identification of highest risk vessels and docking locations, and environmental factors such as coastal hydrodynamics, areas of deposition, physical and chemical parameters and target species' life history traits.

Biosecurity Queensland is working closely with each port and incorporating a high level of interrogation of the scientific literature and latest research outcomes to develop sampling methodologies that are scientifically robust, practicable, efficient and cost-effective, while

accounting for site-specific requirements and environmental variables. The port's Environmental Managers are contributing their local experience and site-specific knowledge to help establish a surveillance program design that is proportionate to the level of risk, the available resources and the effectiveness of selected methodologies in each of the specific locations.

Sampling methods considered for the program included settlement plate arrays, collection of plankton, water or sediments, and visual shoreline searches. Validated molecular techniques will be used to assess and quantify DNA and environmental DNA (eDNA) of target marine pest species from the samples. We hope to adopt a holistic experimental approach to help improve detection sensitivities and achieve the primary surveillance objectives, through application of multi-substrate techniques (as recommended by recent studies, eg. Koziol *et al.,* 2018). The final surveillance pilot design is likely to include a combination of settlement plates and planktonic tows at some or all of the ports. Sample collection techniques will aim to capture the multiple life stages that marine species undergo, which involve different habitats at different stages of the life cycle (ie eggs, dispersive free-swimming larvae, juveniles that settle on or within a substrate). Surveillance timing will account for factors such as seasonal changes in local environmental conditions and target species tolerances, and sampling effort is being refined through communications with academics, research outcomes and other marine pest surveillance programs.

MOLECULAR DIAGNOSTICS

DNA-based techniques are a proven highly effective method of detecting pest organisms in terrestrial and freshwater environments even when present in low abundance. They are also particularly relevant for detecting pest species in the marine environment (eg Bott *et al.,* 2010; Dias *et al.,* 2013), and are a more efficient initial survey approach than the traditional time, cost and labour intensive methods. Surveillance targets may be indistinguishable at early life stages (ie planktonic larvae), have morphological characteristics that are variable or require specialised identification by highly trained and experienced taxonomists, and they may occur in areas inaccessible or not captured by traditional survey methods.

Scientific research outcomes and recommendations from recent studies including the SWASP and a national Department of Agriculture and Water Resources molecular validation program are guiding the assessment and selection of suitably validated molecular diagnostics for the Queensland pilot program. Quantitative PCR (qPCR) and metabarcoding are the primary diagnostic techniques being considered, and the final design will ultimately be influenced by the method which provides the highest level of scientific rigour, while facilitating the most practical, timely, cost-effective and sustainable approach.

LOOKING FORWARD

At the time of writing, the detailed planning of the pilot program design for each port is being finalised to ensure the program meets the needs and objectives of each port and Biosecurity Queensland. It is envisaged that on-ground surveillance activities will commence in mid-2019.

The partnership approach being undertaken to develop, implement and share costs for the surveillance pilot program reinforces the principle that biosecurity is a shared responsibility and ensures capabilities and capacity are being developed throughout a number of key marine biosecurity partners in Queensland. This aims to ensure the mutual benefits of improved marine biosecurity to industry and the community are realised and will continue beyond the life of the pilot program.

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